Proposed Wharekirauponga Underground Mine

Wetland Ecological Effects Assessment

for: OceanaGold New Zealand Limited

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Cover Illustration: One of the wetlands (Waiharakeke 03) identified as part of this project

EXECUTIVE SUMMARY

Bioresearches was engaged by OceanaGold New Zealand Limited (OGNZL) to undertake an assessment of the ecological effects on wetlands located on land above the proposed Wharekirauponga Underground Mine (WUG). This follows the completion of groundwater modelling that shows that there is some potential for a reduction in groundwater levels to occur in a way that could lead to surface-level effects.

As the extent of wetlands within the area potentially affected was not known, or how significant dewatering impacts may be at the surface, Bioresearches and Williamson Water and Land Advisory (WWLA) were engaged to collaboratively assess the impacts of the potential dewatering upon wetlands. This report therefore provides an assessment of the potential ecological impacts of the proposed WUG mine upon wetlands present within the Area of Investigation.

A 305 ha Area of Investigation for this assessment was determined by WWLA, using a combination of ‘depth to groundwater’ and ‘drawdown contour’ datasets to identify where wetlands, if present, would be at greatest risk of impact from dewatering associated with the proposed WUG mine. Wetlands within this Area of Investigation were then identified through the application of the Ministry for the Environment’s (MfE) wetland delineation protocols (MfE, 2022), to ascertain if an area presented with the physical characteristics necessary to be considered a Natural Inland Wetland.

In total, 39 natural inland wetlands were identified within the Area of Investigation. These wetlands are predominantly vegetated with swamp forest, and are of very high ecological value.

WWLA identified that six of the wetlands within the Area of Investigation are most at risk of dewatering effects; however, the modelling predicts that the likelihood of dewatering occurring for wetlands is very low.

Nonetheless, hydrological changes arising from dewatering, if it were to occur, could lead to reductions in wetland extent, or changes in hydrological regimes of the wetlands. This could lead to ecological impacts such as a loss of habitat for flora and fauna or a change in vegetation community. It is considered highly unlikely wetland loss will occur as a result of dewatering. However, because of the uncertainty in whether these effects would occur, and also to aid in the detection of effects, monitoring of both wetlands assessed as most at risk, as well as control or reference wetland/s, is proposed to be undertaken.

If effects of dewatering are detected, it is proposed that remedial actions such as provision of supplementary water, grouting of fissures which drain shallow groundwater and/or reinjection of water into aquifers may occur to augment flows. If these measures are unsuccessful, inadequate or otherwise unable to be undertaken, an offsetting or compensation package will be developed to address any residual effects and ensure that the project results in no net loss of wetland habitat or wetland ecological value.

The magnitude of effect of the project upon wetlands, when the potential effects as well as these proposed effects management measures are accounted for, is considered to be negligible. This corresponds to an overall low level of effect to wetlands within the Area of Investigation. No further effects management measures are recommended to be undertaken.

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1 INTRODUCTION

Bioresearches was engaged by OceanaGold New Zealand Limited (OGNZL) to undertake an assessment of the ecological effects to wetlands on land located above the proposed Wharekirauponga Underground Mine, which is located within the Coromandel Forest Park, north of Waihi township and to the west of Whiritoa township (Figure 1).

Figure 1. Proposed Wharekirauponga Underground Mine (WUG) location

1.1 Project Description

The proposed new underground mine, the Wharekirauponga Underground Mine (WUG), is located approximately 11km north-west of the current mine operation's processing plant within Waihi, under land administered by the Department of Conservation (DOC) (Coromandel Forest Park). Site infrastructure supporting the mine will be located on OGNZL owned farmland at the end of Willows Road, with only minimal surface features within the forest, in the form of fenced vent risers.

Construction of the WUG mine will occur as part of a wider project referred to as the Waihi North Project (WNP), which also includes construction of tunnels to connect the WUG mine to associated surface infrastructure and the existing processing plant at Waihi; a new open pit mine; a temporary rock stack; a tailings storage facility; upgrades to water treatment and processing plants; and reconsenting of existing treated water discharge consents.

These wider project aspects of the WNP are all located outside of the Wharekirauponga Catchment and are not considered as part of this Wetland Ecological Impact Assessment.

1.2 Report Purpose

It was identified through groundwater modelling that the proposed WUG mine may lead to a reduction in groundwater levels; which in turn has the potential to lead to surface-level impacts, such as dewatering of wetlands and drawdown of streams.

Previous vegetation surveys had identified the potential presence of swamp forest within the forest above the proposed WUG mine (Boffa Miskell, 2022), however no dedicated wetland surveys had been undertaken within the area. Therefore, as the extent of wetlands within the affected area was not known, or whether dewatering impacts may occur at the surface such that these wetlands could be affected, Bioresearches and Williamson Water and Land Advisory (WWLA) were engaged to collaboratively assess the impacts of the potential dewatering upon wetlands. This report therefore provides an assessment of the potential ecological impacts of the proposed WUG mine upon wetlands present within the Area of Investigation.

2 SITE DESCRIPTION

The geological unit (an epithermal quartz vein) which OGNZL proposes to mine for gold is located primarily within the Wharekirauponga valley. This valley, and its surrounds, were formed by volcanic flows, which have created steeply sloped hillsides and deep valleys. The valley is located within the Waihi Ecological District, where the climate is characterised by warm, moist summers and mild winters (McEwen, 1987; Burns, 1984). Annual rainfall within the valley is approximately 2514 mm.

The Wharekirauponga Stream drains the valley, which in turn discharges into the Otahu River, which drains into the Pacific Ocean on the southern edge of Whangamata. The upper reaches of the Wharekirauponga Stream catchment, where the Area of Investigation[1] is located , is comprised of five major tributaries: Teawaotemutu Stream; Edmonds Stream, Thompson Stream, Tributary R, and Adams Stream. The groundwater drawdown effects of the proposed mine have potential to extend over this area and also into two other stream catchments, the Otahu Stream catchment to the north, and the Waiharakeke Stream catchment to the south (Figure 2).

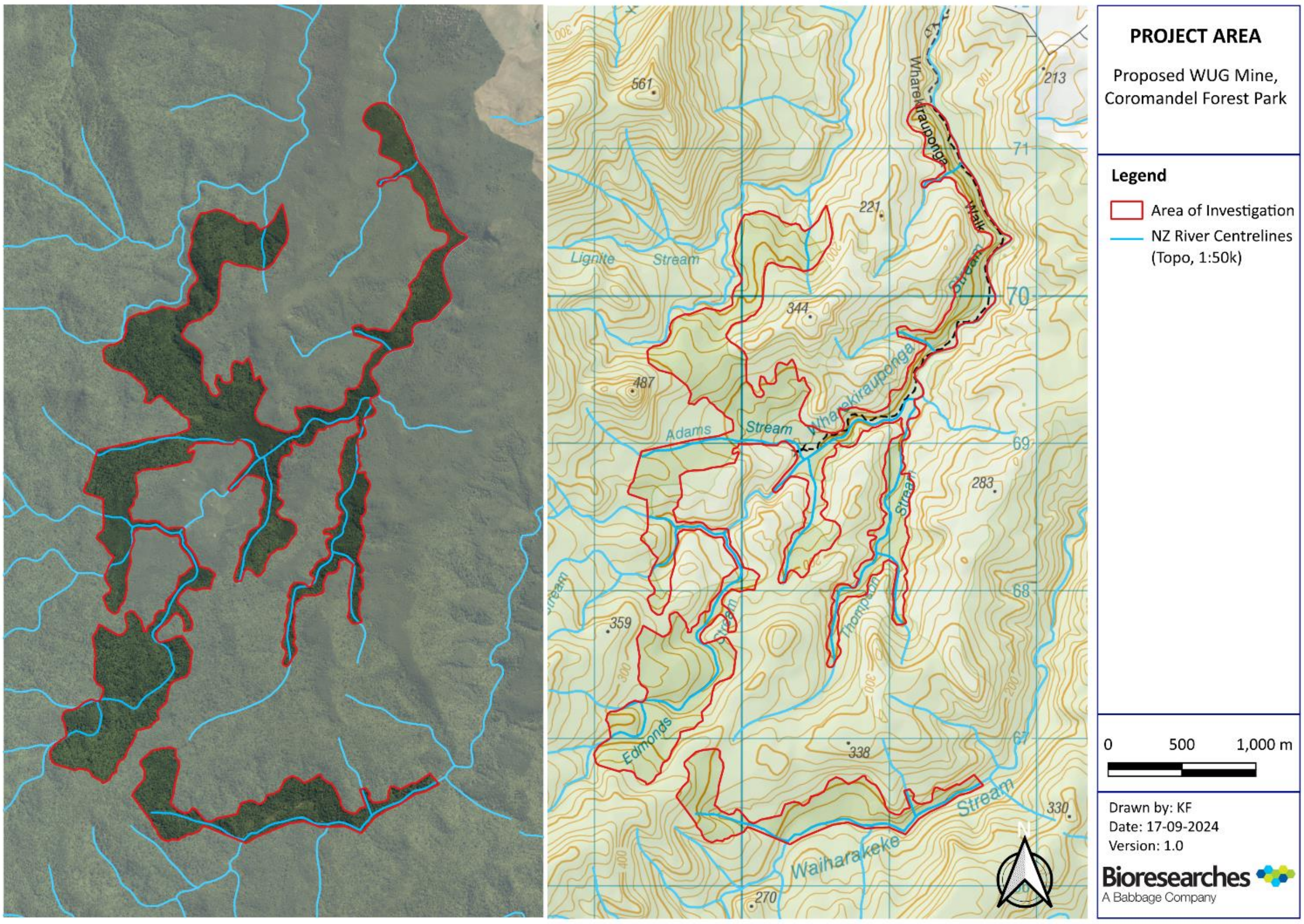

Figure 2. Layout of the Area of Investigation, showing both an aerial and topographic view

The Area of Investigation is vegetated with indigenous flora, which includes both areas of regenerating, kānuka-dominated forest and older growth secondary forest. The general area has undergone historic modification from mining activities and kauri logging; as well as historic vegetation clearance (visible in

[1] For the purposes of this report, the 'Area of Investigation' is the modelled area within which it was determined that risks to wetlands were greatest.

1944 aerial imagery, refer Figure 3), particularly within the lower Wharekirauponga valley, which has now naturally regenerated into the kānuka forest present today. Recent vegetation surveys, undertaken using RECCE plots, have identified three forest types within the Area of Investigation: broadleaved forest, kauri forest and scrubland (Boffa Miskell, 2022).

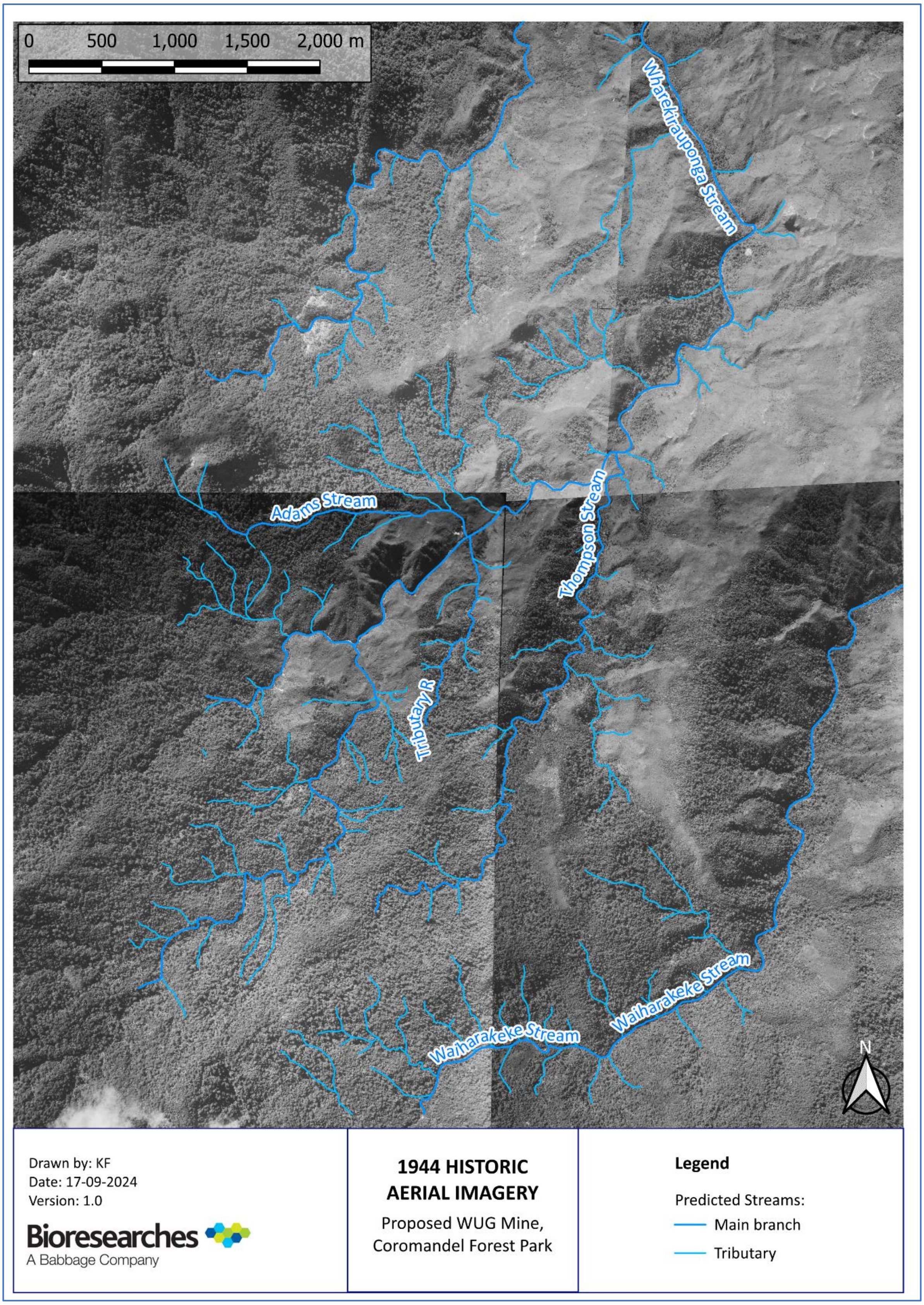

Figure 3. Historic aerial imagery of the Wharekirauponga Valley, from 1944. Retrieved from Retrolens.

3 METHODOLOGY

3.1 Assessment Framework

This assessment generally follows the EcIA Guidelines for use in New Zealand published by the Environmental Institute of Australia and New Zealand (EIANZ) (Roper-Lindsay *et al.*, 2018). The EcIA Guidelines provide a standardised matrix framework that allows ecological effects assessments to be clear, transparent, and consistent. The EcIA Guidelines framework is generally used in Ecological Impact Assessments in New Zealand as good practice, and a detailed analysis of this methodology is presented in Appendix A.

3.2 Desktop Review

A desktop review of available ecological information pertaining to the site was undertaken. This included a review of relevant Waikato Regional Council and Thames Coromandel District Council GIS databases, and a review of previous ecology reports for the site. Specifically, the following information sources were reviewed:

- WKP Biodiversity Monitoring Report (Boffa Miskell, 2022);
- Department of Conservation Threat Classification Series;
- A classification of New Zealand's terrestrial ecosystems (Singers and Rogers, 2014); and
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers *et al.*, 2017).

3.3 Wetland Assessment Study Design

The wetland assessment was carried out by combining the expertise of ecologists from Bioresearches; and hydrologists and hydrogeologists from WWLA.

A 305 ha Area of Investigation for this assessment was determined by WWLA, using a combination of 'depth to groundwater' and 'drawdown contour' datasets (which were prepared by Intera (2024)) to identify where wetlands, if present, would be at greatest potential risk of impact from potential dewatering associated with the proposed WUG mine. The process for determining this area is further explained in Intera (2024).

GIS layers detailing known stream locations within this study area and the wider WUG project area were supplied to Bioresearches. Using this layer and 1 m contours derived from the 'Waikato LiDAR 1m DEM (2021)' dataset, additional potential streams were added to the stream maps.

Due to the large size of the Area of Investigation, it was not possible for it to be entirely covered on foot. Consequently, areas where wetlands were most likely to be present within the Area of Investigation were prioritised, based upon landscape features and topography. Such areas included:

- Areas adjacent to streams or rivers. To assess these areas, the length of all streams within the Area of Investigation which were able to be safely accessed were walked during the site visits.
- Flat or low gradient areas identified by analysis of 1 m lidar GIS contours were also assessed, where it was safe to do so.
- WWLA also completed a desktop analysis to locate any closed depressions within the local area (WWLA, 2023). The closed depressions within the Area of Investigation were then ground truthed to check for wetland presence.

3.4 Site Assessments

Multiple site visits were undertaken between January and September 2024 by qualified ecologists. During the site assessments, the presence and extent of wetland habitats within the Area of Investigation were recorded. The below subsections detail the methodologies used for identifying wetlands.

3.4.1 Wetland identification and delineation

Potential wetland areas were assessed following the Ministry for the Environment's (MfE) wetland delineation protocols (MfE, 2022) to ascertain if the area presented with the physical characteristics to be considered a Natural Inland Wetland.

The definition of a Natural Inland Wetland (as per the NPS-FM) is:

"a wetland (as defined in the [Resource Management] Act) that is not:
(a) in the coastal marine area; or
(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or
(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or
(d) a geothermal wetland; or
(e) a wetland that:
- *(i) is within an area of pasture used for grazing; and*
- *(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless*
- *(iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply."*

Consequently, the first step in delineating a Natural Inland Wetland is to ensure it meets the definition of a wetland under the Resource Management Act (RMA), referred to as 'the Act' in the above definition.

A wetland is defined by the RMA as:

'permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions'.

If the potential wetland met the definition of an RMA wetland, then it was also checked to see if any of the exclusions in the Natural Inland Wetland Definition applied to the area.

If the potential wetland did not meet any of the exclusions; Step 1 (the rapid hydrophytic vegetation test, hereafter 'rapid test') of the MfE wetland delineation process was carried out to determine if the area was a natural inland wetland (Figure 4).

If the rapid test was not appropriate for determining if an area was an RMA wetland, a plot-based vegetation assessment, in accordance with Clarkson (2014), was undertaken so that dominance and prevalence hydrophytic vegetation tests (as required by Step 2, refer Figure 4) could be calculated. These scores are determined based on the occurrence and abundance of plant species assigned the following 'wetland plant indicator ratings' within a vegetation plot:

- Obligate wetland vegetation (OBL) – almost always a hydrophyte, rarely in uplands;
- Facultative wetland (FACW) – usually a hydrophyte but occasionally found in uplands;
- Facultative (FAC) – commonly occurs as either a hydrophyte or non-hydrophyte;
- Facultative upland (FACU) – occasionally a hydrophyte by usually occurs in uplands; and
- Upland (UPL) – rarely a hydrophyte, almost always in uplands.

If results of this were uncertain, hydric soils and hydrology tests were then undertaken by WWLA to determine the wetland status.

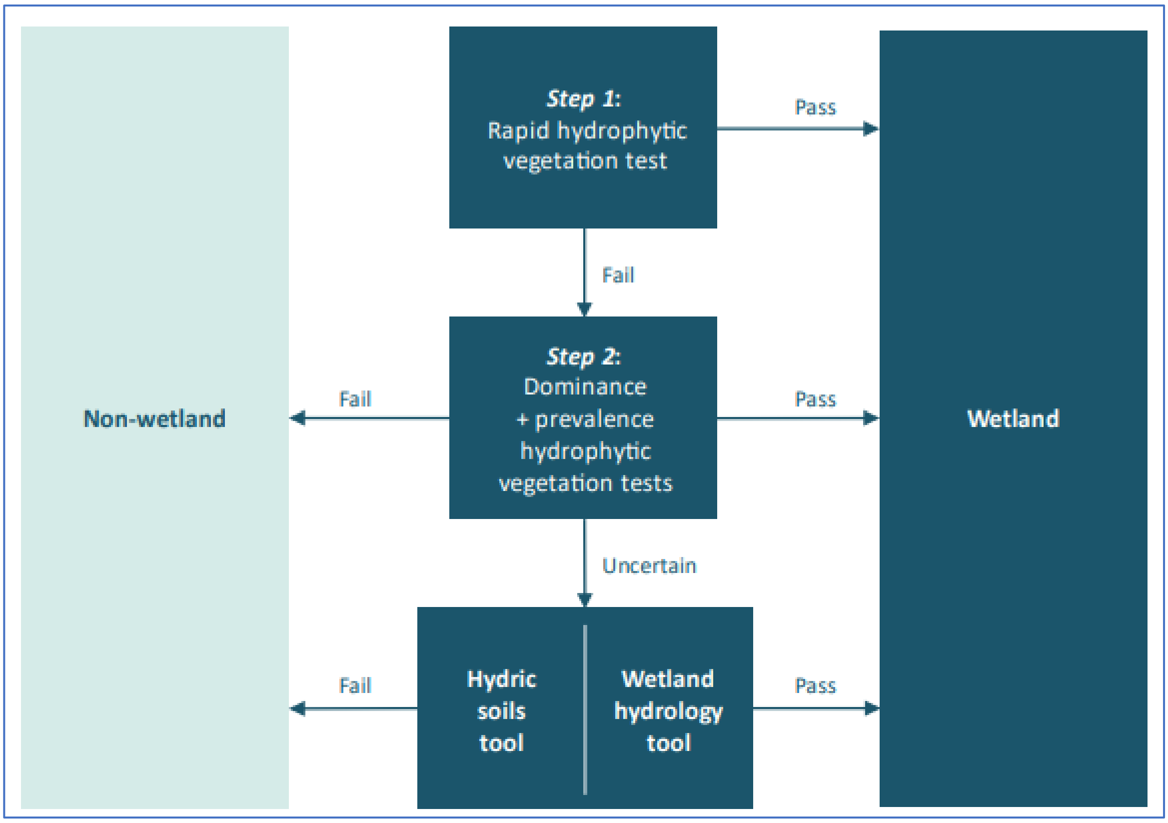

Figure 4.Simple flow chart of steps for delineating a Natural Inland Wetland using the hydrophytic vegetation, hydric soils and wetland hydrology tools. Reproduced from MfE (2022).

All areas of wetland or potential wetland identified by Bioresearches were delineated based on the transition between wetland vegetation and terrestrial vegetation. These delineations were then further refined by WWLA when soils and hydrology tests were undertaken to produce the final maps of wetland extent.

3.5 Excluded Wetland Types

Within the Area of Investigation are gumlands and gumland-type habitats, a subtype of wetland which can meet the definition of a natural inland wetland.

Gumlands occur on land which previously was vegetated with kauri forest. In these areas, soils are strongly podsolised, prone to waterlogging, and leached of nutrients (Clarkson *et al*., 2010). The podsolised soils that form beneath kauri forest contain a silica pan, which acts as a barrier to the drainage of water (Northland Regional Council, 2024). Because of the presence of the pan, they can be saturated in winter due to their poor drainage, and very dry in summer.

Because of their landscape position, often being found on hills, where groundwater is further from the surface, as well as due to the presence of the pan, these wetlands are disconnected from any deeper groundwater layers, and therefore would not be affected by any mine dewatering. Consequently, gumlands were not identified, mapped or delineated during the wetland identification process.

3.6 Wetland Naming Convention

Wetlands were assigned names based upon the name of the stream or stream catchment they were associated with, or the closest stream, and then numbered based upon their landscape position, with numbering starting from the downstream end of each catchment or stream. For example, ‘Edmonds 02’ was the second wetland from the bottom of the Edmonds stream catchment, ‘T Stream North 01’ was the most-downstream wetland identified within the Teawaotemutu Stream North catchment.

3.7 Assessing Effects to Wetlands

To determine the extent to which the identified wetlands may be affected by the dewatering, an understanding of the wetlands water source is required. Wetlands fed by surface water or shallow groundwater are highly unlikely to be impacted by the dewatering; only wetlands fed by deeper groundwater are. To determine which wetlands are likely to be affected, WWLA undertook additional tests to determine the drivers for the formation of each wetland, to assist in determining the water source.

To assist with this, wetlands were classified into four main types (WWLA, 2024):

- Closed depressions: wetlands which are located within closed depressions, primarily fed by surface runoff during rainfall, and are usually located at the base of slopes;
- Depressions with hydrology features: wetlands which are located within a depression, often at the base of slopes or within a valley, where there is also a hydrology feature (e.g. a stream) running through the wetland. These wetlands are also primarily fed by surface runoff;
- Depression with interflow: these wetlands are much like closed depression wetlands, however there is also interflow[2] of water occurring. They are generally located at the base of steep slopes;
- Groundwater supported: also located in depressions, and commonly at the base of steep slopes, however for these wetlands the groundwater is at the surface and therefore the wetlands are considered to be groundwater fed.

[2] Interflow is the flow of water through the unsaturated layers within soil.

In addition to this, wetlands were assessed as to whether they were located close to a geological boundary or where the modelled groundwater depths were less than 1 m. Water samples were also collected and assessed to determine if the water had a groundwater or surface water chemical signature. Finally, this information was collated and used to determine a score predictive of how likely a wetland was to be affected by dewatering (WWLA, 2024).

Once the way in which the wetlands may be impacted by the proposed WUG mine was identified, Bioresearches then addressed the ecological effects of these impacts, following the EIANZ EcIA Guidelines.

4 WETLAND DESCRIPTIONS

4.1 Wetland Identification

In total, 39 natural inland wetlands were identified within the Area of Investigation, with an additional eleven wetlands identified outside of the Area of Investigation (as the Area of Investigation was refined after fieldworks were commenced). All wetlands were identified through the application of the rapid hydrophytic vegetation test. In addition, two additional 'potential wetlands' (Adams 9 and Adams 10) were identified by WWLA. Both of these potential wetlands are located outside of the Area of Investigation, and did not have their status as natural inland wetlands confirmed by application of MfE vegetation tests.

All wetlands are depicted in Figure 5, with close-up maps of the wetlands presented in Appendix B. The additional eleven wetlands and two potential wetlands located outside of the Area of Investigation are not considered further within this report, as these lie outside of the area potentially affected by dewatering.

Wetlands were grouped based upon their location, with seven groups of wetlands identified based upon the catchment within which they were located:

- Otahu / Lignite Stream catchment;
- Wharekirauponga Stream catchment;
- Teawaotemutu Stream catchment;
- Adams Stream catchment;
- Edmonds Stream catchment;
- Tributary R catchment; and
- Waiharakeke Stream catchment.

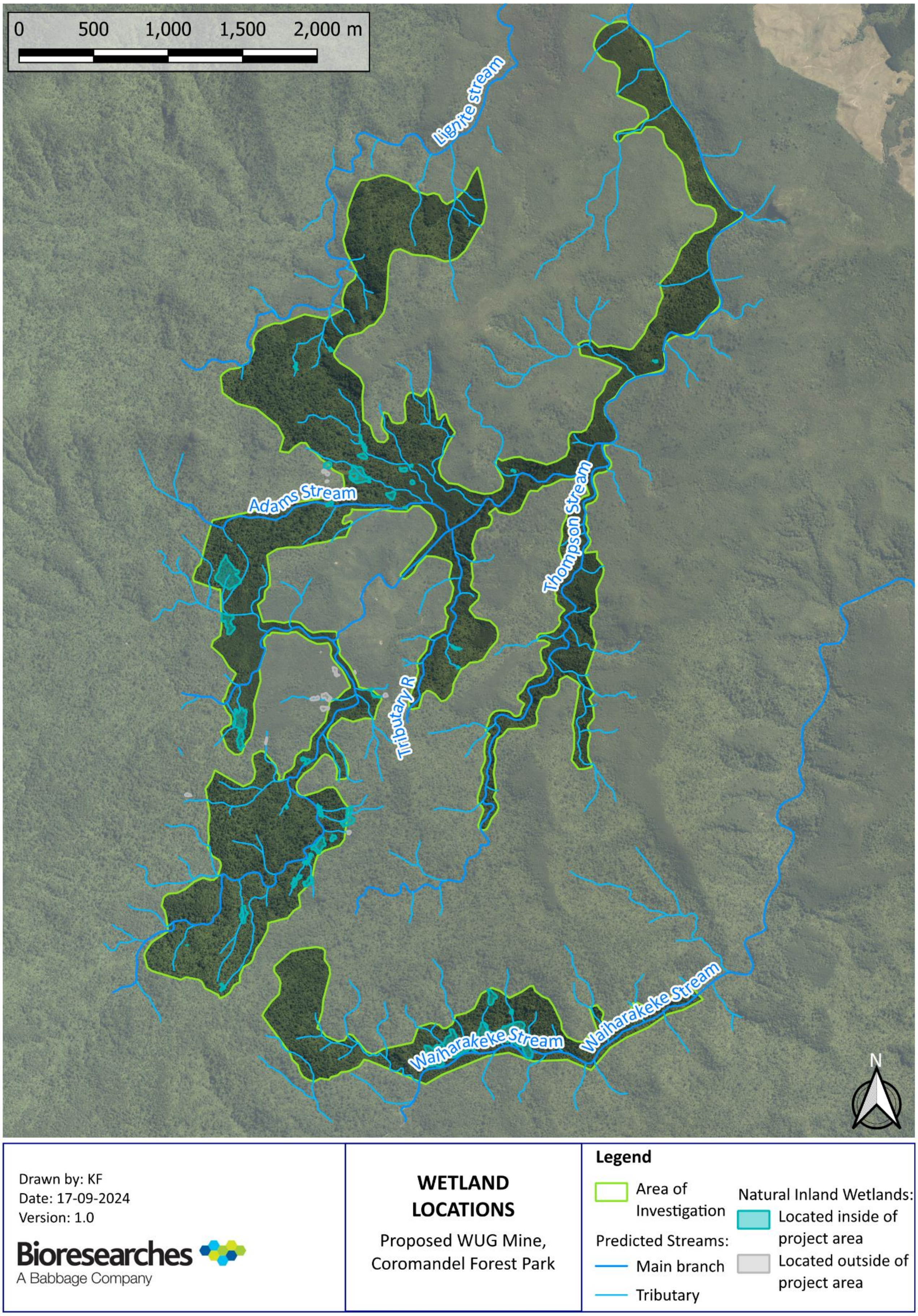

Figure 5. Overview of the wetlands identified within the Area of Investigation. Close-up maps are available in Appendix B.

Table 1 provides a summary of the general characteristics of each of the wetlands identified within the site.

Table 1. Summary of the characteristics of each of the wetlands identified within the Area of Investigation

Wetland	Size (m^2)	Perimeter (m)	Perimeter to area ratio	Wetland Type (WWLA, 2024)	Wetland potentially affected by dewatering score* (WWLA, 2024)	Primary vegetation type	Secondary vegetation type
Adams 01	285	63	0.22	Combined	2.5	Regenerating swamp forest	N/A
Adams 02	495	99	0.20	Groundwater	2	Kahikatea pukatea swamp forest (WF8)	N/A
Adams 03	103	46	0.45	Groundwater	3	Kahikatea pukatea swamp forest (WF8)	N/A
Adams 04	744	115	0.15	Groundwater	3	Kahikatea pukatea swamp forest (WF8)	N/A
Adams 05	856	205	0.24	Groundwater	2	Kahikatea pukatea swamp forest (WF8)	N/A
Adams 06	1,060	141	0.13	Groundwater	2	Kahikatea pukatea swamp forest (WF8)	N/A
Adams 07	4,546	444	0.10	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	Flaxland/ wetland carr (WL18)
Adams 08	877	110	0.13	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	N/A
Adams 11	110	53	0.48	Groundwater	2	Regenerating swamp forest	N/A
Adams 12	455	93	0.20	Combined	1.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 05	106	56	0.53	Surface water	0	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 06	110	50	0.45	Surface water	0	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 07	54	34	0.63	Surface water	0	Kahikatea pukatea swamp forest (WF8)	N/A

Edmonds 10	703	136	0.19	Surface water	1	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 13	69	43	0.62	Surface water	0	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 14	633	202	0.32	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 15	2,434	309	0.13	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 17	2,429	242	0.10	Groundwater	4	Kahikatea pukatea swamp forest (WF8)	Flaxland/ wetland carr (WL18)
Edmonds 18	483	102	0.21	Combined	3.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 19	455	114	0.25	Combined	3.5	Kahikatea pukatea swamp forest (WF8)	Flaxland/ wetland carr (WL18)
Edmonds 20	317	89	0.28	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	Flaxland/ wetland carr (WL18)
Edmonds 21	1,167	175	0.15	Combined	3.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 22	977	205	0.21	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 23	387	116	0.30	Combined	1.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 24	1,763	210	0.12	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	N/A
Edmonds 25	12	19	1.58	Not assessed by WWLA	Not assessed by WWLA	Kahikatea pukatea swamp forest (WF8)	N/A
Otahu 01	233	69	0.30	Surface water	0	Kahikatea pukatea swamp forest (WF8)	N/A
Otahu 02	343	108	0.31	Surface water	1	Kahikatea pukatea swamp forest (WF8)	N/A
T Stream North 01	3,355	340	0.10	Surface water	1	Kahikatea pukatea swamp forest (WF8)	N/A

T Stream North 02	10,520	472	0.04	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	N/A
T Stream South 01	6,612	620	0.09	Combined	2.5	Kahikatea pukatea swamp forest (WF8)	N/A
Tributary R 01	420	99	0.24	Groundwater	2	Kahikatea pukatea swamp forest (WF8)	N/A
Tributary R 02	101	42	0.42	Surface water	1	Kahikatea pukatea swamp forest (WF8)	N/A
Waiharakeke 01	50	30	0.60	Surface water	0	Kahikatea pukatea swamp forest (WF8)	N/A
Waiharakeke 02	36,300	1800	0.05	Surface water	1	Kahikatea pukatea swamp forest (WF8)	Rushland
Waiharakeke 03	241	63	0.26	Surface water	1	Kahikatea pukatea swamp forest (WF8)	N/A
Waiharakeke 04	18,44	203	0.11	Surface water	1	Kahikatea pukatea swamp forest (WF8)	N/A
Wharekirauponga 01	174	60	0.34	Combined	1.5	Kahikatea pukatea swamp forest (WF8)	N/A
Wharekirauponga 02	125	57	0.46	Surface water	2	Kahikatea pukatea swamp forest (WF8)	N/A

* = scores assigned by WWLA (2024), with a score of 0 indicating that a wetland was highly unlikely to be affected by dewatering, and a score of 4 indicating the greatest likelihood of a wetland being affected by dewatering.

4.2 Wetland Vegetation Descriptions

All wetlands identified within the site, except two (Adams 01 and Adams 11) were vegetated, or primarily vegetated, with a variant of kahikatea pukatea swamp forest (WF8, as per classifications in Singers & Rogers (2014)). Adams 01 and 11 were instead vegetated with a regenerating forest type. The below subsections describe the vegetation identified within the wetlands present within the Area of Investigation.

Following the vegetation descriptions, Photo 1 to Photo 8 provide examples of the vegetation present within the wetlands.

4.2.1 Canopy Species

4.2.1.1 Forested wetlands

Canopy vegetation within the wetlands exhibiting the variant of kahikatea pukatea swamp forest was comprised of a canopy generally dominated by pukatea (*Laurelia novae-zelandiae*) and swamp maire (*Syzygium maire*), however it is noted that kahikatea was present in far lower densities than expected in WF8 forest – it was absent or near absent from the canopies of the wetlands, and occurred in low abundance within the subcanopy. The reasons for this are not known; this could be a natural variant of this habitat type, or potentially related to historic logging of kahikatea, as is reported in some other examples of this habitat type (Singers *et al*., 2017).

Other common canopy species present where vegetation was of a shorter stature included wheki̅ (*Dicksonia squarrosa*), tī kōuka (cabbage tree; *Cordyline australis*), nīkau (*Rhopalostylis sapida*), putaputawētā (*Carpodetus serratus*), māhoe (*Melicytus ramiflorus*), and lancewood (*Pseudopanax crassifolius*), with the less hydrophytic of these species more often growing in drier 'mounds' within the wetlands.

The two wetlands which were not vegetated with kahikatea pukatea swamp forest, Adams 01 and Adams 11, were situated within regenerating kānuka forest (VS2 as per Singers & Rogers (2014)). In these wetlands, canopies were primarily kānuka overhanging from outside of the wetland, as well as immature swamp maire, pukatea, and whekī, with occasional mānuka (*Leptospermum scoparium*).

4.2.1.2 Non-forested areas within wetlands

Some of the wetlands also had open areas without a continuous tree canopy. This varied from large areas which occupied a significant portion of the wetland area (present within Waiharakeke 02, Edmonds 17, Edmonds 19, Edmonds 20 and Adams 07), to small, localised areas within wetlands, likely where a treefall had occurred and the tree had not been replaced. In these areas, the swamp forest vegetation was replaced with a herbaceous-dominated community that was vegetated with kiokio (*Parablechnum novae-zelandiae*), mapere (*Gahnia xanthocarpa*), kiekie, tī kōuka, *Machaerina* sp., and sapling trees, including swamp maire, kahikatea, pukatea, putaputawētā, kanono and whekī. This habitat was considered to best be designated as flaxland/wetland carr (WL18) habitat. Also present, although less prevalently than the flaxland/wetland carr habitat, were areas of Machaerina sedgeland.

In Waiharakeke 02, the wetland with the largest area of herbaceous cover, rushland, was present, vegetated primarily with soft rush (*Juncus effusus*) and wīwī (*J. edgariae*).

4.2.2 Subcanopy and Groundcover Species

Subcanopies of the wetlands were generally sparse, with denser vegetation present on the drier mounds within the wetlands. Common subcanopy species within the wetlands included saplings of the species listed above, as well as kiekie (*Freycinetia banksii*), kanono (*Coprosma grandifolia*), hangehange (*Geniostoma ligustrifolium* var. *ligustrifolium*), tānekaha (*Phyllocladus trichomanoides*), and māpou (*Myrsine australis*).

Groundcover within the wetlands was generally sparse, or the understory was dominated by kiekie and/or māpere so that no bare ground remained. Where groundcover was present, common groundcover species and other herbaceous understory species included māpere, kiokio, tangle ferns (*Gleichenia* spp.). Also present were orchids, including spider orchids (*Corybas* sp.) and *Acianthus sinclairii*, nertera (*Nertera dichondrifolia*), and sphagnum moss.

4.2.3 Epiphytes, lianes and notable species

The mature swamp forest also supported a wide variety of epiphytic species and lianes. Common species included kiekie, astelias (*Astelia* spp.), supplejack (*Ripogonum scandens*), spleenwort ferns (*Asplenium polyodon, A. flaccidum, A. oblongifolium*), multiple orchid species, including bamboo orchids (*Earina* spp.), puawānanga (*Clematis paniculata*), hound's tongue fern (*Zealandia pustulata* subsp. *pustulata*), fragrant fern (*Dendroconche scandens*), fork ferns (*Tmesipteris* sp.), filmy ferns (*Hymenophyllum* spp.), puka (*Griselinia lucida*), and rātā (*Metrosideros perforata*, *M. fulgens*).

One other plant species which was less common, but notable due to its threat status, was ramarama (*Lophomyrtus bullata*), which was present in wetlands in the Waiharakeke catchment.

Exotic weed species identified within the wetlands included pampas (*Cortaderia selloana*), blackberry (*Rubus fruticosus*), and in Waiharakeke 02, soft rush and spearwort (*Ranunculus flammula*). Weeds were not observed within every wetland, and, generally, weeds occurred sparsely where they were observed, with the exception of the rushland habitat in Waiharakeke 02, and what is presumed to be a slip deposit within Adams 07, upon which pampas was growing densely.

4.2.4 Wetland Photos

Photo 1 to Photo 8 below provide examples of the varying vegetation types identified within the wetlands throughout the Area of Investigation.

Photo 1. An example of the vegetation present within one of the open areas of wetland, without a dense tree canopy

Photo 2. Another example of the vegetation present within one of the open areas of wetland, without a dense tree canopy

Photo 3. Dense kiekie, as was present in the understory of most of the wetlands present within the site

Photo 4. Example of one of the many areas where the groundcover and subcanopy of the wetlands was relatively sparse

Photo 5. A moderately densely vegetated subcanopy

Photo 6. Māpere-dominated subcanopy. After kiekie, this was the second most common understory composition

	
Photo 7. Rushland habitat, only identified within wetland Waiharakeke 02	***Photo 8. Machaerina sedgeland habitat***

4.3 Summary of WWLA Hydrological Findings

Soil Moisture Water Balance Modelling undertaken by WWLA indicates that the identified wetlands can all be supported by climate [i.e., rainfall and surface water inflows] alone, and therefore any reduction in shallow groundwater levels is not expected to lead to a change in wetland extent throughout the project area (WWLA, 2024).

WWLA identified that there is potential that the number of consecutive days that the soils will be saturated will reduce during a year, however, the model results show that even if dewatering were to occur at the same time as drought conditions (worst case scenario), the wetlands would still meet the criteria of being a functional wetland (WWLA, 2004).

Using their assessment criteria, WWLA identified eight wetlands which are considered to have a higher susceptibility to being affected by dewatering, if a linkage between deep and shallow groundwater was to develop due to dewatering. These wetlands include:

- Edmonds 17;
- Edmonds 18;
- Edmonds 20;
- Edmonds 22;
- Adams 3;
- Adams 4;
- Adams 9 and
- Adams 10.

As Adams 9 and Adams 10 are located outside of the Area of Investigation provided to Bioresearches[3], their ecological assessment was not within the scope of works for this report. Because of this, formal

[3] These potential wetlands were identified incidentally by WWLA staff when walking between wetlands identified by Bioresearches.

vegetation tests have not been applied to these potential wetlands to confirm their status as natural inland wetlands, and an ecological value has not been assigned to them.

4.4 Ecological Value

The wetlands within the site are considered to have **'very high'** ecological value. The rationale for this is detailed below in Table 2.

Table 2. Ecological value assessment for the wetlands identified within the Area of Investigation

Matter	Description
Representativeness	**High** The wetlands are highly representative of a variant of swamp forest. All vegetation tiers are present and exotic species are rarely encountered throughout the wetlands. The wetlands all have areas of permanent saturation, and thus are permanent landscape features. Section 11A and Table 11-1 of the Waikato Regional Policy Statement set out the criteria for identifying areas of significant indigenous biodiversity and their characteristics as they exist at the time the criteria are being applied. Thus, the wetlands within the Area of Investigation are considered to be significant as they meet more than one of the criteria listed, namely criteria 3 (the wetlands provide habitat for Threatened – Nationally Critical swamp maire); criteria 6 (wetland habitat for indigenous plant communities); and criteria 9 (an area of indigenous vegetation or habitat that is a healthy and representative example of its type). Although largely intact, the wetlands are located within a forest system which is not pest animal free and without extensive pest control. Impacts from pest animals are evident; with low abundances of sensitive fauna present, and signs of damage to vegetation from pest browse and digging.
Rarity/ distinctiveness	**Very High** The identified wetlands range in size from 12 m^2 through to 3.6 ha. In total, 8.2 ha of wetland was identified within the 305 ha Area of Investigation, accounting for 2.7% of the total area. It is expected that the swamp forest vegetation communities recorded are present throughout the Coromandel Forest Park, which totals approximately 72,000 ha. Ausseil *et al.* (2008) estimate that 2.8% of the original wetland extent remains within the Coromandel area; with 737 ha of wetland remaining. This is lower than the 7.9% reported for the wider Waikato Region, where 28,226 ha of wetland is reported to remain. Specifically for swamp habitats, which the wetlands within the site are, 2% are thought to remain within the Coromandel. However, Ausseil *et al*. (2008) note that wetlands with low stature vegetation like rushes or sedges are more readily captured in satellite imagery, and it is difficult to separate forested wetlands from dry forest; and that smaller wetlands are likely to be overlooked. Thus, it is possible that the reported wetland extents for the Coromandel area do not include the many examples of small swamp forest wetlands present within the Coromandel Forest Park which are highly likely have remained intact. This could lead to an underreporting of the total wetland area, and therefore overreporting of the potential wetland loss. Nonetheless, it is recognised that wetlands are a greatly reduced habitat type within the wider landscape, and wetlands vegetated with mature forest are also far rarer than they would historically have been.

	The wetlands likely provide habitat for a similar suite of fauna species to those identified as present within the wider area. This includes those with elevated threat classifications such as: yellow-crowned kākāriki (*Cyanoramphus auriceps*; At Risk - Declining) and kākā (*Nestor meridionalis septentrionalis*; At Risk - Recovering);[4] arboreal lizards, including elegant and forest geckos (*Naultinus elegans* and *Mokopirirakau granulatus*, respectively), both which are At Risk – Declining;[5] Fish species, including At Risk - Declining taxa such as longfin eel (*Anguilla dieffenbachii*);[6] and It is also possible that At Risk – Declining Hochstetter's frogs (*Leiopelma hochstetteri*)[7] are residents or visitors to the wetlands. In addition to fauna, Threatened or At Risk (TAR) flora identified within the wetlands includes: • At Risk – Declining mānuka; • Threatened – Nationally Vulnerable akatea and climbing rāta; and • Threatened – Nationally Critical ramarama and swamp maire.
Diversity and pattern	**High** Vegetation communities are highly diverse, supporting natural successional and altitudinal patterns.
Ecological context	**Very High** The wetlands within the Area of Investigation form part of a very large area of contiguous forest habitat within the lower coromandel Peninsula. The wetlands, and their surrounds, support a diverse range of flora and fauna. The wetlands are also closely linked to aquatic habitats, with the majority being directly connected to a stream habitat.
Overall ecological value	**Very High**

[4] Bird threat classifications from Robertson *et al.* (2021).

[5] Lizard threat classifications from Hitchmough *et al.* (2021).

[6] Freshwater fish threat classifications from Dunn *et al.* (2017).

[7] Amphibian threat classifications from Burns *et al.* (2017).

5 ECOLOGICAL EFFECTS OF POTENTIAL DEWATERING TO WETLANDS

5.1 Predicted Dewatering in Relation to Wetlands

As described above in Section 4.3; the following wetlands within the Area of Investigation are considered the most likely to be susceptible to the effects of dewatering:

- Edmonds 17;
- Edmonds 18;
- Edmonds 20;
- Edmonds 22;
- Adams 3; and
- Adams 4.

These wetlands are depicted in Figure 6.

However, Soil Moisture Water Balance Modelling undertaken by WWLA indicates that the identified wetlands can all be supported by climate [i.e., rainfall and surface water inflows] alone, and therefore any reduction in shallow groundwater levels is not expected to lead to a change in wetland extent throughout the project area (WWLA, 2024).

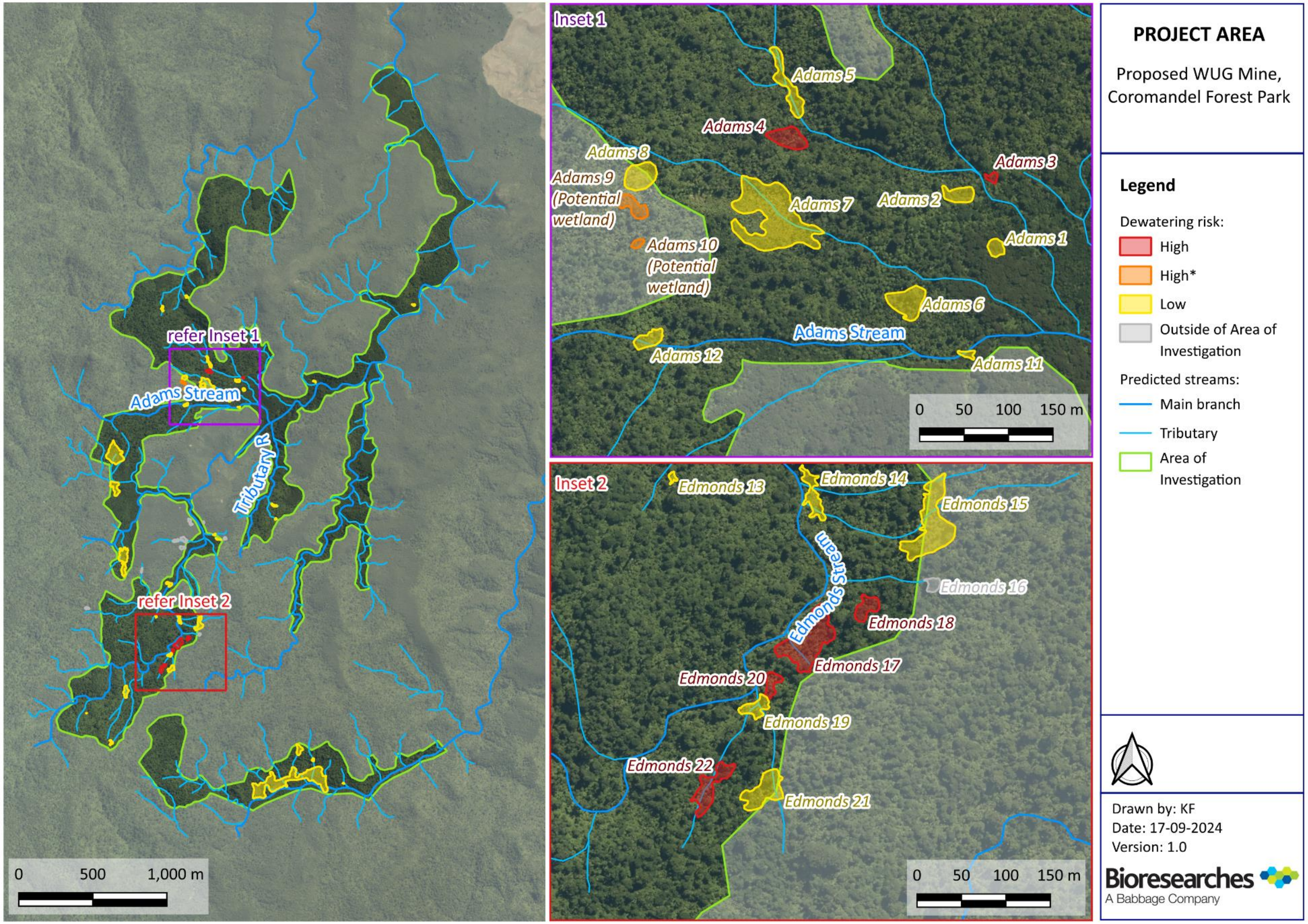

Figure 6. Wetlands identified as most at risk from the effects of dewatering. * = identified as high risk, but not confirmed to be a natural inland wetland by Bioresearches (through application of MfE wetland delineation methodologies), as is located outside of the Area of Investigation.

5.2 Potential Effects of Dewatering to Wetlands

Despite the very low likelihood that wetlands are impacted by dewatering, a reduction in groundwater levels, may indirectly impact wetlands within the site by:

- Causing a reduction in wetland extent, and therefore a loss of wetland habitat within the Area of Investigation; and/or

- Changing the hydrological functioning and features of wetlands (e.g., so the extents of standing water, permanently saturated areas, and intermittently saturated areas within a wetland may change, both temporally and in overall extent). This may in turn lead to a change in the vegetation community, as:
    - Vegetation is no longer able to grow where it presently does (e.g., it may cause loss of obligate wetland species from within or within areas of a wetland), and/or
    - Vegetation is placed under increased stress, which then, cumulatively, with the impacts of other stressors, leads to their loss from the wetland (e.g., stressed swamp maire trees will then be more susceptible to impacts from the fungal pathogen myrtle rust (*Austropuccinia psidii*) than if they were otherwise healthy). Other sources of stress, such as climate change, may further exacerbate this.

      This may occur to such a degree that the wetland's habitat type changes, even if the area still retains wetland characteristics and there is no change in wetland extent. In addition, fauna utilising the wetland will likely be affected, both from a loss of habitat (e.g., aquatic habitat for fish may be lost if the area of standing water reduces) and the habitat provisioning of the wetlands for fauna may also change as the vegetation community changes and in turn, food supplies change.
    - Finally, it is also recognised that a reduction in water levels may allow pest animals to more readily access wetland areas which are currently difficult to access. This may in turn place both wetland flora and fauna under increased pressure from browsing and predation.

5.3 Detecting Effects Through Monitoring

To ensure that potential effects to wetlands associated with dewatering are detected, monitoring of wetlands is proposed. This will be undertaken through monitoring of both wetland vegetation communities and hydrogeological conditions, both within the six (possibly eight) wetlands identified as most at risk within the Area of Investigation, and within 'reference wetland/s' located within a local, unaffected catchment, which will act as a control group to aid in detecting whether any change in wetland characteristics is attributable to the WUG mine.

Reference wetlands will ideally be very similar to the wetlands within the Area of Investigation, in wetland type and class, vegetation composition, hydrology, and will ideally be situated on similar geology and with a similar climate to that within the Wharekirauponga valley.

The vegetation component of the monitoring is proposed to be undertaken in general accordance with the Handbook for Monitoring Wetland Condition (Clarkson, 2004). The standard approach to monitoring in accordance with Clarkson (2004) includes the establishment of permanent vegetation plots within a wetland. The plots are then monitored on a regular interval, so that changes in vegetation composition can be tracked, and utilised to provide an index for wetland condition. Limitations of Clarkson (2004) are that a large portion of focus of the condition index is that it measures the proportion of native and exotic species in a plot to provide a plot score; and in situations where changes in wetland hydrology are potentially occurring, the plant community may change, but if a native species is replaced with a native species, this will not be reflected in the plot score.

Therefore, to assist in tracking any changes in hydrology and therefore the vegetation community, it is recommended that the dominance test and prevalence index (as per Clarkson, 2014) are also applied to the data collected from vegetation plots as a means of tracking 'wetness' through the wetland ratings of species present within the wetland. This will provide a quantitative means to track, for example, if obligate wetland species are being replaced with facultative wetland species over time, even if all species are native.

Also prescribed as part of the Clarkson (2004) methodology are basic hydrological methods for tracking groundwater levels. These may be replaced by more technical methodologies such as the utilisation of piezometers, as described in WWLA (2024).

Wetland monitoring methodologies should be detailed in a specific Wetland Monitoring Plan which details the wetlands selected for monitoring; the methodologies used for monitoring, including monitoring frequency; and trigger levels for when remedial actions and/or offsetting or compensation should be applied to address ecological effects of any dewatering.

5.4 Magnitude of Effect and Level of Effect Without Effects Management

Based upon the application of the criteria discussed in Table 3, it is considered that the project will have a **low** magnitude of effect to wetlands within the Area of Investigation if no effects management measures are applied. A low magnitude of effect is summarised in the EIANZ EcIA Guidelines as a:

> *"Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature."*

When applying the criteria for describing the level of effects (refer Table 6 in Appendix A); a low magnitude of effect upon an ecological feature with a very high ecological value corresponds to a **Moderate** level of effect[8].

It is recommended by the EIANZ EcIA guidelines that a level of effect of Moderate or above be managed through the application of effects management measures. Therefore, potential effects management measures which could be applied, should monitoring detect a sufficient level of impact to wetlands, are discussed in Section 7.

[8] A level of effect that corresponds to Moderate, High, or Very High is generally accepted by ecologists to constitute a 'significant ecological effect' under the RMA, while a Low or Very Low level of effect is usually considered to correspond to a 'minor ecological effect' or 'less than minor ecological effect' under the RMA. It is usual for a 'Very High' level of effect to trigger re-design or avoidance.

Table 3. Magnitude of effect assessment for the potential dewatering of wetlands identified within the Area of Investigation

Matter	Description
Spatial Scale	When addressing the Magnitude of Effect in accordance with the EIANZ EcIA guidelines, the spatial scale or extent of the effect is an important factor in determining the magnitude of an effect. When considered at the Area of Investigation scale (and therefore excluding Adams 8 and Adams 9), of the wetlands identified within the Areas of Investigation, which collectively cover approximately 8.2 ha; six wetlands have been identified as most likely to be affected by dewatering. These wetlands collectively cover 0.505 ha, or 6.3% of the total wetland area within the Area of Investigation. Modelling suggests that these wetlands are highly unlikely to be affected by dewatering; and thus an overly conservative approach may be to assume that the six affected wetlands may experience a 5% reduction in total area. Such a reduction would correspond to an 0.3% loss of wetland area within the Area of Investigation. No data were available on wetland extent in the Ecological District level. At the scale of the Coromandel Forest Park, it is considered likely that the vast majority of wetland habitat has remained intact. On a broader scale, as discussed in Section 5.4; data on the extent of wetlands within the Coromandel Peninsula and wider Waikato Region are limited by a lack of ability to detect wetlands within forested habitats, and thus estimates of the extent of wetland loss, particularly in areas of high forest cover (such as the Coromandel Peninsula) are likely inflated. Nonetheless, it is accepted that a large proportion of wetland habitats within the Coromandel have been lost; or highly modified, with their original forest cover replaced with exotic, herbaceous vegetation communities.
Temporal Scale	The mine is proposed to operate for 14 years followed by a period of about a decade during which groundwater levels will re-establish. As 'permanent' effects are considered to occur when effects are greater than 25 years (one human generation), the dewatering, if it occurs, will be a temporary, albeit long-term effect. As the effects of dewatering only are detectable in the driest periods, then the effect will be occasional rather than continuous. However, if the dewatering is significant enough to lead to a change in the vegetation community, then the follow-on effect will be continuous.
Duration and reversibility	Following mine closure, it is expected that groundwater levels will return to 'normal' approximately 25 years after mine operations commence.
Risk and Uncertainty	As described above, it is impossible to predict with certainty how the wetlands may be affected. Despite this, a scoring system (based upon wetland type, the wetland location relative to a geological boundary, it's location relative to the depth to groundwater and the signature of water collected from the wetland (to assist in determining the presence of groundwater)) has been adopted which identified a range of wetlands most likely to be affected by dewatering. A Soil Water Balance model then applied to the catchment predicts a very low likelihood of any effect to wetlands occurring.
Overall magnitude of effect	**Low**

6 PROPOSED EFFECTS MANAGEMENT MEASURES

Good practice when proposing a project involves adhering to the effects management hierarchy (New Zealand Government, 2014). The steps to this hierarchy are Avoid, Minimise, Remedy, Offset and Compensate. The following textbox contains definitions for each of these terms. The definitions for avoidance, minimisation and remedying are sourced from 'Guidance on Good Practice Biodiversity Offsetting in New Zealand' (New Zealand Government, 2014), and the definitions for offsetting and compensation are from the EIANZ EcIA Guidelines.

Avoidance: *measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity. This results in a change to a 'business as usual' approach; for example, re-routing of roads to avoid the most sensitive areas (New Zealand Government, 2014).*

Minimisation: *measures taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided, as far as is practically feasible; for example, retaining wildlife corridors to reduce impacts of roads (New Zealand Government, 2014).*

Rehabilitation/restoration (remedying): *measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/or minimised; for example, replanting roads that are no longer required or were widened to accommodate trucks carrying construction materials (New Zealand Government, 2014).*

Offset: *measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and/or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity (Roper-Lindsay et al. (2018)).*

Compensate: *may include non-biodiversity exchanges, such as financial or labour exchange; or biodiversity exchanges that are not like-for-like or are out of kind (Roper-Lindsay et al., 2018).*

Avoidance and minimisation of potential impacts to wetlands Edmonds 17, Edmonds 18, Edmonds 20, Edmonds 22, Adams 3 and Adams 4; and, if confirmed as natural inland wetlands, Adams 9 and Adams 10, are considered impossible to undertake in relation to this project, particularly when considering the very low likelihood of any effect occurring to wetland habitats as a result of this project; and, if an effect does occur, a low level of effect which is predicted. Nonetheless, the following sections detail potential actions which will be undertaken to ensure the effects management hierarchy is fully adhered to, should ecological impacts to the wetlands be detected through monitoring.

6.1 Remedial Actions

If it is detected through monitoring that the wetlands are being ecologically affected by the dewatering, then the actions described in Sections 6.1.1 to 6.1.3 will be considered for adoption to mitigate the effects of dewatering. The adoption of any method must be preceded by a confirmed link between dewatering and at least a measurable impact on shallow groundwater levels that, if not mitigated, would likely lead to a decrease in wetland area or water levels. Greater detail on these remedial actions is available within the Wharekirauponga Mine Groundwater and Surface Water Management and Monitoring Plan (OceanaGold, 2024), where these methods are described in detail in relation to their potential use for maintenance of stream flows. If required, the same methodologies would be applied to maintain water levels within wetlands.

6.1.1 Grouting

Grouting is a process where cracks and fissures through which shallow groundwater drains are filled with a cement, chemical, polymer or resin-based grout to prevent water losses to the mine. This therefore maintains shallow groundwater levels.

6.1.2 Supplementary water

Supplementary water may be added to the wetlands to maintain their water levels. It is expected that if needed at all, application of supplementary water would only be needed in dry months such as summer when water levels are naturally lower. Supplementary water may be sourced from local boreholes (placed in such a location that the taking of water will not have other ecological consequences); from water collected locally in tanks located on existing drill platforms; or through the application of treated deep groundwater retrieved from within the mine.

6.1.3 Reinjection

This option involves capturing the groundwater inflowing to the mine, which is part of normal operations, and reinjecting a portion back into selected locations of an affected overlying aquifer. A determination would need to be made on whether the reinjected supply required treatment, but as it is the maintenance of the water level overlying the point of reinjection that is the objective, and not the discharge of the reinjected water into the surface water, treatment may not be necessary.

6.2 Offsetting or Compensation Measures

If the above remedial measures to augment water supply to wetlands affected by dewatering are not successful, or not able to be applied to a specific wetland (e.g., a wetland located in a very remote portion of the site or a location where the works necessary to augment supply water to the wetland pose a greater ecological risk to the wetland or the surrounding forest or stream habitat than is deemed to be gained by the augmentation of additional water), then offsetting or compensation measures would be necessary to be applied to address the residual ecological impacts of the dewatering.

An offsetting or compensation package would therefore be developed to ensure that the project does not lead to a net loss of ecological value. Such a package would utilise best-practice offsetting or compensation calculation tools (e.g., the Biodiversity Offsetting Accountability Model ('BOAM'; Maseyk *et al*. (2015)), or the Biodiversity Compensation Model ('BCM' ; Baber *et al*. (2021)).

Potential offsetting or compensation measures which may be undertaken include:

- The creation of additional wetland/s within the local area, which will be vegetated with native wetland species and pest-controlled;
- The restoration of other local wetland/s through measures such as planting and plant and animal pest control, to recreate additional swamp forest habitat. There is an abundance of modified wetland habitat present locally which, prior to deforestation of the local area, would have been vegetated with swamp forest and is now vegetated with exotic wetland and therefore is suitable for restoration;

- Financial contribution to local wetland restoration programmes or similar, ecologically beneficial programmes for wetlands. It must be noted that financial contributions are difficult to quantify and to date sufficient guidance on appropriate compensation values are limited.

It is recommended that as a condition of consent, an appropriate offsetting or compensation package should be developed should ecological effects occur that cannot be addressed through the remedial actions described above.

6.3 Level of Effect Following Implementation of Effects Management Measures

If the above effects management measures, including both remedial actions and offsetting or compensation actions are adopted so that no net loss of ecological value is achieved, the magnitude of effect of the dewatering of wetlands is considered to be **Negligible**. This corresponds to a **Low** level of effect. Therefore, no further effects management measures are considered necessary.

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APPLICABILITY AND LIMITATIONS

Restrictions of Intended Purpose

This report has been prepared solely for the benefit of OceanaGold New Zealand Limited as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgements are to be relied on, they should be independently verified with appropriate legal advice.

Maps and Images

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Bioresearches.

Appendix A Ecological Impact Assessment Methodology

The assessments were undertaken in general accordance with Ecological Impact Assessment guidelines, published by the Environment Institute of Australia and New Zealand (EIANZ; Roper-Lindsay *et al*., 2018). The Guidelines provide criteria for assigning value to habitat for assessment purposes. Values are assigned (High, Moderate, Low, Very Low, Table 14) based on the following four assessment matters (as described in Roper- Lyndsay *et al*., 2018):

1. Representativeness
2. Rarity / Distinctiveness
3. Diversity / Pattern
4. Ecological Context

The level of effect is then determined by determining the magnitude (Table 15) and combining the value of the ecological feature/attribute with the score or rating for magnitude of effect to create a criterion for describing the level of effects (Table 16). The cells in Table 3 italics in represent a 'significant' effect under the EIANZ 2018 guidelines.

Cells with low or very low levels of effect represent low risk to ecological values rather than low ecological values per se. A moderate level of effect requires careful assessment and analysis of the individual case. For moderate levels of effects or above, measures are expected to be introduced to avoid through design, or appropriate mitigation needs to be addressed (Roper-Lindsay *et al*., 2018).

Table 4. Criteria for assigning value to habitat/species for assessment (reproduced from Roper-Lindsay et al., 2018).

Value	Determining Factors
Very High	Nationally Threatened species found in the 'zone of influence' (ZOI) either permanently or seasonally. Area rates 'High' for at least three of the assessment matters of Representativeness, Rarity/distinctiveness, Diversity and Pattern, and Ecological Context. Likely to be nationally important and recognised as such.
High	Species listed as At Risk – Declining found in the ZOI either permanently or seasonally. Area rates 'High' for two of the assessment matters, and 'Moderate' and 'Low' for the remainder OR area rates 'High' for one of the assessment matters and 'Moderate' for the remainder. Likely to be regionally significant and recognised as such.
Moderate	Species listed as At Risk – Relict, Naturally Uncommon, Recovering found in the ZOI either permanently or seasonally. Locally uncommon or distinctive species. Area rates 'High' for one of the assessment matters, 'Moderate' or 'Low' for the remainder OR area rates as 'Moderate' for at least two of the assessment matters and 'Low' or 'Very Low' for the remainder. Likely to be important at the level of the Ecological District.
Low	Nationally and locally common indigenous species. Area rates 'Low' or 'Very Low' for majority of assessment matters, and 'Moderate' for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Exotic species including pests, species having recreational value. Area rates 'Very Low' for three assessment matters and 'Moderate', 'Low' or 'Very Low' for the remainder.

Table 5. Criteria for describing the magnitude of effects (reproduced from Roper-Lindsay et al., 2018).

Magnitude	Description
Very High	Total loss of, or a very major alteration to, key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the Site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss of major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances and patterns; AND/OR Having minor effect on the known population or range of the element/feature.
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Table 6. Criteria for describing the level of effects (reproduced from Roper-Lindsay et al., 2018). Where text is italicised, it indicates 'significant effects' where mitigation is required.

		Ecological Value				
		Very High	High	Moderate	Low	Negligible
Magnitude of Effect	Very High	***Very High***	***Very High***	***High***	***Moderate***	Low
	High	***Very High***	***Very High***	***Moderate***	Low	Very Low
	Moderate	***High***	***High***	***Moderate***	Low	Very Low
	Low	***Moderate***	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net Gain	Net Gain	Net Gain	Net Gain	Net Gain

Appendix B Detailed wetland maps

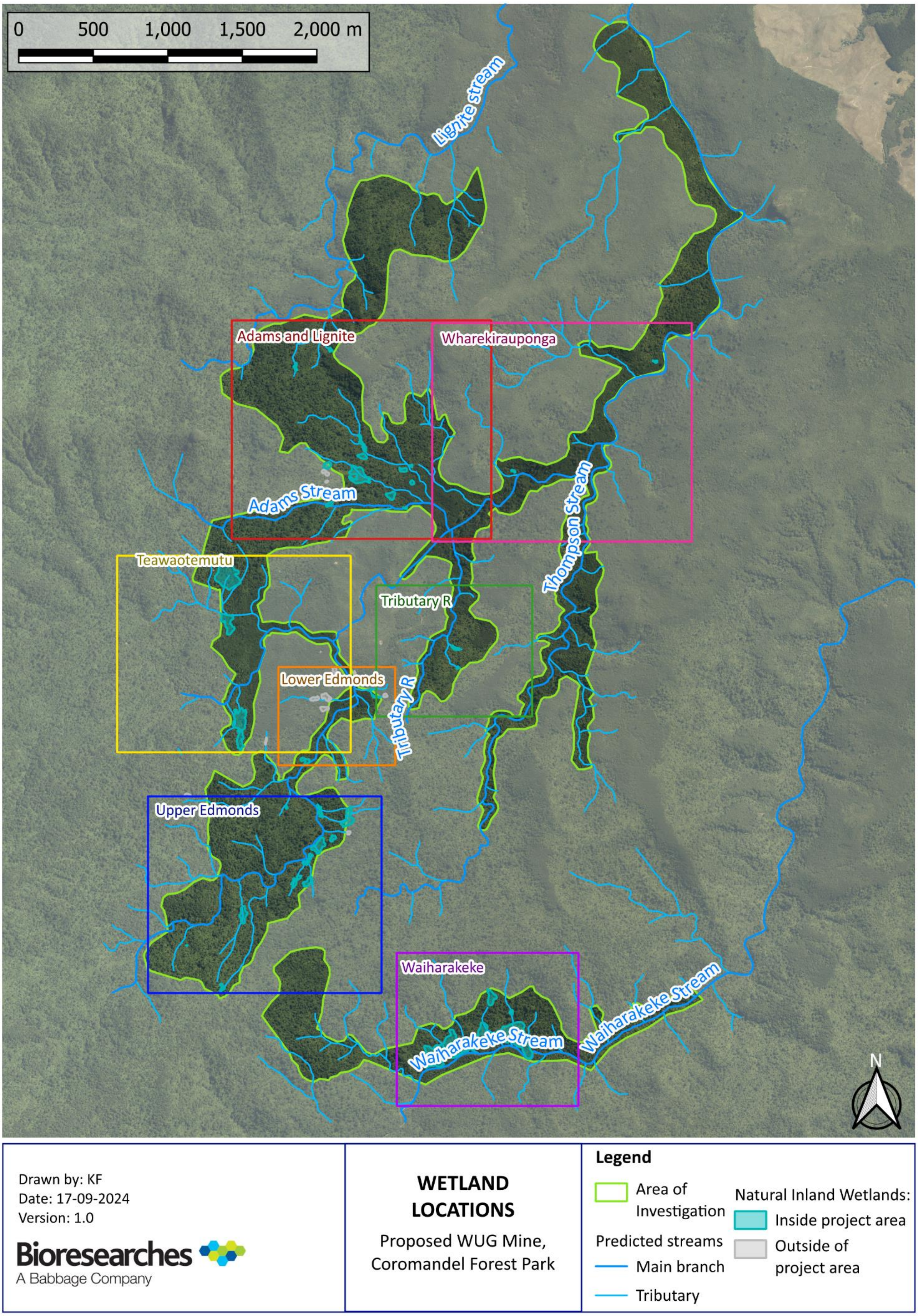

Figure 6. Overview of wetland locations

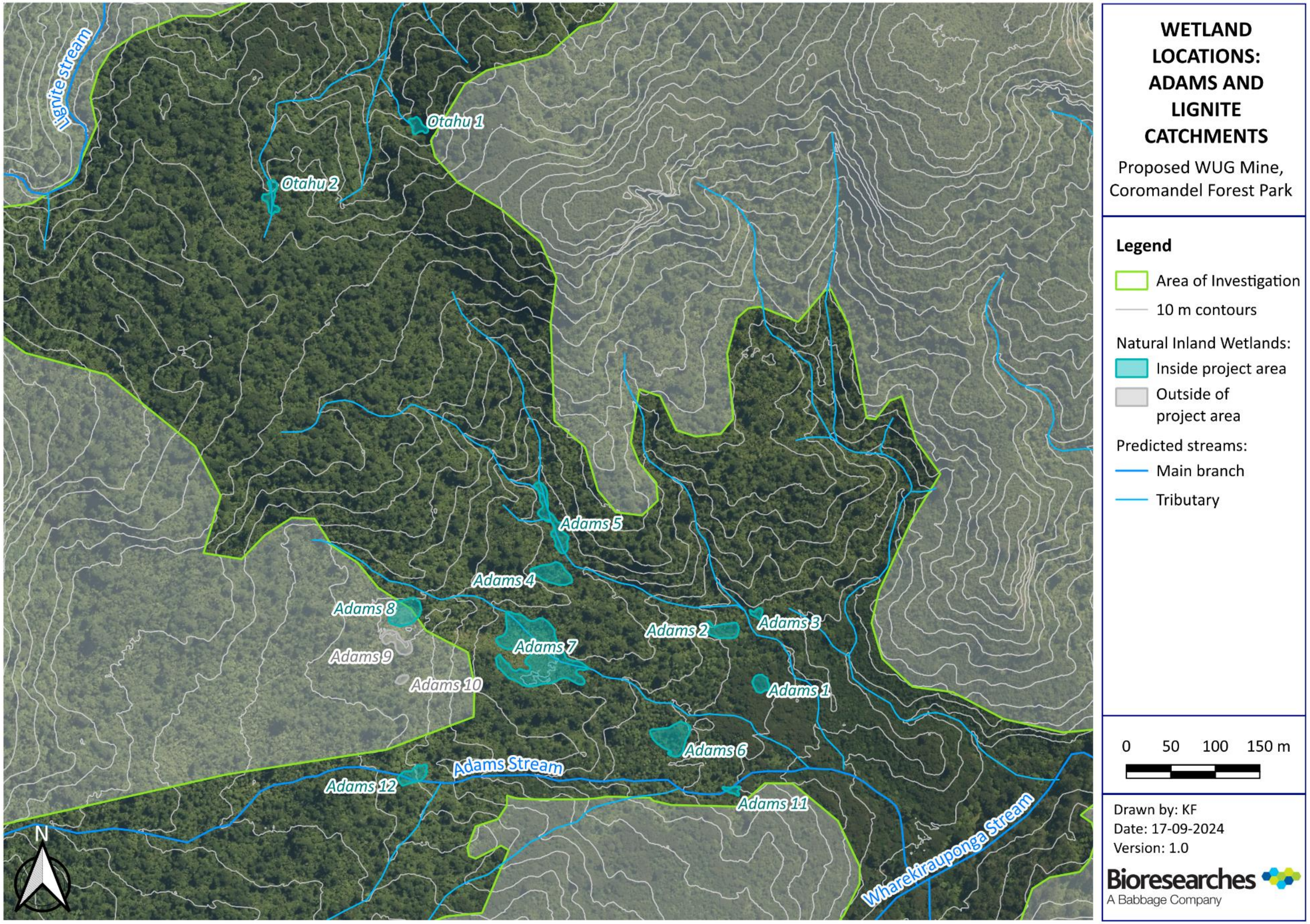

Figure 7. Wetlands identified within the Adams Stream and Otahu Stream catchments

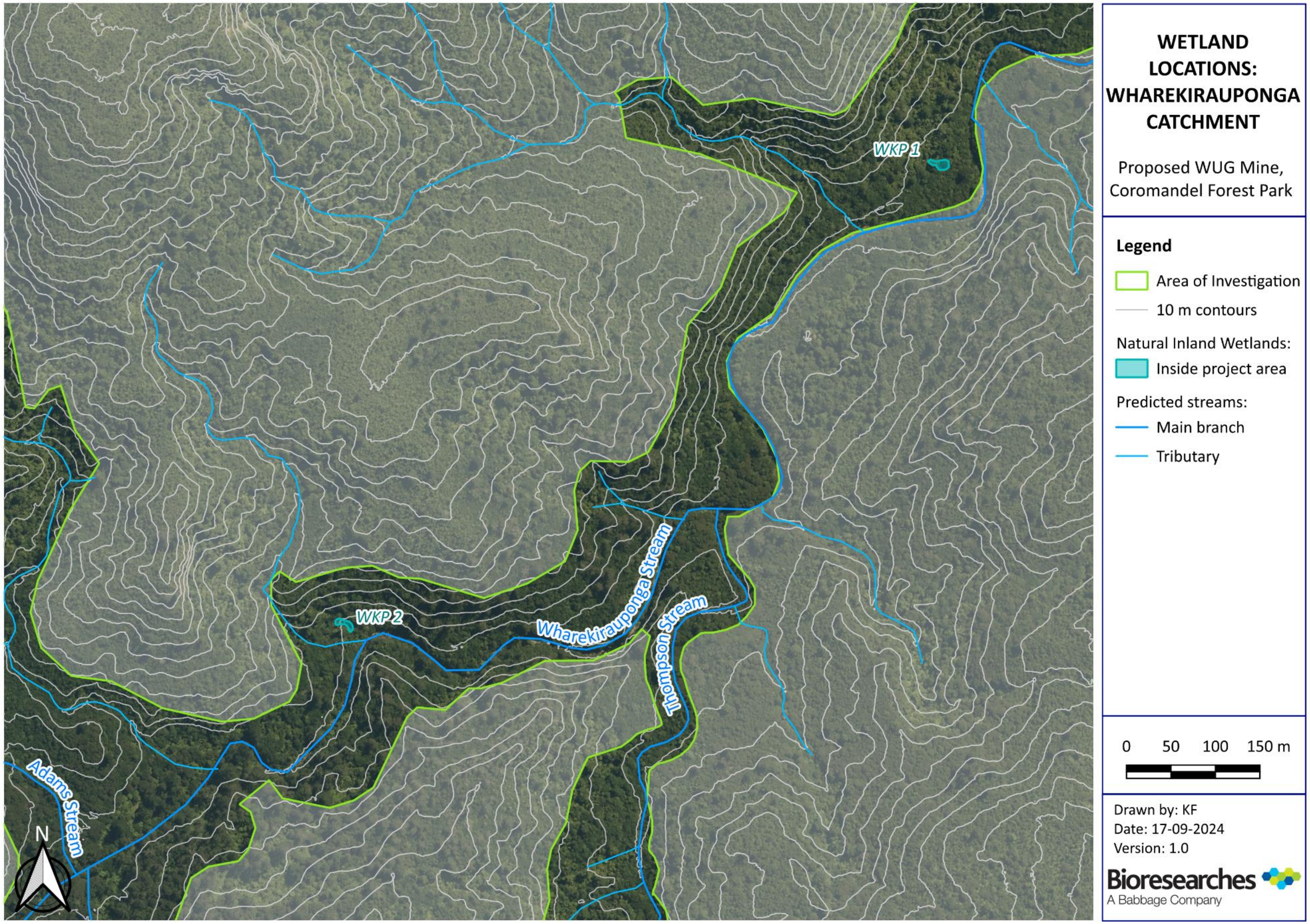

Figure 8. Wetlands identified within the Wharekirauponga Stream catchment

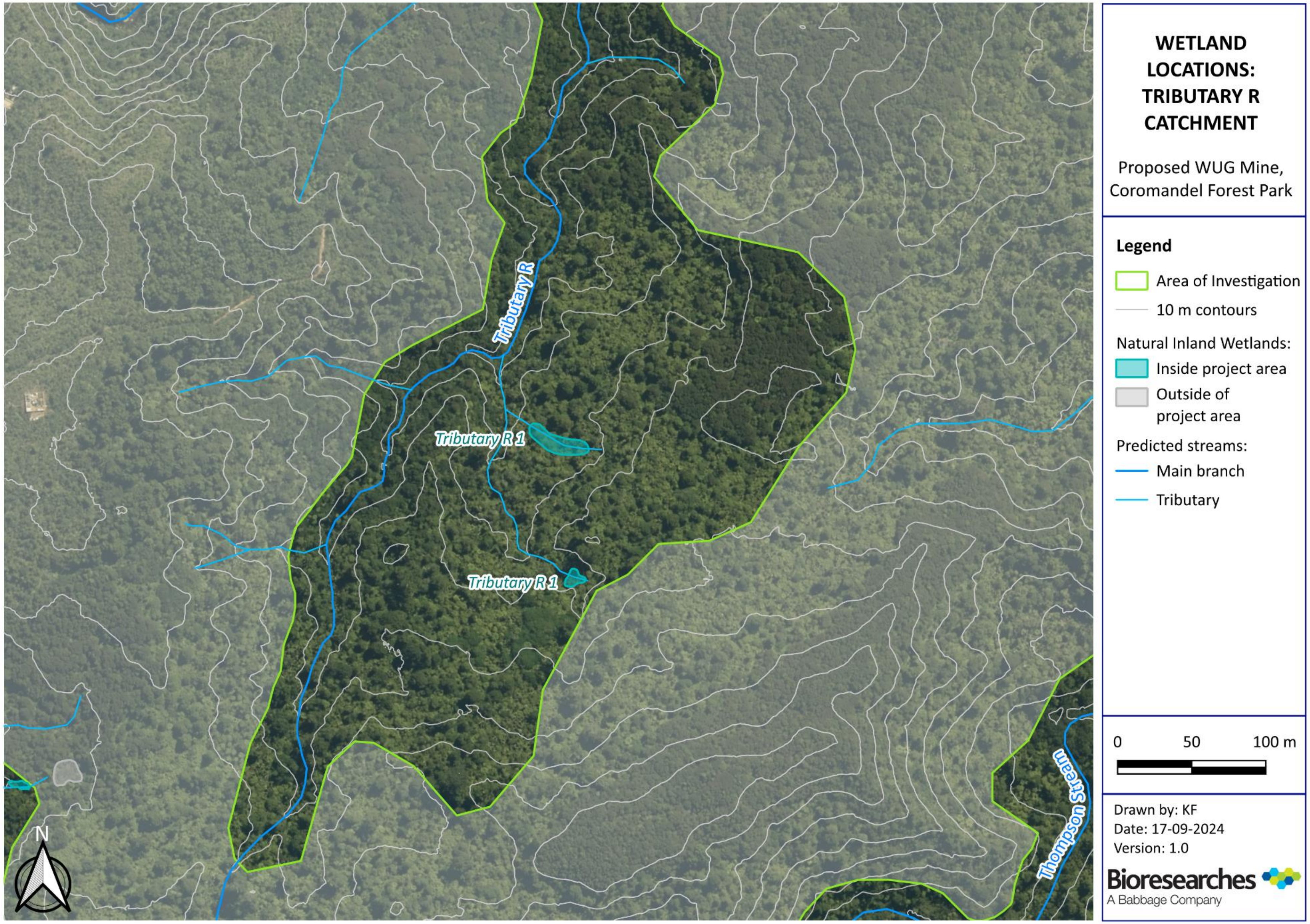

Figure 9. Wetlands identified within the Tributary R Stream catchment

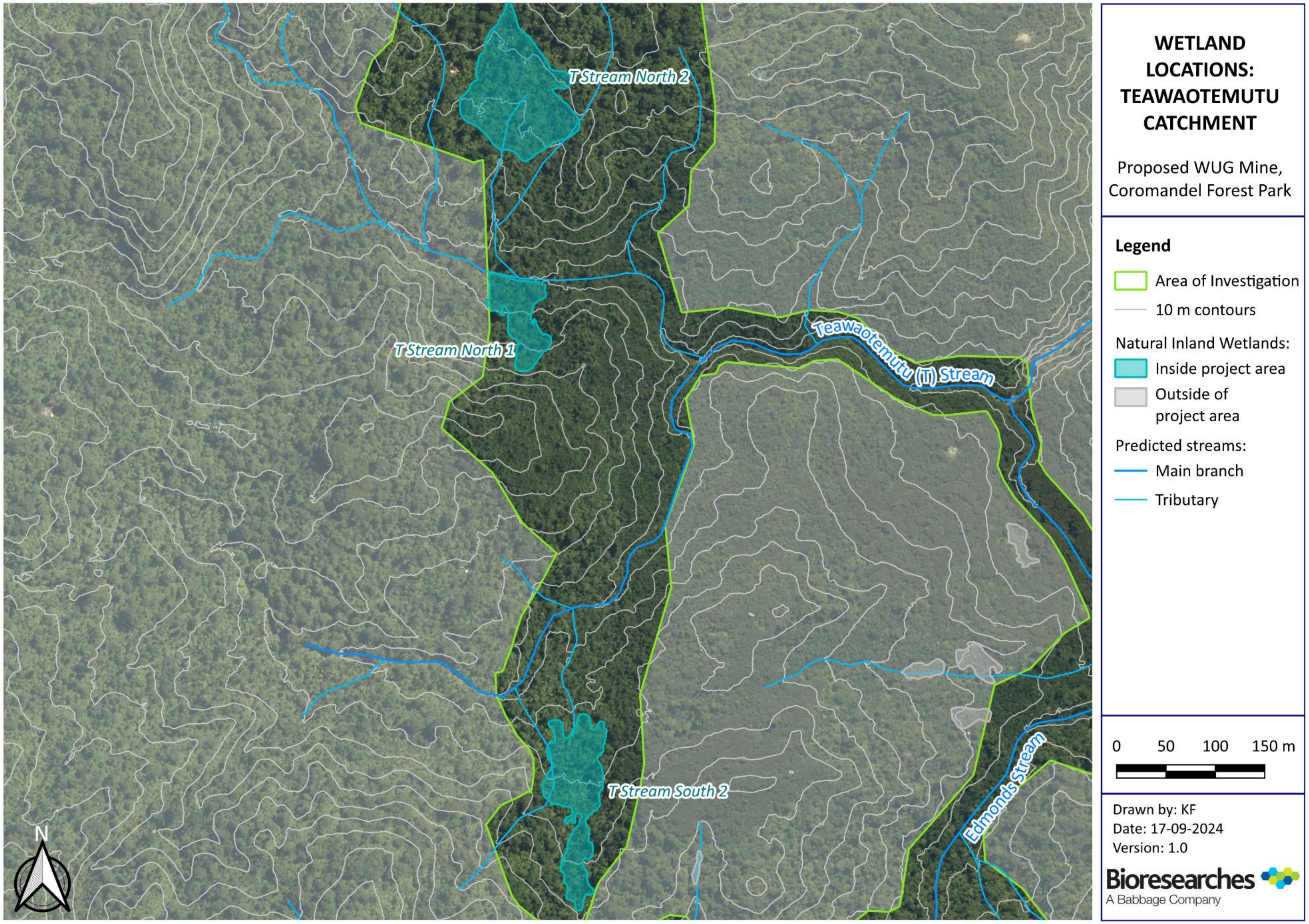

Figure 10. Wetlands identified within the Teawaotemutu Stream catchment

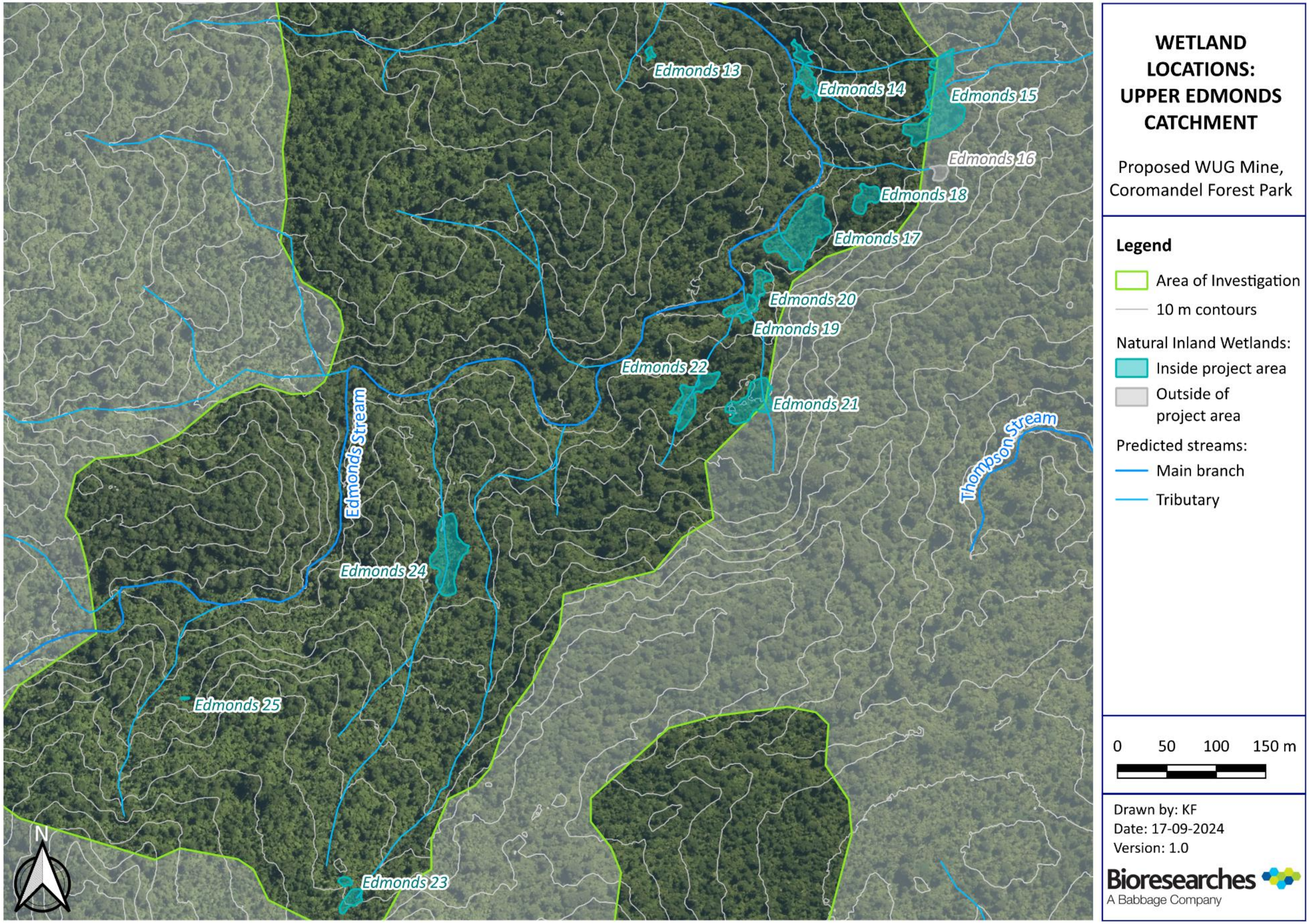

Figure 11. Wetlands identified within the lower Edmonds Stream catchment

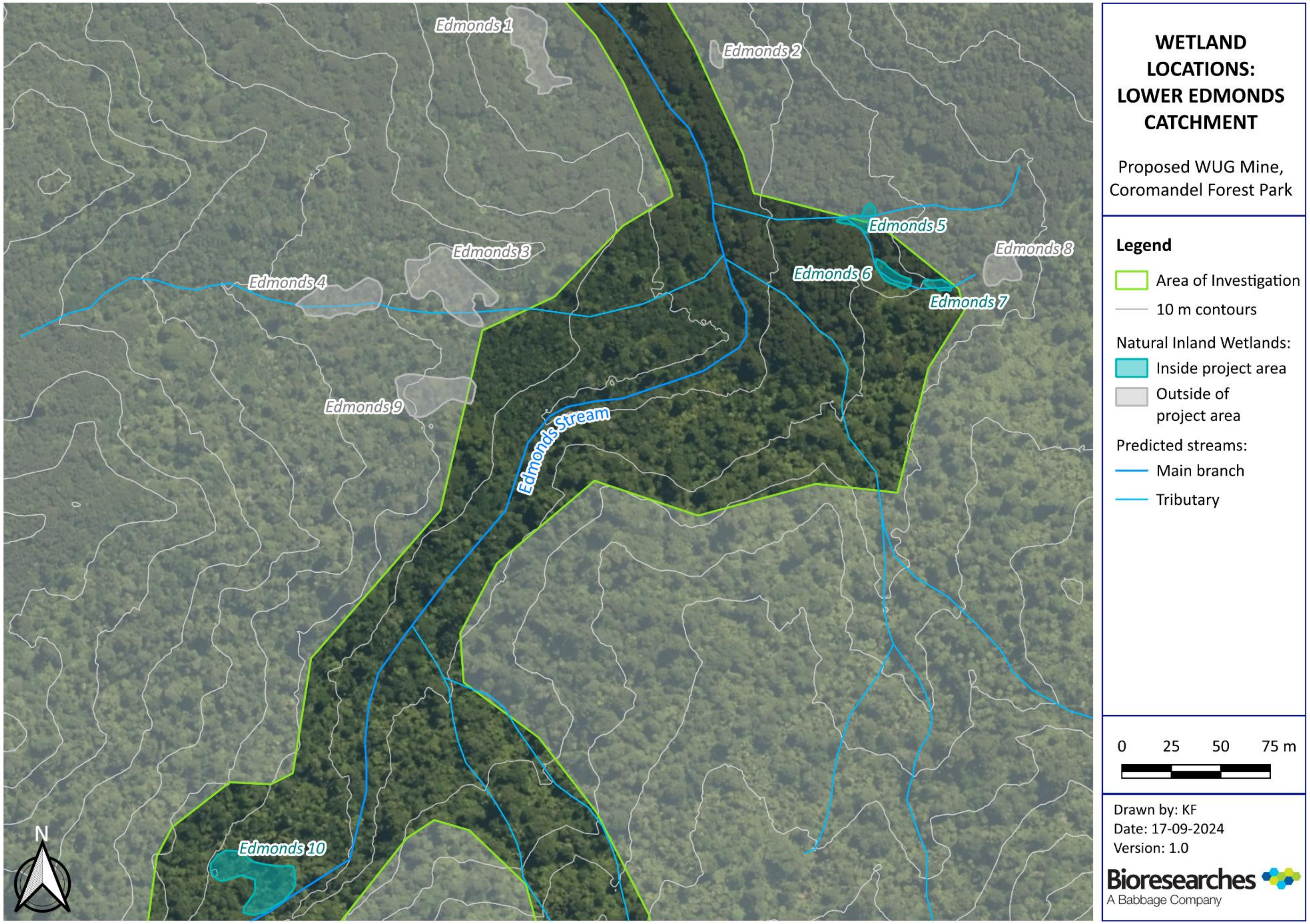

Figure 12. Wetlands identified within the upper Edmonds Stream catchment

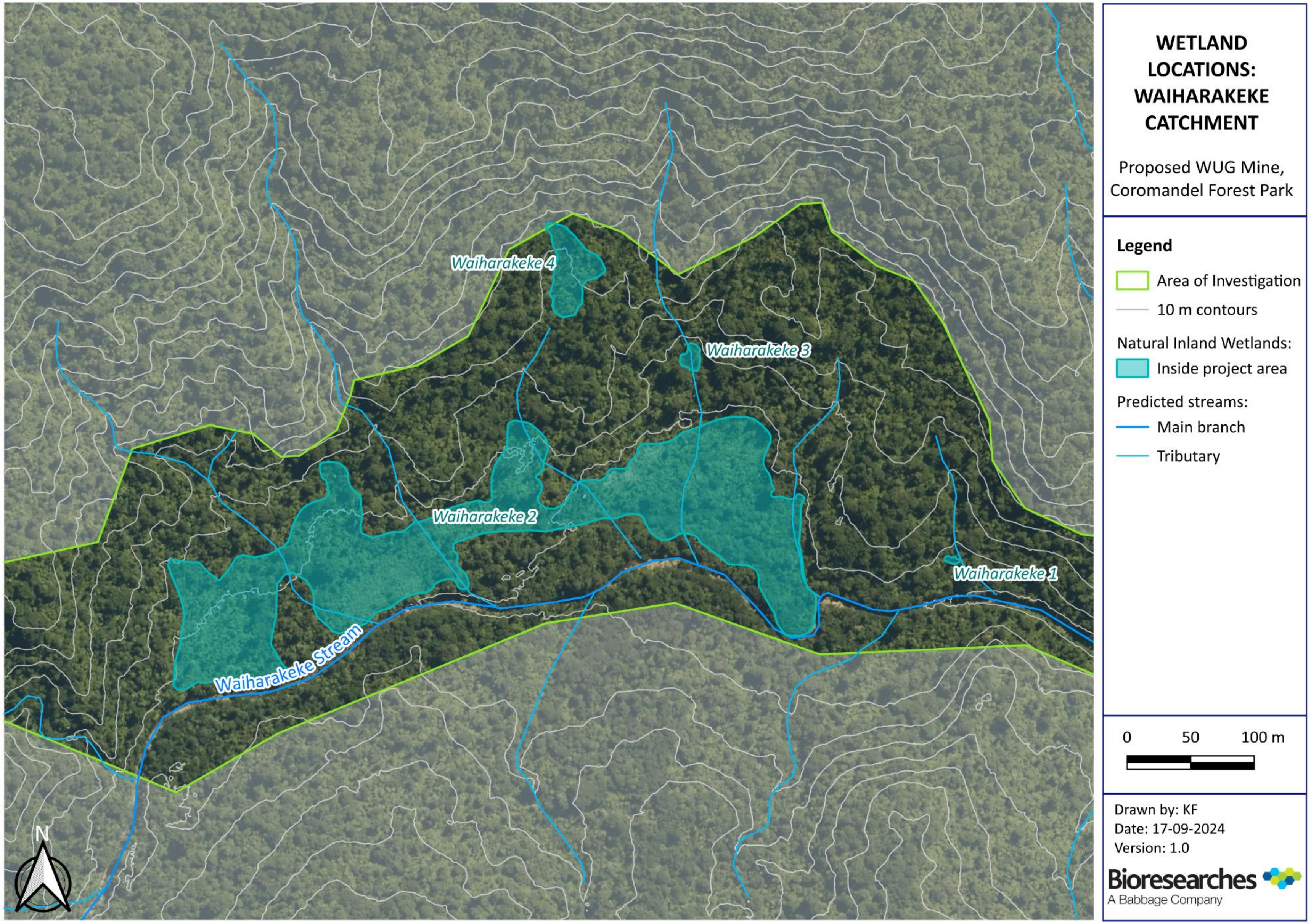

Figure 13. Wetlands identified within the Waiharakeke Stream catchment

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