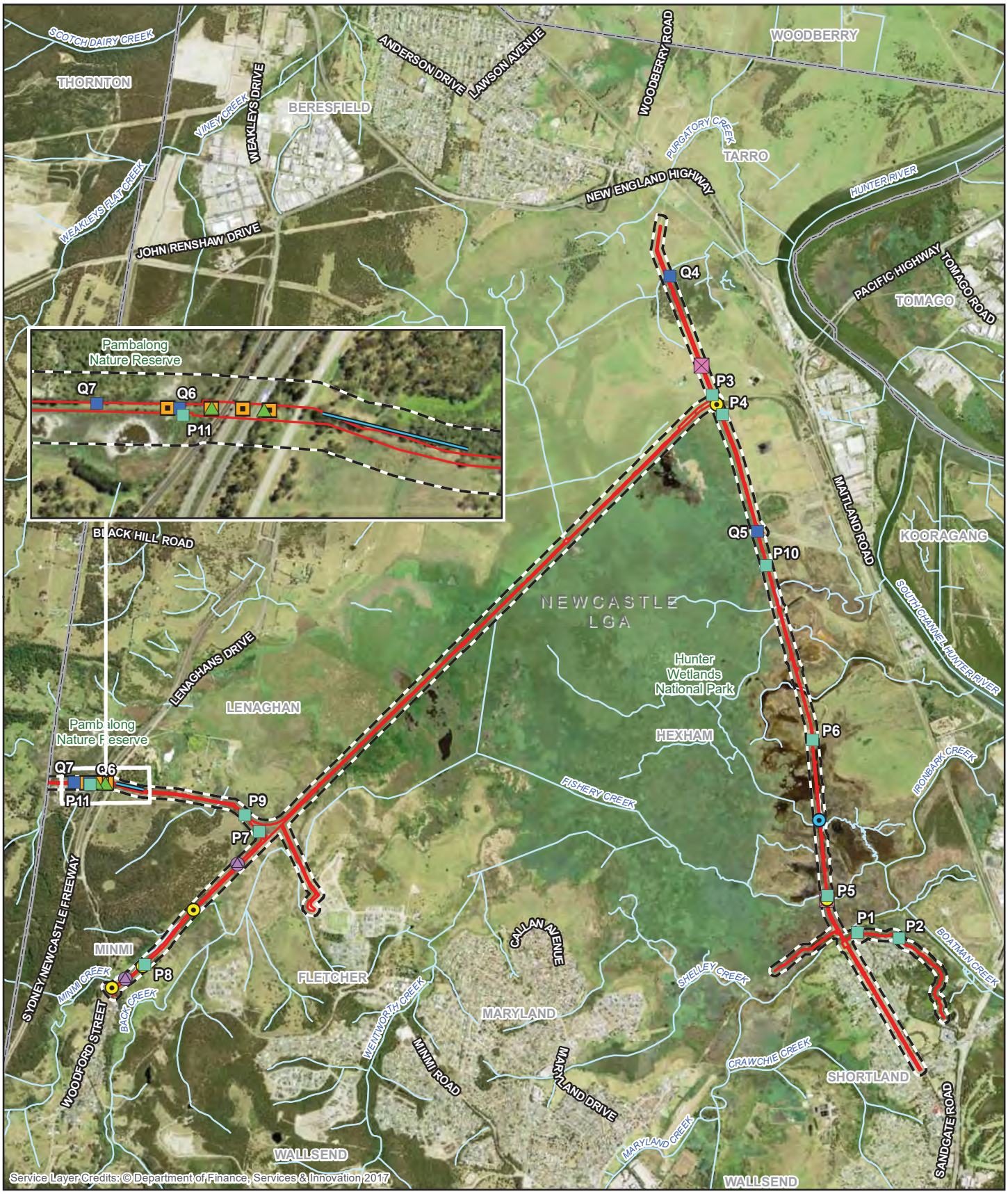
3.6 Staff qualifications

This BDAR was prepared by Cecilia Phu (accredited assessor number BAAS17058) in accordance with the BAM, with assistance from other GHD staff. The assessment is based on field surveys completed by Cecilia Phu, Kim Baker, Philippa Fagan (accredited assessor number BAAS18117) and other GHD staff. A technical review of the report was undertaken by Jayne Tipping. Relevant staff qualifications are provided in Table 3-9.

Table 3-9 GHD ecology staff and qualifications

Name	Position/Proposal Role	Qualifications	Relevant Experience
Jayne Tipping	Principal ecologist - Technical Review of BDAR	BSc (Ecology) MEnvLaw	26+
Dr Gilbert Whyte	Senior flora ecologist - desktop assessment and field surveys	BBioSc (Hons) PhD (Botany) BAM accredited	10+
Dr Kirsten Crosby	Senior fauna ecologist - targeted microbat field surveys	BSc (Hons) PhD (Zoology) BAM accredited	13+
Cecilia Phu	Senior flora ecologist -field surveys BAM calculator and BDAR reporting	BSc (Hons, botany) BAM accredited	11+
Kimberly Baker	Fauna ecologist - Field surveys and BDAR reporting	BSc	8+
Felicity Williams	Fauna ecologist - BDAR reporting	BSc (Hons, zoology)	8+
Philippa Fagan	Flora ecologist – Field surveys	MBus&Env Mgt. BBiod. & Cons. BAM accredited	4+
Shelley Thompson	Graduate ecologist – BDAR reporting	BSc (Hons, Animal Behaviour)	4+
Bianca Seal	Graduate ecologist- field surveys	BSc	2+
David Martin	Undergraduate Ecologist- field surveys	BEnvSc	2+



LEGEND

- Subject site
- Study Area
- Watercourse
- LGA boundary
- BBAM plot surveys (2016)
- BAM plot surveys (2019)
- Anabat survey
- Call Playback
- Diurnal bird surveys
- Nocturnal microbat survey
- Spotlighting
- Stagwatching
- Arboreal trap line

Paper Size A4

0 300 600 900 1,200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

Survey effort (2019)

Figure 3-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR003_SurveyEffort_0.mxd

Data source: LPI: DTDB / DCDB, 2017, Aerial 2012. Created by: fmackay

4. Existing environment

This chapter has been prepared in accordance with Section 4 of the BAM (OEH, 2017a). It identifies a range of landscape features that occur on the subject site or within the buffered assessment area surrounding the subject site. Landscape features are likely to influence the biodiversity values of a site, and are used to inform the habitat suitability of the subject site for threatened species.

This chapter also identifies other site context attributes, including percentage native vegetation cover in the buffered assessment area (Section 4.3 of the BAM, OEH, 2017a), native vegetation cover/extent within the subject site (Section 5.1 of the BAM, OEH, 2017a), patch size areas (Section 5.3 of the BAM, OEH, 2017a) and other biodiversity attributes not assessed under the BC Act and the BAM.

4.1 Landscape features

Table 4-1 below identifies the landscape features relevant to the subject site and expands on each feature where appropriate in the following sub-sections.

Table 4-1 Landscape features of the subject site

Landscape feature	Subject site
Method applied for site context components	Linear-based (500 m buffered assessment area)
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin
IBRA subregion	Hunter (Figure 4-1)
BioNet NSW landscapes (former Mitchell landscapes)	• Lower Hunter Channels and Floodplains (majority of subject site) • Gosford - Cooranbong Coastal Slopes (Shortland and Minmi ends) • Watagan Ranges (near Pambalong Nature Reserve)
Rivers, streams and estuaries	The following rivers, streams and estuaries have been mapped within or downstream of the subject site and buffered assessment area: • Hunter River • Ironbark Creek • Fishery Creek • Purgatory Creek • Minmi Creek • Un-named first and second order streams
Wetlands	The following Nationally Important Wetlands have been mapped within the subject site and buffered assessment area: • Shortland Wetlands Centre • Hexham Swamp • Ramsar wetland: Site 24 - Hunter Estuary Wetlands Coastal Wetlands defined under the Coastal Management SEPP are also mapped within the subject site and buffered assessment area.

Landscape feature	Subject site
Connectivity of different areas of habitat	The subject site includes key fauna corridors mapped under the Key Habitats and Corridors (KHC) Project (Scotts, 2003) (DECCW, 2011). Wetland and dry sclerophyll forest habitats within the subject site are part of larger patches of forests and wetland vegetation within the buffered assessment area and wider locality. A network of roads and dual carriageway lanes in turn intersects these patches. Notwithstanding, the wetland and swamp vegetation types are still hydrologically connected to other significant areas of wetland habitat.
Areas of geological significance and soil hazard	There are no areas of geological significance within the subject site. Acid sulfate soil risk mapping indicates that there is a high probability of occurrence of acid sulfate soils across the majority of the subject site. The acid sulfate soil risk is high, and is associated with estuarine and alluvial processes on backswamps, plains and bottom sediments. Estimated depth to acid sulfate soils include 1-2 metres and 2-4 metres.
Areas of outstanding biodiversity value	There are no areas of outstanding biodiversity value mapped within the subject site.
Percent native vegetation cover	See Section 4.2.

4.1.1 BioNet NSW landscapes

The vegetation characteristics of the subject site is generally consistent with the mapped BioNet NSW landscapes for which the published descriptions are reproduced below (DECC, 2008a), with estuarine and brackish swamps and wetlands featured across the majority of the buffered assessment area, and dry sclerophyll forests and sheltered forests in the south-western portion of the buffered assessment area (Figure 4-1).

The Gosford – Cooranbong Coastal Slopes and Watagan Ranges landscapes are located in the south-western end of the subject site (around the Minmi connection), which broadly corresponds to the lower footslopes and plains on the eastern fall of the Sugarloaf Range. There are no range, plateau, cliff line or rock outcrop habitats within the subject site as described for these soil landscapes but these habitats are likely to be present further to the west beyond the buffered assessment area.

Lower Hunter Channels and Floodplains

'*Channel, floodplain, and estuarine swamps on Quaternary alluvial estuarine sediments of the Hunter River estuary tract, general elevation 0 to 30m, local relief <10m. Harsh brown texture-contrast soils on the third terrace, gradational sandy loam on the second terrace and loamy sand on the low terrace and floodplain. Acid peaty silty sand, silt and clay in swamps, uniform quartz sand with podsol development on marginal coastal dunes and sand sheets. Open grassland with scattered yellow box (*Eucalyptus melliodora*), forest red gum (*Eucalyptus tereticornis*), rough-barked apple (*Angophora floribunda*) on higher fluvial landscapes. Freshwater and brackish swamps with open water, aquatic plants and fringe woodlands of broad-leaved paperbark (*Melaleuca quinquenervia*), swamp mahogany (*Eucalyptus robusta*), river oak (*Casuarina cunninghamiana*), swamp oak (*Casuarina glauca*), common reed (*Phragmites australis*), river mangrove (*Aegiceras corniculatum*), grey mangrove (*Avicennia marina*) and extensive saltmarsh in tidal areas.*'

Gosford – Cooranbong Coastal Slopes

'*Coastal fall of the Sydney Basin, rolling hills and sandstone plateau outliers of Triassic Narrabeen sandstones, extensive rock outcrop and low cliffs along ridge margins, general elevation 0 to 75m. Texture-contrast soils on lithic sandstones and shales. Loamy sand alluvium along creeks. Organic sand and mud in lagoons and swamps. Open forest and woodland of smooth-barked apple (*Angophora costata*), red bloodwood (*Corymbia gummifera*), brown stringybark (*Eucalyptus capitellata*), Sydney peppermint (*Eucalyptus piperita*), spotted gum (*Corymbia maculata*), bastard mahogany (*Eucalyptus carnea*), northern grey ironbark (*Eucalyptus siderophloia*) and grey gum (*Eucalyptus punctata*) on hills and slopes. Small areas of closed forest with; turpentine (*Syncarpia glomulifera*), lilly pilly (*Acmena smithii*), mountain cedar wattle (*Acacia elata*), coachwood (*Ceratopetalum apetalum*), sassafras (*Doryphora sassafras*) and water gum (*Tristaniopsis laurina*) in gullies under high escarpments Prickly-leaved tea-tree (*Melaleuca stypheliodes*) and other shrubs with swamp mahogany (*Eucalyptus robusta*), swamp oak (*Casuarina glauca*), sedges and common reed (*Phragmites australis*) on swampy creek flats. Coastal heath subject to salt spray on headlands.*'

Watagan Ranges

'*Steep dissected ranges with small areas of plateau on Triassic lithic sandstone, shale, tuff and claystone, general elevation 30 to 300m, local relief 100m. Rock outcrop common with low cliff lines and wide benches. Yellow-brown gradational and texture-contrast soil profiles. Complex vegetation varying with aspect, rainfall and fire history. Low shrubs and woodland of scribbly gum (*Eucalyptus haeomostoma*), red bloodwood (*Corymbia gummifera*), she-oak (*Allocasuarina *sp.*), *Banksia *sp., and *Acacia *sp., with patches of silvertop ash (*Eucalyptus sieberi*) and mountain mallee (*Eucalyptus stricta*) on ridges. Slopes with grey ironbark (*Eucalyptus paniculata*), white mahogany (*Eucalyptus acmenoides*), descending to smooth-barked apple (*Angophora costata*), turpentine (*Syncarpia glomulifera*), tallow wood (*Eucalyptus microcorys*), brush box (*Lophostemon confertus*) and Sydney blue gum (*Eucalyptus saligna*) with pockets of rainforest in the creeks.*'

4.1.2 Geology, soils, topography

The 1:100,000 Newcastle Geological Map (Gorbert and Chesnut, 1975) indicates that south of Ironbark Creek in the vicinity of Shortland, the subject site is underlain by the Tomago Coal Measures. From the crossing of Ironbark Creek to just south of Tarro the subject site is underlain by Quaternary sediments including silt, clay and estuarine sediments. The subject site is also underlain by these Quaternary sediments between Shortland and the proposed connections with Fletcher and Minmi. West of the proposed connection with Fletcher, the subject site is generally underlain by the Permian Newcastle Coal Measures including coal, tuff, conglomerate, sandstone and shale.

The subject site is characterised by a vast, low lying plain which is subdivided into the three major landscape types:

- Saline/brackish swamp, adjacent to the Hunter River
- Freshwater marsh
- Relic beach located on the margins of the swamp to the north and west

The margins of the swamp comprise open valleys of low relief with alluvial plains and terraces.

Elevations of the surrounding terrain range from 20 - 50 metres Australian height datum (AHD) with gradual inclines and declines in topography.

The 1:100,000 Soil Landscapes of Newcastle (Matthei, 1995b) shows that the buffered assessment area lies within numerous soil landscapes (see Table 4-2). There are also areas mapped as Disturbed Terrain (Figure 4-2).

Table 4-2 Newcastle soil landscapes mapped across the buffered assessment area

Soil landscape	Process	Geology	Topography	Vegetation	Distribution within buffered assessment area
Beresfield	Residual	Permian Tomago Coal Measures	Undulating low hills and rises. Elevation 20-50 m.	Partial cleared tall open forests characterised by Spotted Gum – ironbark forests, i.e. *Corymbia maculata* (Spotted Gum) – ironbark (*E. paniculata*, *E. fibrosa*) – stringybark (*E. eugenioides*, *E. oblonga*), with *Eucalyptus tereticornis* (Forest Red Gum) and paperbarks on lower slopes and in drainage lines.	Shortland area, south of Ironbark Creek. Also around Minmi and Fletcher connection.
Bobs Farm (variant a)	Beach	Holocene (i.e. Quaternary) estuarine mud deposits (silt and clays), underlain by tidal delta sands in some areas	Broad, flat, swampy on estuarine plains. Elevation 1-3 m.	Predominantly cleared she-oak and paperbark swamp vegetation, including *Casuarina glauca* (Swamp Oak), *Melaleuca quinquenervia*, (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany).	Around Minmi and Fletcher connection.
Hamilton	Residual	Quaternary sand overlaying clay deposits	Level to undulating, broad, well-drained sands. Elevation up to 12 m.	Completely cleared for urban development.	West of the M1, small area around Pambalong Nature Reserve.

Soil landscape	Process	Geology	Topography	Vegetation	Distribution within buffered assessment area
Hexham Swamp	Swamp	Quaternary estuarine/lacustrine sediments; silt and clays.	Broad, swampy estuarine plains. Elevation up to 2 m.	Sedgeland, with predominantly cleared open woodland on swamp margins. Includes mangrove forests, *Phragmites australis* (Common Reed) swamps, saltmarsh varying with changes in salinity and tidal influences. Less saline to brackish areas support seasonal fresh swamps, semi-permanent fresh swamps and fresh meadows, wet grasslands and open woodlands of *Casuarina glauca* (Swamp Oak) and *Melaleuca linariifolia* (Flax-leaved Paperbark).	Majority of central portion of buffered assessment area, from Ironbark Creek to Tarro, corresponding to the Hunter Wetland National Park.
Killingworth	Erosional	Permian Newcastle Coal Measures	Undulating to rolling hills and low hills. Elevation 50-160 m.	Largely uncleared open forest with some woodland. Includes Spotted Gum forests *Corymbia maculata* (Spotted Gum) – mahogany (*E. umbra*) - ironbark (*E. paniculata*, *E. fibrosa*) – stringybark (*E. eugenioides*); heathy woodlands *Corymbia gummifera* (Red Bloodwood) – *Angophora costata* (Smooth-barked Apple) on sandstone crest; and paperbark understories in poorly drained areas.	Around Minmi connection.

Soil landscape	Process	Geology	Topography	Vegetation	Distribution within buffered assessment area
Millers Forest	Estuarine	Holocene (i.e. Quaternary) alluvial sediment - predominantly clay, silt and sand from overbank deposition of the lower Hunter and Williams Rivers	Extensive alluvial plain, characterised by backswamps, ox-bows, constructed levees. Elevation up to 6 m.	Cleared tall open forests of *Casuarina glauca* (Swamp Oak), *Melaleuca styphelioides* (Prickly-leaved Paperbark), *Cupaniopsis anacardioides* (Tuckeroo) and occasionally *Eucalyptus amplifolia* (Cabbage Gum). *Aegiceras corniculatum* (River Mangrove) occurs on riverbanks and *Phragmites australis* (Common Reed) often grows in shallow water	North of the Hunter Wetland National Park to Tarro.
Rivermead	Residual	Quaternary or Tertiary aged alluvium.	Moderately broad to extensive, level to gently undulating terraces, Elevation 5-10 m.	Completely cleared tall open forests. Remnant vegetation comprises grassy tall open forests of *Eucalyptus tereticornis* (Forest Red Gum) and *E. moluccana* (Grey Box).	West of the M1 near Pambalong Nature Reserve.
Wyong	Alluvial	Quaternary sediments (sand, silt, gravels, clays)	Generally broad, poorly drained, deltaic floodplains and alluvial flats. Levees, meander scrolls, ox-bows and swamps are common.	Original closed forests extensively cleared and replaced with pasture, with remnants comprising paperbarks (*Melaleuca styphelioides*, *M. linariifolia*), *Eucalyptus longifolia* (Woollybutt) and *E. robusta* (Swamp Mahogany). Some *E. saligna* (Sydney Blue Gum) along better drained levee banks and terraces and *Casuarina glauca* (Swamp Oak) along tidal channel banks.	West of the M1 near Pambalong Nature Reserve.

4.1.3 Local and important wetlands

The buffered assessment area encompasses a coastal lowland environment situated on the Hunter River floodplain and is dominated by estuarine and freshwater wetland habitats. As such, it features a number of important wetlands, which are briefly described below.

DIWA Important Wetlands

Two Nationally Important Wetlands identified in the Directory of Important Wetlands in Australia (DIWA) are mapped within the buffered assessment area (Figure 4-3). Information below on each wetland is reproduced from DEE (2010b).

Shortland Wetlands Centre

Remnant floodplain wetlands on the edge of Hexham Swamp (now largely corresponding to the Hunter Wetlands National Park on the western side of the Hunter River); supports semi-permanent/seasonal freshwater ponds and marshes, and freshwater swamp forests. The construction of floodgates on the adjacent Ironbark Creek has prevented periodic inundation of brackish water from the Hunter River. Important breeding area for egret species, with the freshwater swamp forest known to be utilised as a heronry by 2000 breeding pairs of four egret species.

Hexham Swamp

Largest wetland in Hunter region. Predominately within the bounds of the Ironbark Creek Sub-Catchment which drains 12 500 ha of low-lying residential and agricultural lands. Before the construction of floodgates on Ironbark Creek in 1971, approximately one third of this was estuarine wetland. Migratory waders and many smaller birds used the estuarine wetlands as feeding habitat. The freshwater wetlands attracted a range of waterbirds, including ducks, egrets, ibis, crakes, etc. Because of its large size, Hexham Swamp has a large carrying capacity for waterbirds. Historical records indicate that the waters of Hexham Swamp were an important fisheries habitat prior to construction of the floodgates. Ten frog species have also been recorded in Hexham Swamp, including the endangered Green & Golden Bell Frog (*Litoria aurea*).

RAMSAR site 24: Hunter Estuary Wetlands

The Hunter Estuary Wetlands Ramsar site is comprised of two components, (1) Kooragang Nature Reserve (now part of Hunter Wetlands National Park on the eastern side of the Hunter River) and (2) Hunter Wetlands Centre Australia. The Hunter Wetlands Centre component is located in the Ironbark Creek Catchment in the suburb of Shortland, 12 km northwest of Newcastle and 2.5 km west of the Kooragang component of this Ramsar site (Figure 4-4). Although not contiguous, these two components are linked hydrologically and by a wildlife corridor comprising Ironbark Creek, Hunter River and Ash Island. Important as both a feeding and roosting site for a large seasonal population of shorebirds and as a waylay site for transient migrants. Over 250 species of birds have been recorded within the Ramsar site, including 45 species listed under international migratory conservation agreements. In addition, the Ramsar site provides habitat for the nationally threatened Green and Golden Bell Frog, Red Goshawk and Australasian Bittern.

Coastal Management SEPP – Coastal Wetlands

Coastal wetlands defined under the Coastal Management SEPP are mapped over the majority of the buffered assessment area, corresponding broadly to the wetlands presented above (Figure 4-5).

4.1.4 Rivers, streams and estuaries

The proposal is located on the Hunter River floodplain, occurring within 900 metres of the southern channel of the Hunter River at its closest point. The proposal also crosses a number of significant creeks and drainage channels, including Ironbark Creek, Fishery Creek, Purgatory Creek and Minmi Creek. These are summarised in Table 4-4 and shown in Figure 4-6. The proposal is located largely within the Ironbark Creek catchment, which is the main tributary draining into the Hunter River. Estuarine environments are concentrated in the eastern half of the buffered assessment area where Ironbark and Fishery Creek flows into the Hunter River, and transition to freshwater environments with increasing distance from the Hunter River.

4.1.5 Connectivity

The buffered assessment area intersects key fauna corridors mapped under the Key Habitats and Corridors (KHC) Project (Scotts, 2003; DECCW, 2011) and is shown on Figure 4-7:

Table 4-3 Key fauna corridors intersecting the buffered assessment area

Name	Class	Focal species
Hexham link	subregional	non-forest link
Lenaghans Flat	subregional	Brush-tailed Phascogale
Minmi	subregional	Brush-tailed Phascogale
Richardson Road	regional	Brush-tailed Phascogale

Wetland and dry sclerophyll forest habitats within the subject site are part of larger patches of forests and wetland vegetation within the buffered assessment area and wider locality. These patches in turn are intersected by a network of roads and dual carriageway lanes, including:

- Pacific Motorway (M1)
- New England Highway (A1)
- Maitland Road/Pacific Highway (A43)
- Newcastle Link Road (A15)
- Newcastle Inner City Bypass (A37)

Although woodland and forest habitats within the buffered assessment area are generally disconnected from surrounding vegetation patches by the road network, the wetland and swamp vegetation is still hydrologically connected, particularly along Ironbark Creek, to other significant areas of wetland habitat.

Table 4-4 Waterways and estuaries within or downstream of the subject site

Waterway name	Strahler order[1]	Riparian corridor width[2]	Characteristics and location
Hunter River	9	50 metres	Does not intersect the buffered assessment area but the wetlands within the buffered assessment area drain into the Hunter River. The Hunter River is also a wave dominated barrier estuary with an open, trained entrance (OEH, 2018b).
Ironbark Creek	4	40 metres	Located immediately north of Shortland, within the Hunter Wetlands National Park. Ironbark Creek has a primarily urbanised catchment. The creek has been subject to significant areas of urbanised channelization in its upper reaches. In its lower reaches, and within the buffered assessment area, Ironbark Creek occurs as a permanent, tidal influenced channel with fully vegetated banks and natural riverbed/banks. Likely to contain valuable fish habitat.
Fishery Creek	4	40 metres	Located immediately north of Ironbark Creek, within the Hunter Wetlands National Park. Fishery Creek is the dominant drainage channel for the tidal inundation and flooding of the Hunter Wetlands National Park, and has several unnamed associated drainage arms and channels which intersect the buffered assessment area immediately north of the major Fishery Creek channel crossing. Although shallow, Fishery Creek has clear channel formation with vegetation regeneration occurring along its banks and associated floodplains. Likely to contain valuable fish habitat, this section of Fishery Creek has also been mapped as part of the indicative distribution area for the threatened Purple Spotted Gudgeon.
Minmi Creek	4	40 metres	Intersects the buffered assessment area immediately east of Lenaghans Drive at Minmi. Minmi Creek occurs as an intermittent stream with semi-permanent pools forming after rain events, which connects with Fishery Creek within the Hunter Wetlands south of the buffered assessment area and is likely to contain minimal fish habitat for aquatic species.
Purgatory Creek	3	30 metres	Occurs in the northern section of the buffered assessment area immediately south of the New England Highway, near Tarro. This stream occurred as an intermittent waterway with little to no defined drainage channel, and a lack of permanent aquatic flora. Purgatory Creek is unlikely to contain fish habitat.
Un-named creeks	1 and 2	10 and 20 metres	A number of un-named first and second order streams intersect the subject site.

[1] Strahler stream ordering system (Strahler, 1952) [2] Width on each side of waterway is indicated

4.1.6 Areas of geological significance or soil hazard features

Geological features

There are no areas of geological significance within the buffered assessment area or subject site, including no karst, caves, rock outcrops, crevices and cliffs.

Acid sulfate soils

Acid sulfate soil risk mapping (Tulau, 2008) indicates that there is a high probability of occurrence of acid sulfate soils across the majority of the subject site, associated with estuarine and alluvial processes on backswamps, plains and bottom sediments. The estimated depth to the acid sulfate soils layer are between 1 to 4 metres across the buffered assessment area.

The environmental risk associated with disturbance of the acid sulfate soil layer is categorised as high across the majority of the site (Figure 4-8). The ground within the subject site has historically been disturbed for the construction of the old rail tracks and the elevated trail around the wetland. The surrounding undisturbed ground encompassing the wetland is likely to contain acid sulfate soils, which are commonly associated with coastal estuarine landscapes like mangroves, saltmarsh and backswamps (OEH, 2019a).

The buffered assessment area is mapped as Class 2, Class 3 and Class 5 acid sulfate soil under the Newcastle LEP. Development consent is required under Clause 6.1 for works below natural ground surface and for which the water table is likely to be lowered (Class 2) and more than one metre below the natural ground surface or works by which the water table is likely to be lowered more than one metre below the natural ground surface (Class 3).

4.2 Site context

4.2.1 Percent native vegetation cover

The percent native vegetation cover was calculated for the BAM assessment area in accordance with Section 4.3 of the BAM (OEH, 2017a), using a 500-metre buffer for linear projects.

The vegetation extent of native woody and non-woody vegetation was estimated based on observations from site visits in combination with aerial photo interpretation. Native vegetation extent that was mapped include remnant woody cover representing:

- Eucalypt forests and woodland
- Non-woody vegetation corresponding to native wetland vegetation (including reedlands and saltmarsh)
- Mangroves

Areas excluded from the estimated native vegetation extent include:

- Cleared areas
- Water bodies or water channels
- Grasslands representing exotic pasture, lawn or sporting fields
- Street trees, landscaped trees, trees surrounding sports fields and within parklands or urban green spaces
- *Juncus acutus* (Sharp Rush) dominated areas of wetland

The results of the percent native vegetation cover assessment is summarised in the table below and shown on Figure 4-9.

Table 4-5 Percent native vegetation cover

Attribute	Value
500 metre buffered area (ha)	1674.4
Total native vegetation (ha)	989.4
% native vegetation cover	59.1
Cover class	30-70%

4.2.2 Patch size

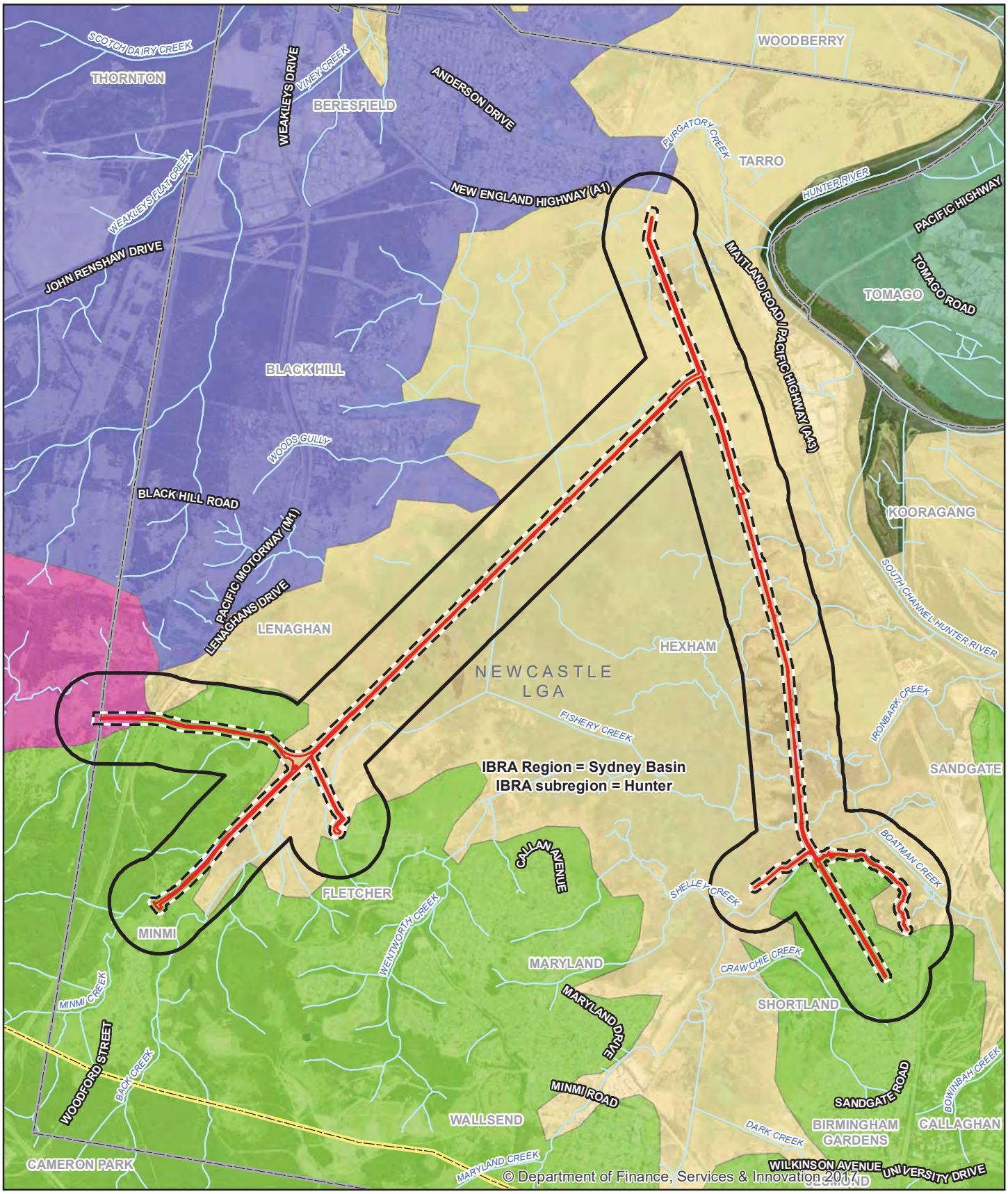
Patch size is defined under the BAM (OEH, 2017a) as an area of intact native vegetation that:

- Occurs on the development site (i.e. proposal site).
- Includes native vegetation that has a gap of less than 100 m from the next area of moderate to good native vegetation (or ≤ 30 m for non-woody ecosystems).

Intact native vegetation must contain all structural layers (strata) characteristic of the PCT.

Patch size may extend onto adjoining land that is not part of a development site or a stewardship site. Patch size area is assigned to each vegetation zone as a class, being < 5 ha, 5-24 ha, 25-100 ha or ≥ 100 ha.

The patch size class applied to all vegetation zones within the subject site is ≥ 100 ha. All vegetation zones to the east of the M1 are connected to an intact native vegetation patch exceeding 100 ha and broadly comprising the non-woody wetland vegetation associated with the Hunter Estuary Wetlands. The vegetation zones to the west of the M1 are connected to an intact native vegetation patch exceeding 100 ha and broadly comprising the forests associated with the Sugarloaf Range.



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- Watercourse
- LGA boundary
- IBRA bioregion boundary

Mitchell Landscapes

- Gosford - Cooranbong Coastal Slopes
- Lower Hunter Channels and Floodplains
- Newcastle Coastal Ramp
- Sydney - Newcastle Barriers and Beaches
- Watagan Ranges

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

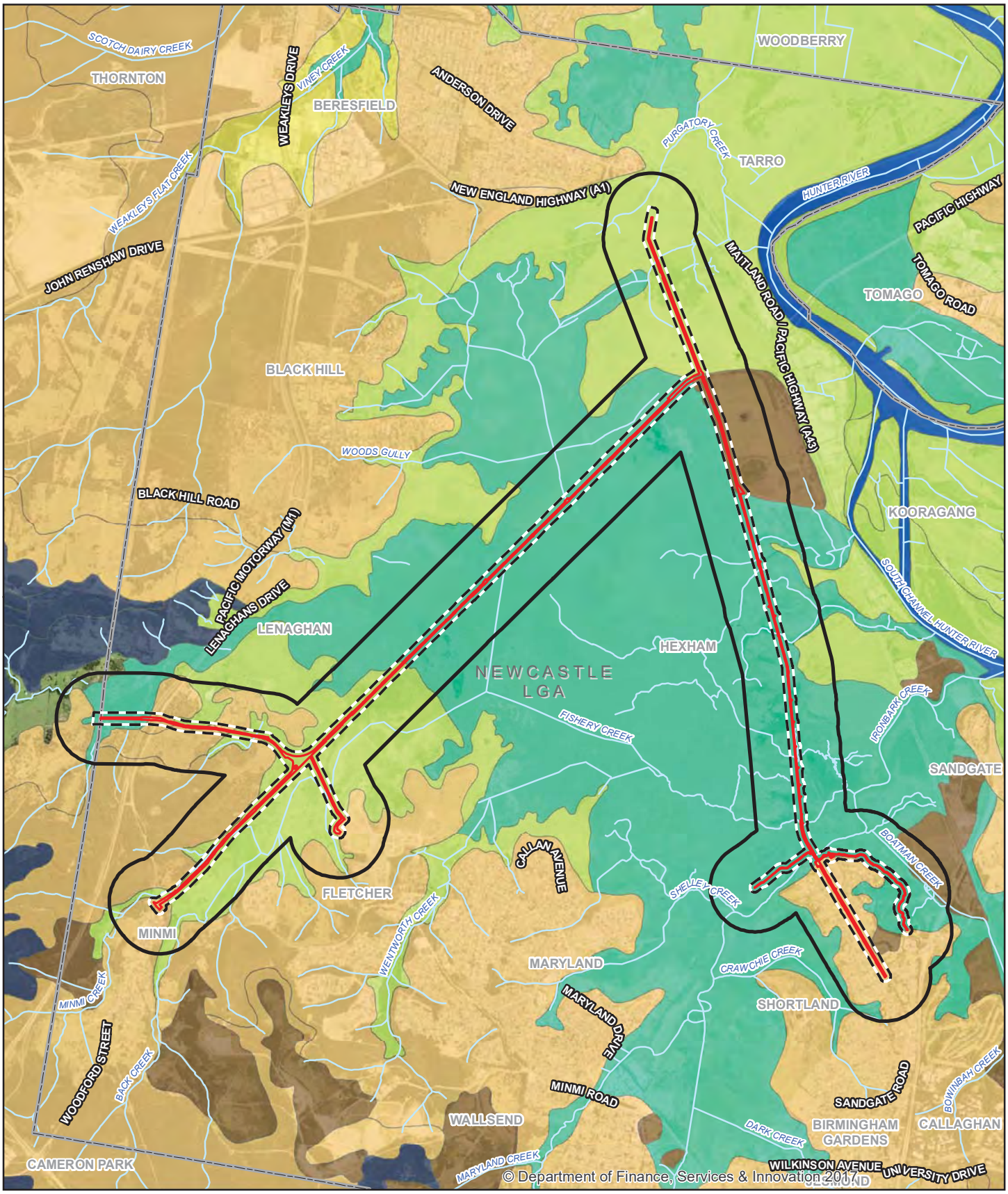
Landscape features: BioNet NSW landscapes and IBRA (sub)regions

Figure 4-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR004_LandscapeFeat_IBRA_0.mxd

Data source: LPI: DTDB / DCDB , 2017, Aerial Imagery, 2012; DSEWPaC: IBRA Bioregions, 2013; DECCW: Mitchell landscapes, 2008. Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- Watercourse
- LGA boundary

Soil Landscapes

- Areas Disturbed By Post Settlement Human Activity
- Coastal Alluvial Plains (Saline)
- Floodplains / Terraces (Alluvial soils)
- Steep Slopes
- Swamps / Waterlogged Areas
- Undulating Low Hillslopes
- Water

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

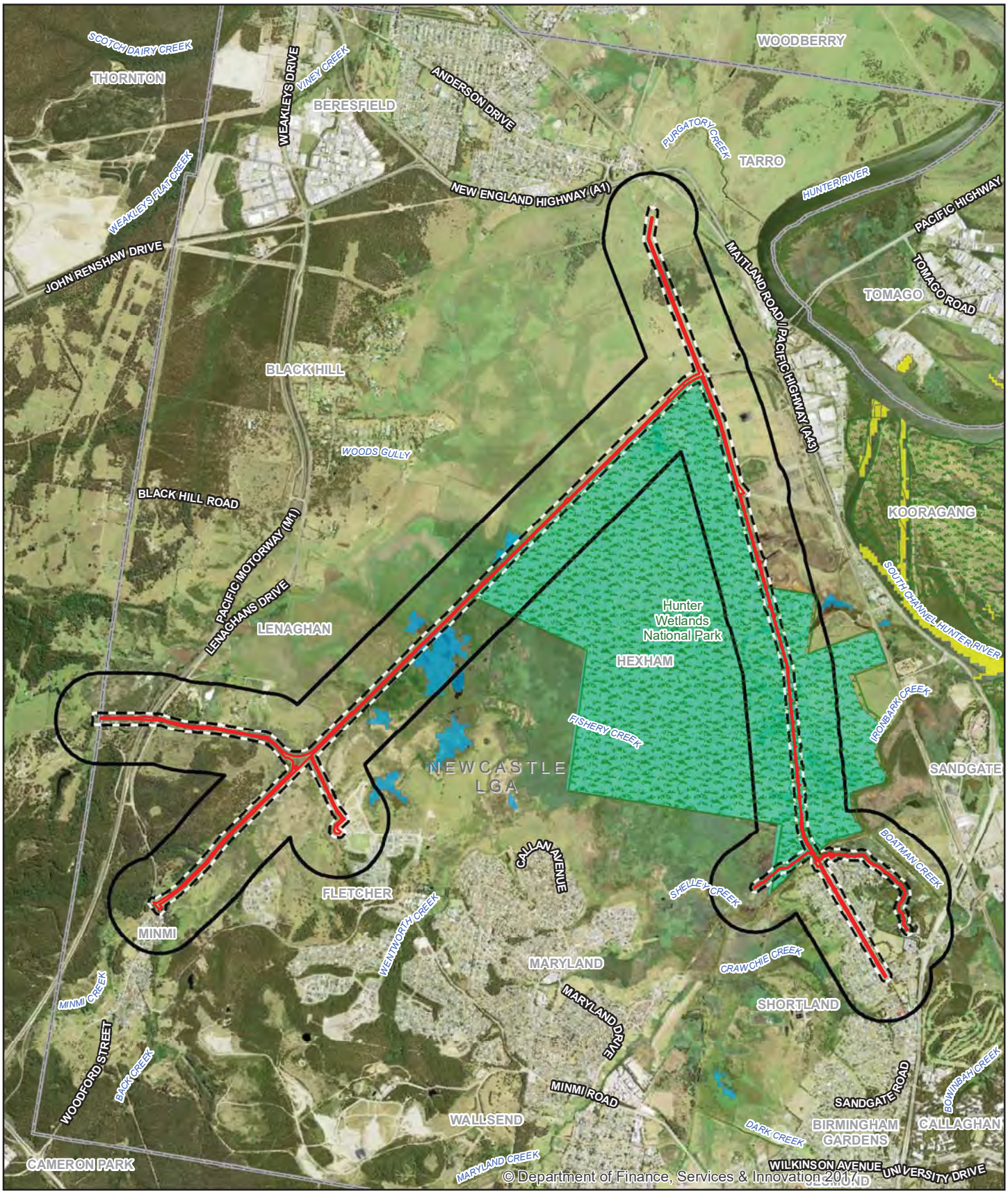
Landscape features: Soil landscapes

Figure 4-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR005_LandscapeFeat_Soils_0.mxd

Data source: LPI: DTDB / DCDB / Aerial Imagery, 2016; DPI: Soil Landscapes 2008. Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- LGA boundary
- Hunter Wetlands National park

Directory Important Wetlands Australia

- Hexham Swamp
- Kooragang Nature Reserve
- Shortland Wetlands Centre

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

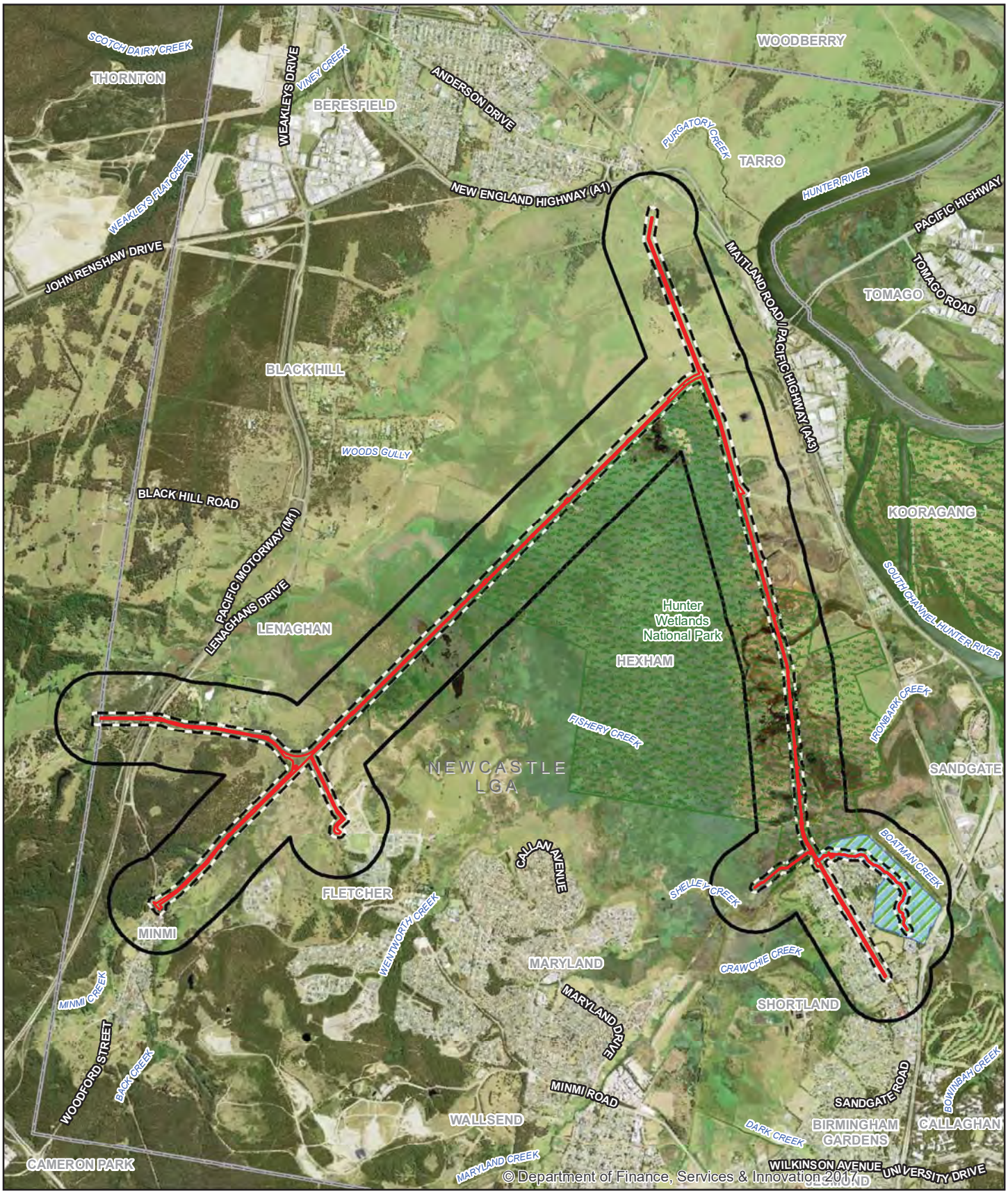
Landscape features: Nationally important wetlands

Figure 4-3

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR006_LandscapeFeat_DIWA_0.mxd

Data source: LPI: DTDB / DCDB / Aerial Imagery, 2016; DIWA: Wetlands 2019 . Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- LGA boundary
- Hunter Wetlands National park
- Hunter Estuary Wetlands ((Ramsar site 24)

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

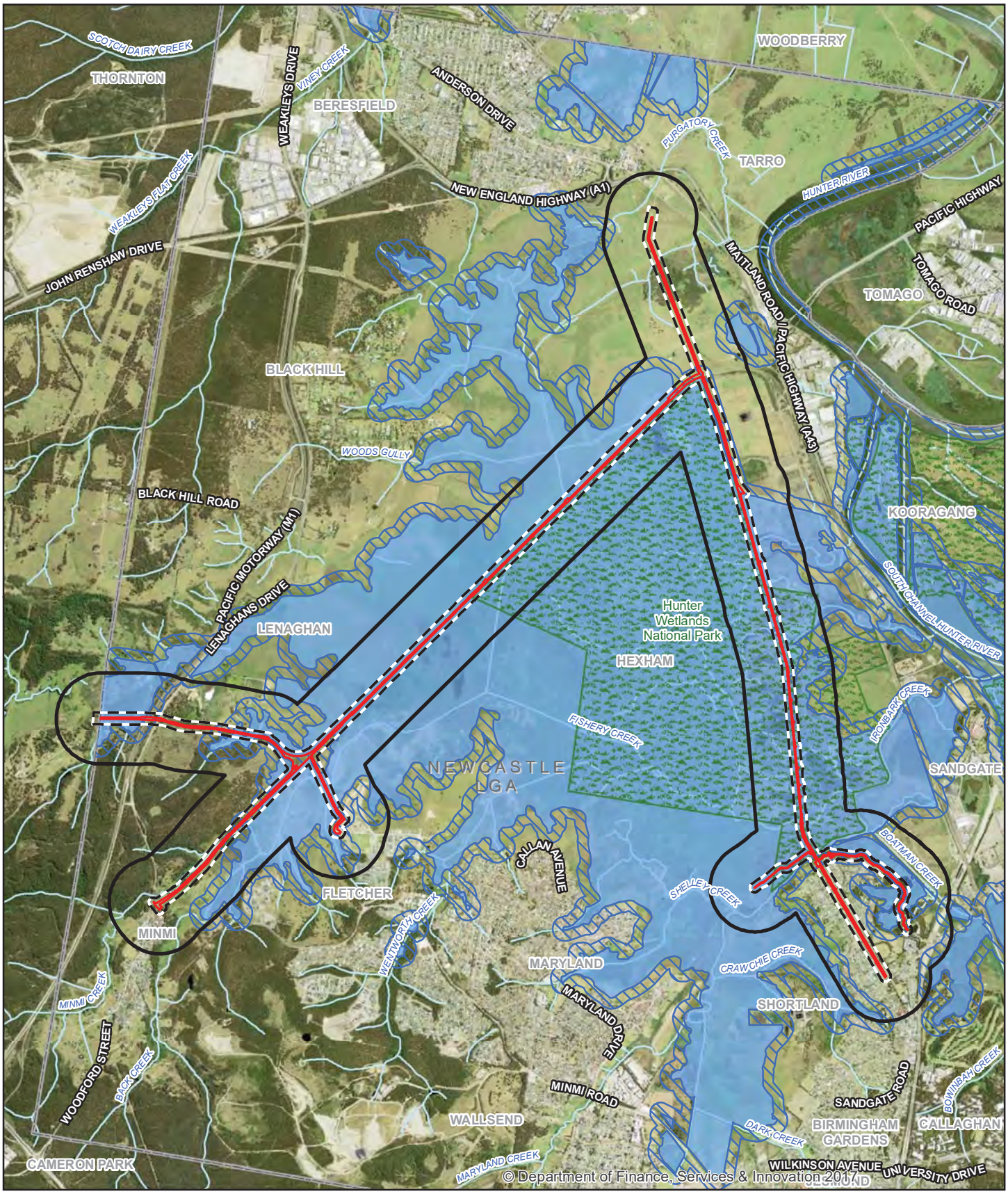
Landscape features: Hunter Estuary Wetlands (Ramsar site 24)

Figure 4-4

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR007_LandscapeFeat_Ramsar_0.mxd

Data source: LPI: DTDB / DCDB / Aerial Imagery, 2016; DSEWPaC: Ramsar Wetlands 2013 . Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- Watercourse
- LGA boundary
- Hunter Wetlands National park

Coastal Management SEPP

- Coastal wetlands
- Proximity area for coastal wetlands

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

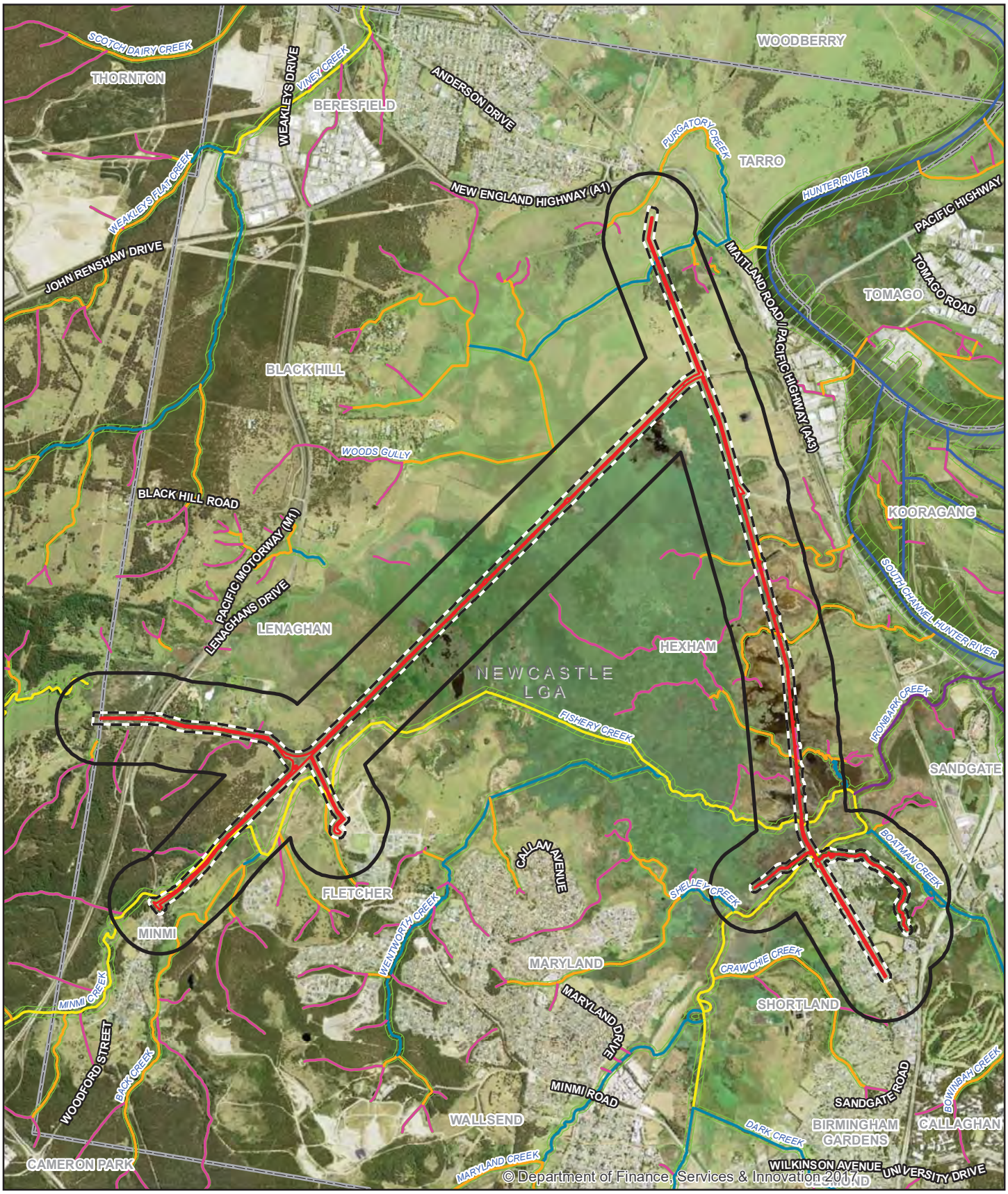
Landscape features: Coastal Management SEPP - Coastal Wetlands

Figure 4-5

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR008_LandscapeFeat_SEPPS_0.mxd

Data source: DPE: Coastal Management SEPP, 2017; LPI: DTDB / DCDB , 2017, Aerial Imagery, 2012. Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- LGA boundary
- Riparian corridor
- Strahler Stream Order
  - 1
  - 2
  - 3
  - 4
  - 5
  - 9

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

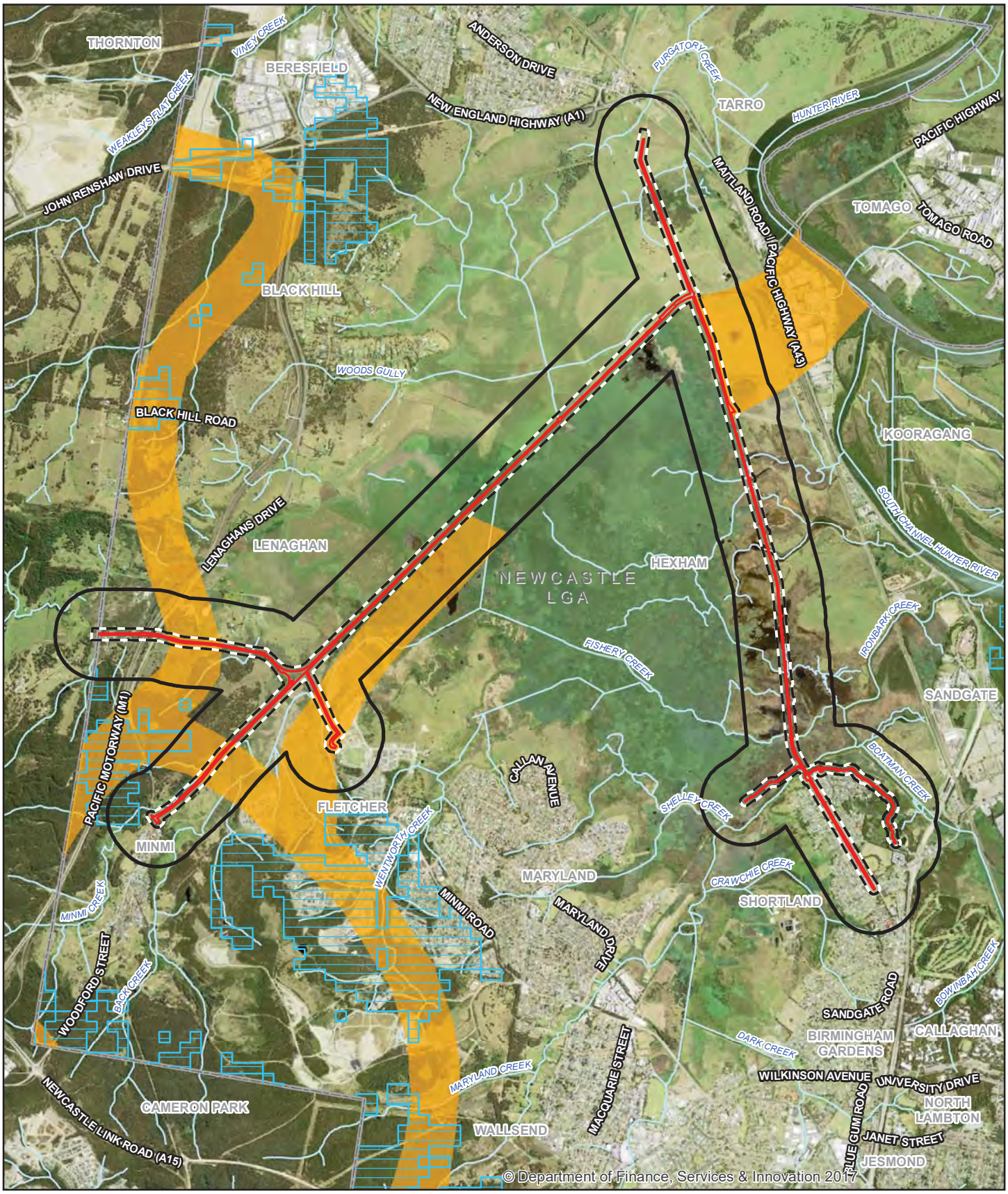
Landscape features: Stream orders and riparian buffers

Figure 4-6

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR009_LandscapeFeat_StreamOrders_0.mxd

Data source: LPI: DTDB / DCDB / Aerial Imagery, 2016; DPI: Stream Orders, 2019. Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- Watercourse
- LGA boundary
- Key fauna habitats
- Key fauna corridors

Paper Size A4

0 340 680 1,020 1,360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

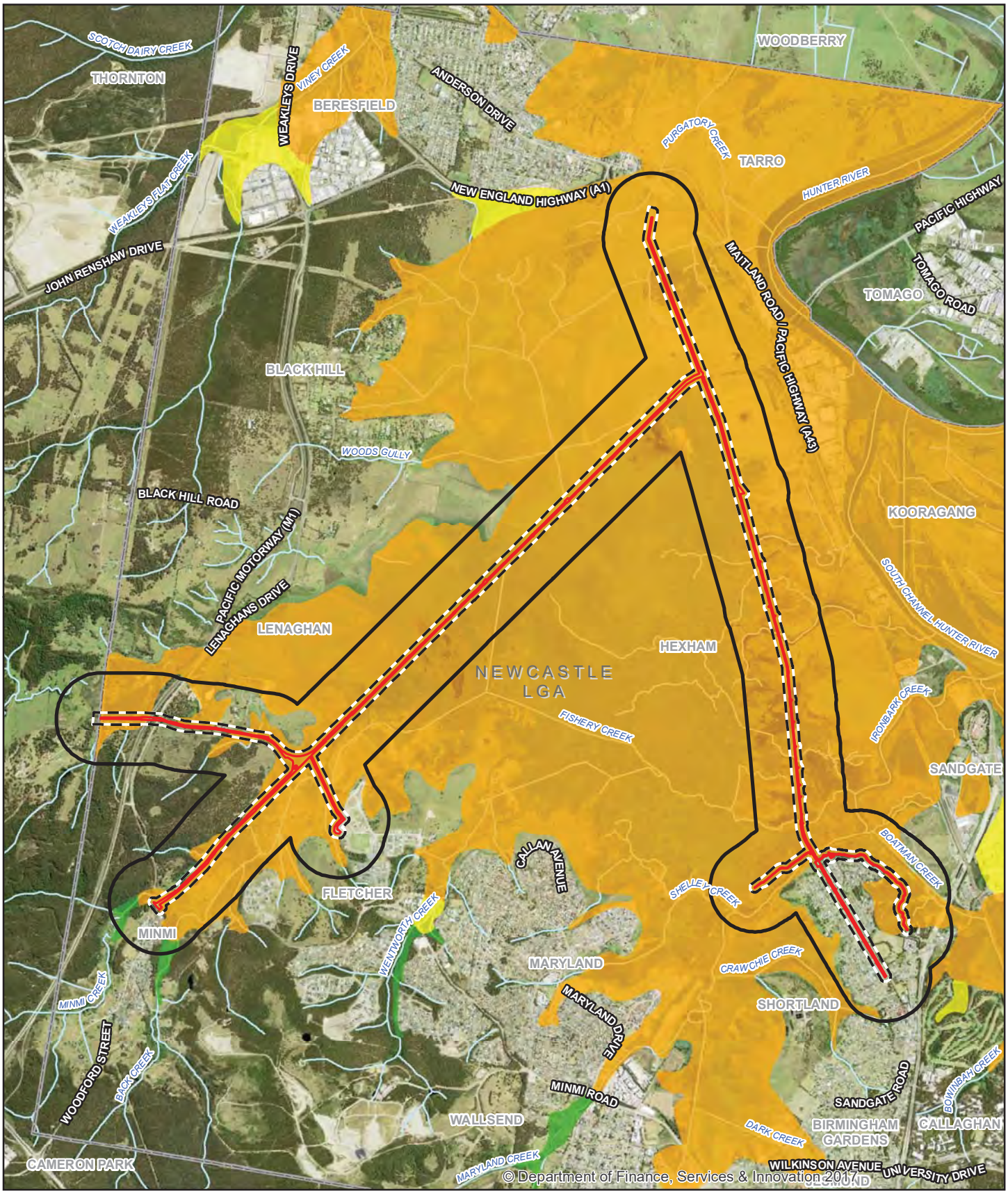
Landscape features:
Key fauna corridors

Figure 4-7

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR010_LandscapeFeat_FaunaCorridors_0.mxd

Data source: LPI: DTDB / DCDB / Aerial Imagery, 2016; DECCW: Key Fauna Corridors / Habitats,2008. Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- Watercourse
- LGA boundary

Acid Sulfate Soil Risk

- High probability of occurrence
- Low probability of occurrence
- No known occurrence

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

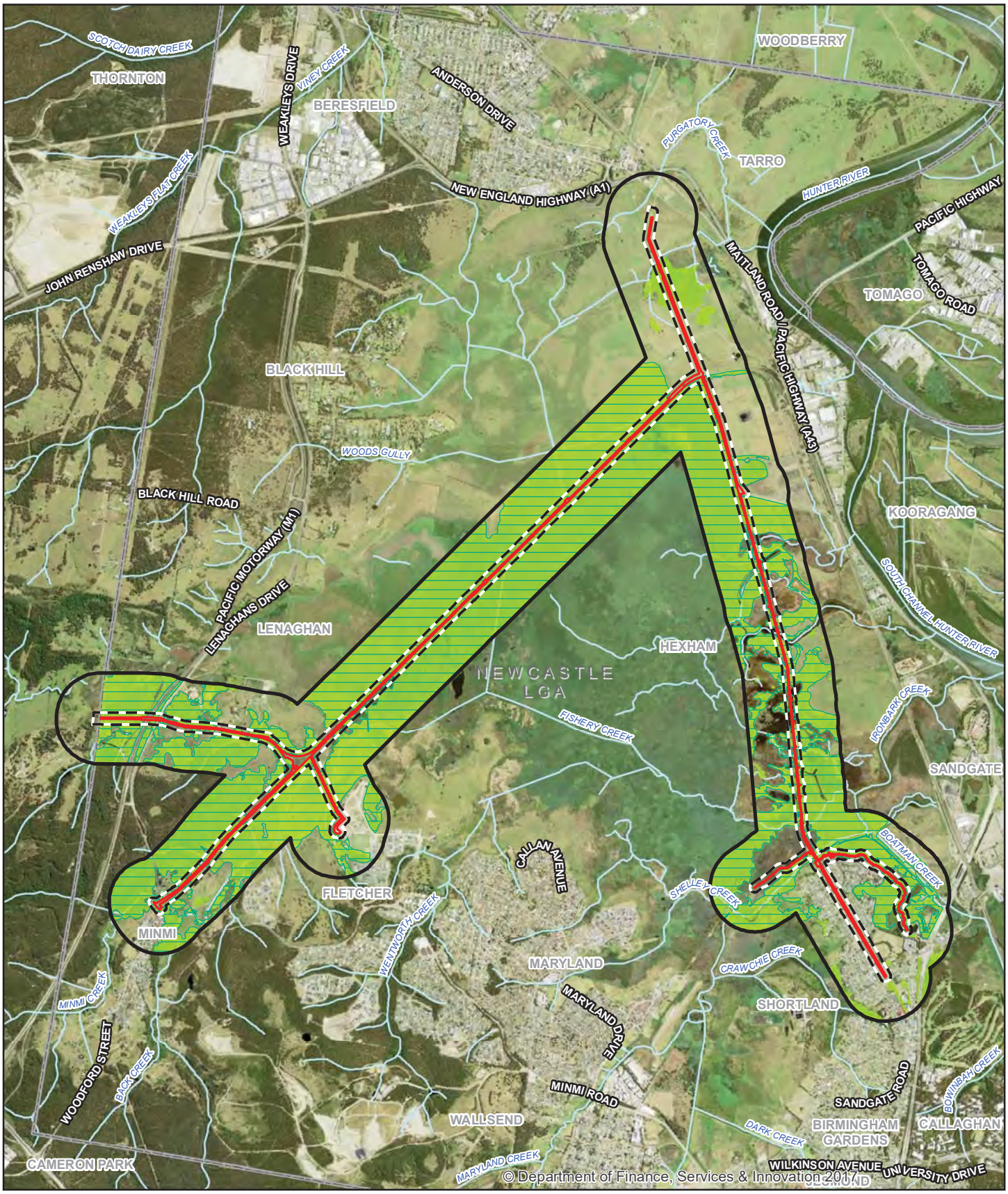
Landscape features: Acid sulfate soil risk mapping

Figure 4-8

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR011_LandscapeFeat_ASS_0.mxd

Data source: LPI: DTDB / DCDB / Aerial Imagery, 2016; OEH: ASS Risk, 2017. Created by: fmackay



LEGEND

- Subject site
- Study Area
- Landscape assessment (500m buffer)
- Watercourse
- LGA boundary
- Native vegetation cover
- Patch size (>100 hectares)

Paper Size A4

0 330 660 990 1,320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Job Number 22-18317
Revision 0
Date 23 Sep 2019

Landscape features: Native vegetation cover and patch size

Figure 4-9

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR012_LandscapeFeat_NativeVeg_0.mxd

Data source: LPI: DTDB / DCDB / Aerial Imagery, 2016. Created by: fmackay

5. Vegetation and habitat

5.1 Vegetation of the study area

5.1.1 General description

The proposal is located within the Hunter subregion of the Sydney Basin bioregion. The subregion is broadly underlain by Quaternary sediments including silt, clay and estuarine sediments in the east and Permian Newcastle Coal Measures including coal, tuff, conglomerate, sandstone and shale in the west. Open valleys of low relief on the western margin of the subregion intergrades to alluvial plains and terraces to the east. The subregion supports of a variety of vegetation types including forest and open woodland, lowland rainforests, lowland forests, grasslands, coastal upland swamps, saltmarsh and freshwater wetlands (McVicar *et al.*, 2015).

The study area and surrounds are primarily characterised by a low-lying plain, resulting in saline and brackish swamps and freshwater marsh adjacent to major hydrological channels, including the Hunter River, Ironbark Creek, Fishery Creek, Purgatory Creek and Minmi Creek. These areas are subject to both tidal inundations from the Hunter River, and freshwater inputs from the multiple tributaries that flow into the area from the west. The hydrological characteristics of the study area and surrounding locality have resulted in the formation of significant wetland habitats, including the Ramsar listed Hunter Estuary Wetlands (DECCW, 2009). These wetland habitats include brackish and freshwater reedlands and grasslands, and estuarine communities that support a significant number of migratory birds, shorebirds and aquatic nursery habitat (McVicar *et al.*, 2015).

Estuarine vegetation typified by mangrove and saltmarsh species like *Juncus kraussii* (Sea Rush), *Sarcocornia quinqueflora* (Samphire), and *Avicennia marina* (Grey Mangrove) are concentrated in the eastern portion of the study area where tidal waters from the Hunter River flow into the Ironbark Creek catchment. The prevalence of brackish and freshwater species, such as *Phragmites australis* (Common Reed) and *Typha orientalis* (Broadleaf Cumbungi) respectively, increases to the west with increasing distance from the Hunter River and tidal influences. Reedlands and herbaceous swamps are concentrated in the west of where the land is periodically inundated by fresh water from numerous first and second order tributaries flowing into the low-lying area.

Above the treeless wetlands, the lower slopes and low-lying areas in the western portion of the study area support forested wetland and backswamp vegetation featuring trees such as *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus tereticornis* (Forest Red Gum), *Casuarina glauca* (Swamp Oak), and various paperbark species including *Melaleuca styphelioides* (Prickly-leaved Tea Tree) and *Melaleuca quinquenervia* (Broad-leaved Paperbark). Sheltered sites support tall trees such as *Eucalyptus saligna* (Sydney Blue Gum) and *Syncarpia glomulifera* (Turpentine) with a mesic understorey characterised by *Glochidion ferdinandi* (Cheese Tree) and *Acmena smithii* (Lilly Pilly) (OEH, 2016b). Adjoining rolling hills support open forest vegetation with a mixture of shrubs and grasses in the understorey, dominated by *Corymbia maculata* (Spotted Gum), ironbark species, *Angophora floribunda* (Rough-barked Apple) and sometimes *Eucalyptus punctata* (Grey Gum).

Newcastle has a long history associated with agriculture, mining, and more recently, urban expansion (NCC, 2012). Much of the region is also managed as national parks, nature reserves and for environmental conservation. Land clearing and draining of the floodplains associated within these industries in combination with land conservation has resulted in a semi-cleared landscape connected to larger tracts of vegetation on ranges and along major waterways. On a local scale, the study area has been affected by the construction of floodgates on Ironbark Creek in 1971. Prior to the construction of the floodgates, approximately one third of Hexham Swamp was estuarine with the remainder in the western portion comprising freshwater wetlands.

With the construction of the floodgates, the estuarine zone contracted further to the east and was replaced by freshwater reedlands. Historical records indicate that the waters of Hexham Swamp were an important fisheries habitat prior to construction of the floodgates. The floodgates have since been reopened and this dynamic system is likely to continue to vary with changes in tidal influence (DEE, 2010a).

5.1.2 Native vegetation cover

The native vegetation extent within the subject site was mapped in accordance with Section 5.1 of the BAM (OEH, 2017a) and includes all areas of native vegetation, including areas where woody cover may have been removed and only native groundcover remains. The subject site was mapped using site data in combination with aerial photo interpretation at an average scale of 1:1000 and no greater than 1:2000.

The majority of the subject site has been historically cleared for the former HWC Chichester rising main and Richmond Vale railway and is dominated by exotic grasslands. The extent of native vegetation mapped within the subject site is approximately 3.3 ha and represents the fringes of remnant native woodland patches and wetland vegetation extending offsite into the study area (see Figure 5-1). Much of this vegetation is affected by weeds like *Rubus fruticosus* (Blackberry), *Lonicera japonica* (Japanese Honeysuckle), *Juncus acutus* (Sharp Rush) and exotic grasses.

There is approximately 26.5 ha of non-native vegetation in the subject site, the majority of which is exotic grasslands dominated by *Cenchrus clandestinus* (Kikuyu) and *Paspalum dilatatum* (Paspalum). Other areas of non-native vegetation include planted vegetation established in the Hunter Wetland Centre. In the study area, patches of groundcover vegetation almost entirely dominated by the introduced *Juncus acutus* (Sharp Rush) was recorded in estuarine and brackish environments associated with the lower reaches of Ironbark and Fishery Creek at the Shortland end of the subject site.

5.1.3 Plant community types and vegetation zones

There are 11 PCTs mapped within the study area. Of these, 10 PCTs occur within the subject site. A number of the PCTs conform to threatened ecological communities listed under the BC Act and EPBC Act. Two of these PCTs, comprising mangrove and saltmarsh vegetation, are defined as key fish habitat, and are protected marine vegetation under the FM Act. The vegetation types (including PCTs, derived grassland and non-native or non-indigenous vegetation) mapped within the study area are summarised in Table 5-1.

The vegetation zones identified within the subject site are detailed in Table 5-2 and shown on Figure 5-1. Table 5-2 also presents the vegetation integrity score components as required by Table 25 of the BAM (OEH, 2017a). Description profiles of the PCTs present in the study area are provided in Table 5-3 to Table 5-14.

Table 5-1 Plant community types within the study area

Plant Community Type (PCT)	BC Act status	EPBC Act status	FM Act status	Extent in subject site (ha)	Extent in study area (ha)
PCT 1528 - Jackwood - Lilly Pilly - Sassafras riparian warm temperate rainforest of the Central Coast.	EEC	CEEC	-	0.18	1.11
PCT 1568 - Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	Not listed	Not listed	-	0.22	1.33
PCT 1590- Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Not listed	Not listed	-	0.04	1.67
PCT 1598- Forest Red Gum grassy open forest on floodplains of the lower Hunter	EEC	Not listed	-	0.76	3.47
PCT 1619- Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Not listed	Not listed	-	0.00	0.09
PCT 1718- Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	EEC	Not listed	-	0.41	4.83
PCT 1727 - Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	EEC	EEC	-	0.60	9.86
PCT 1747- Grey Mangrove low closed forest	Not listed	Not listed	Protected marine vegetation (Key Fish Habitat)	0.24	8.50
PCT 1746- Saltmarsh Estuarine Complex	EEC	VEC	Protected marine vegetation (Key Fish Habitat)	0.02	0.62
PCT 1737- Typha Rushland	EEC	Not listed	-	0.85	45.34
PCT 1808- Common Reed on the margins of estuaries and brackish lagoons along the New South Wales coastline	EEC	Not listed	-	0.01	29.21
Planted vegetation	n/a	n/a	n/a	0.12	1.79
Exotic grassland	n/a	n/a	n/a	26.33	68.59
Juncus acutus reedland	n/a	n/a	n/a	0.00	0.90
TOTAL AREA (hectares)				**29.8**	**177.3**

EEC = endangered ecological community, VEC = vulnerable ecological community, CEEC = critically endangered ecological community

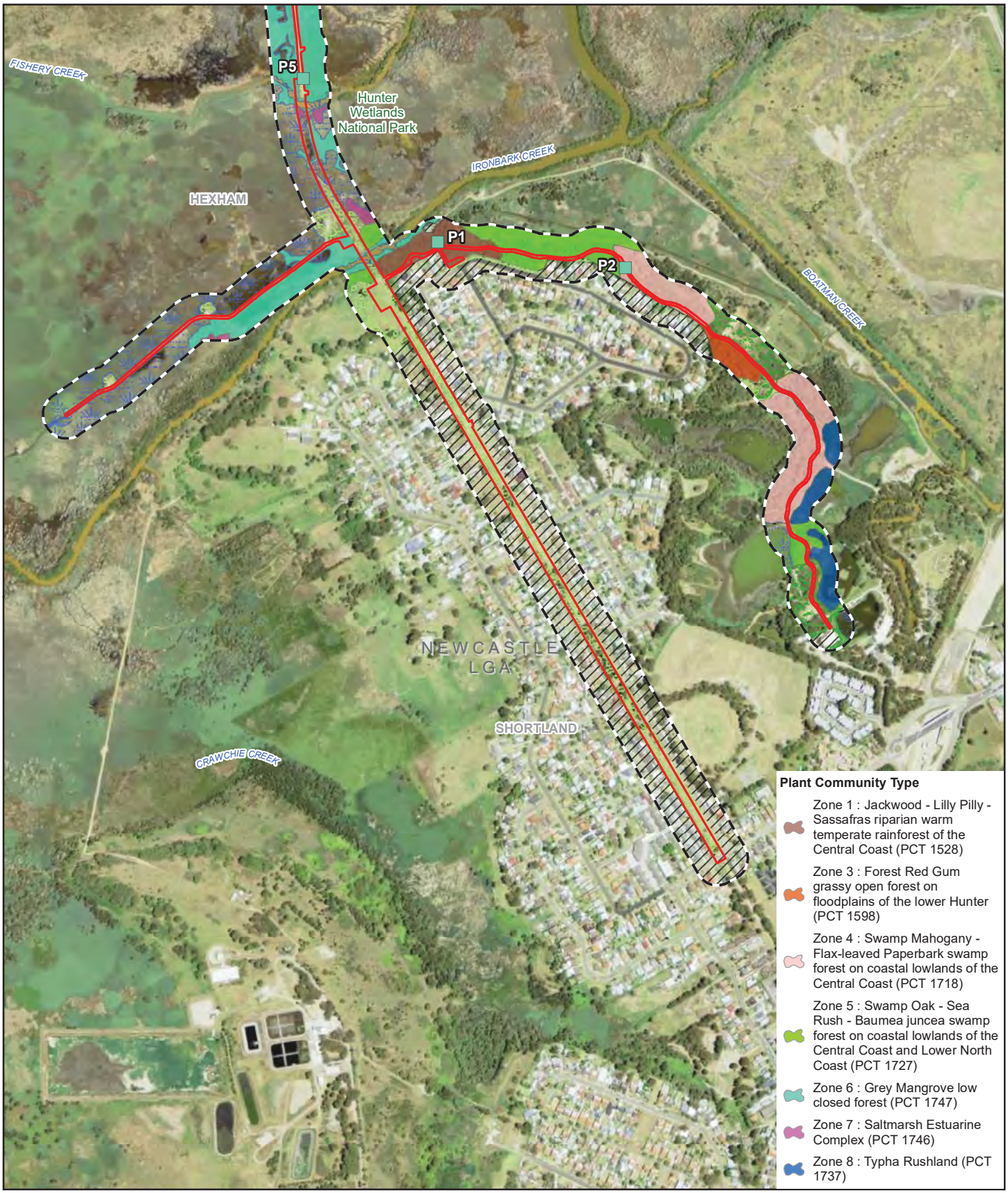
Table 5-2 Vegetation zones within the subject site

Vegetation zone	Plant Community Type (PCT)	Condition	Area (ha)	Patch size (ha)	Composition score	Structural score	Functional score	Vegetation integrity score
1	PCT 1528 - Jackwood - Lilly Pilly - Sassafras riparian warm temperate rainforest of the Central Coast.	intact	0.18	> 101	66	50.2	100	69.2
2	PCT 1568 - Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	intact	0.22	> 101	29.7	41.3	68.4	43.8
# see table note	PCT 1590- Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	intact	0.04	> 101	n/a	n/a	n/a	n/a
3	PCT 1598- Forest Red Gum grassy open forest on floodplains of the lower Hunter	intact	0.76	> 101	76.7	21.8	94.6	54.1
4	PCT 1718- Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	intact	0.41	> 101	41.1	24.4	65.5	40.3
5	PCT 1727 - Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	intact	0.60	> 101	34.4	18.4	45	30.5
6	PCT 1747- Grey Mangrove low closed forest	intact	0.24	> 101	68.9	98.5	-	82.4
^ see table note	PCT 1746- Saltmarsh Estuarine Complex	intact	0.02	> 101	n/a	n/a	n/a	n/a
7	PCT 1737- Typha Rushland	intact	0.85	> 101	69.9	91.2	-	79.8
* see table note	PCT 1808- Common Reed on the margins of estuaries and brackish lagoons along the New South Wales coastline	intact	0.01	> 101	n/a	n/a	n/a	n/a

PCT 1590 is present within the subject site as two small patches; has been combined with the nearest PCT (i.e. PCT 1598) to form one vegetation zone due to its size.

^ PCT 1746 has been combined with the nearest PCT (i.e. PCT 1747) to form one vegetation zone due to its size.

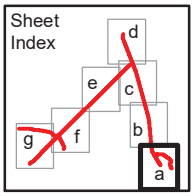
* PCT 1808 has been combined with the nearest PCT (i.e. PCT 1737) to form one vegetation zone due to its size.



LEGEND

- Subject site
- Study Area
- BAM plot surveys (2019)
- Exotic grassland
- Plantings
- Cleared
- Water

Sheet Index



Paper Size A4

0 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Plant community types and vegetation zones within the study area

Figure 5-1a

Job Number	22-18317
Revision	0
Date	23 Sep 2019

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

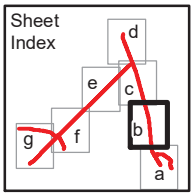
G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR013_Vegetation_DDP_0.mxd

Data source: LPI: DTDB / DCDB, 2017, Aerial Imagery, 2012. Created by: fmackay

LEGEND

- Subject site
- Study Area
- BAM plot surveys (2019)
- Juncus acutus reedland
- Exotic grassland
- Water

Sheet Index



Paper Size A4

0 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Plant community types and vegetation zones within the study area

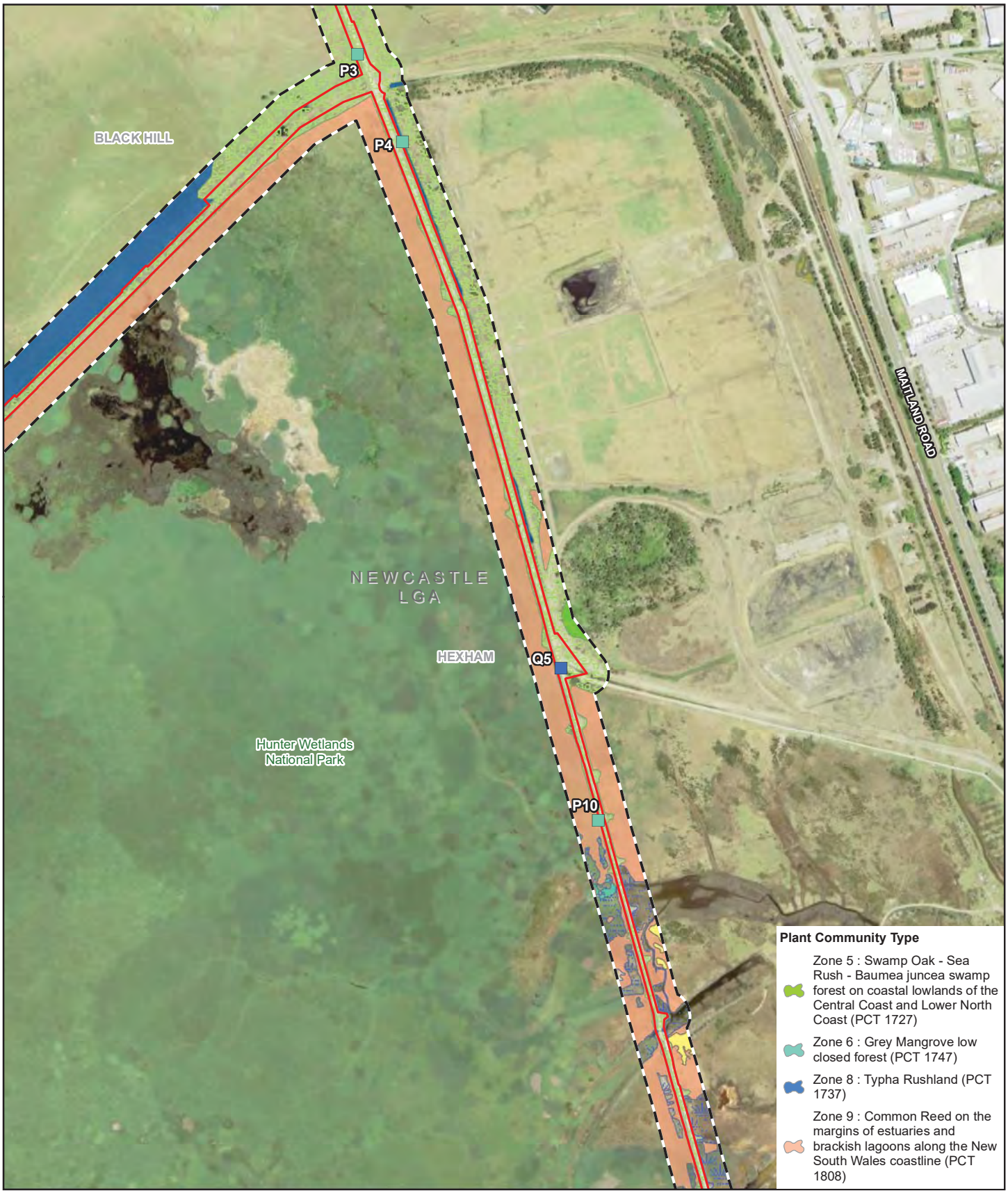
Figure 5-1b

Job Number 22-18317
Revision 0
Date 23 Sep 2019

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR013_Vegetation_DDP_0.mxd

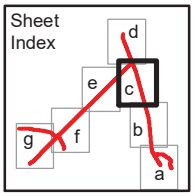
Data source: LPI: DTDB / DCDB, 2017, Aerial Imagery, 2012. Created by: fmackay



LEGEND

- Subject site
- Study Area
- BBAM plot surveys (2016)
- BAM plot surveys (2019)
- Juncus acutus reedland
- Exotic grassland
- Water

Sheet Index



Paper Size A4

0 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Plant community types and vegetation zones within the study area

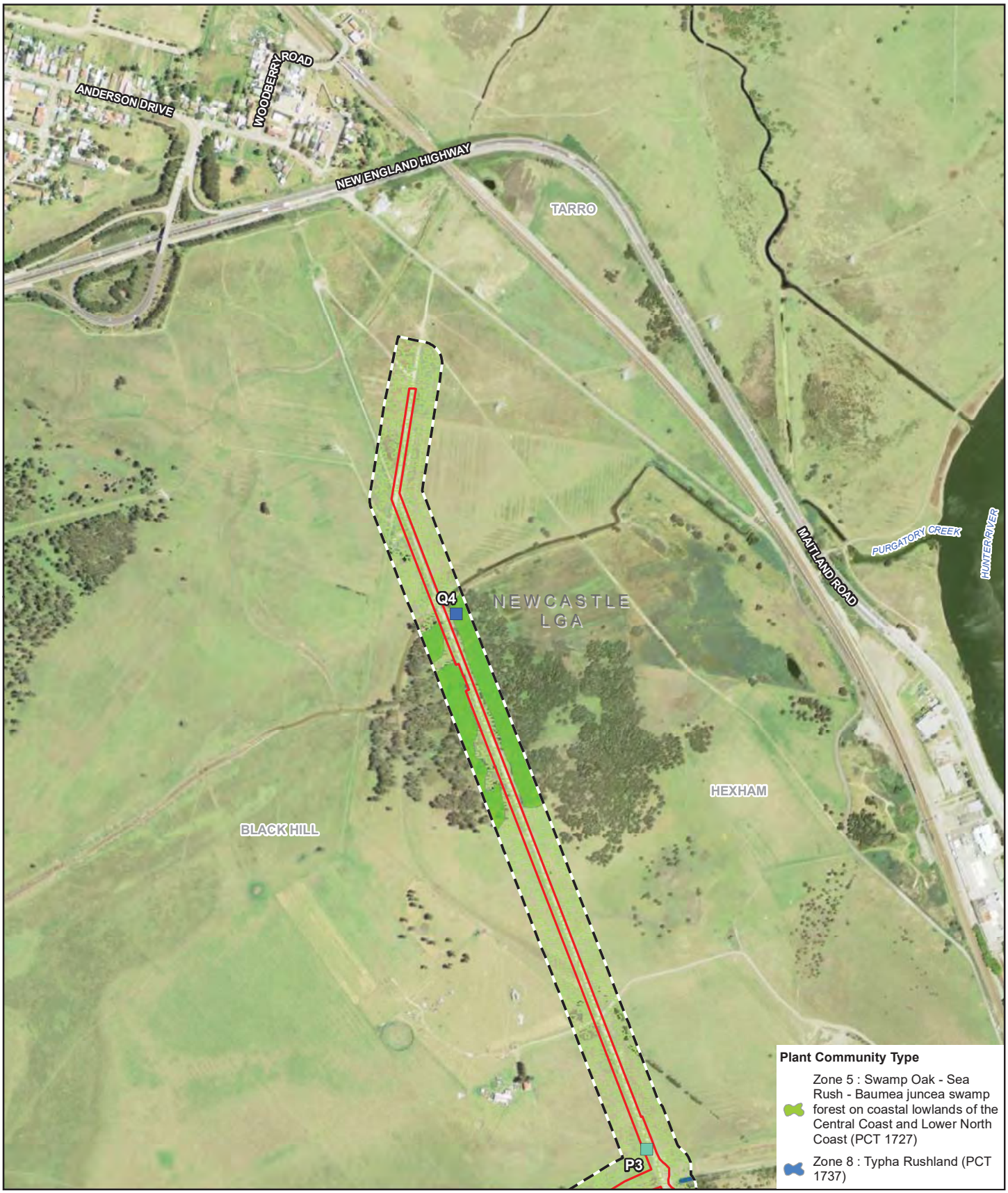
Figure 5-1c

Job Number	22-18317
Revision	0
Date	23 Sep 2019

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR013_Vegetation_DDP_0.mxd

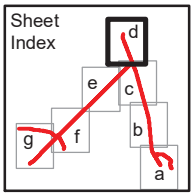
Data source: LPI: DTDB / DCDB, 2017, Aerial Imagery, 2012. Created by: fmackay



LEGEND

- Subject site
- Study Area
- BBAM plot surveys (2016)
- BAM plot surveys (2019)
- Exotic grassland

Sheet Index



Paper Size A4

0 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Plant community types and vegetation zones within the study area

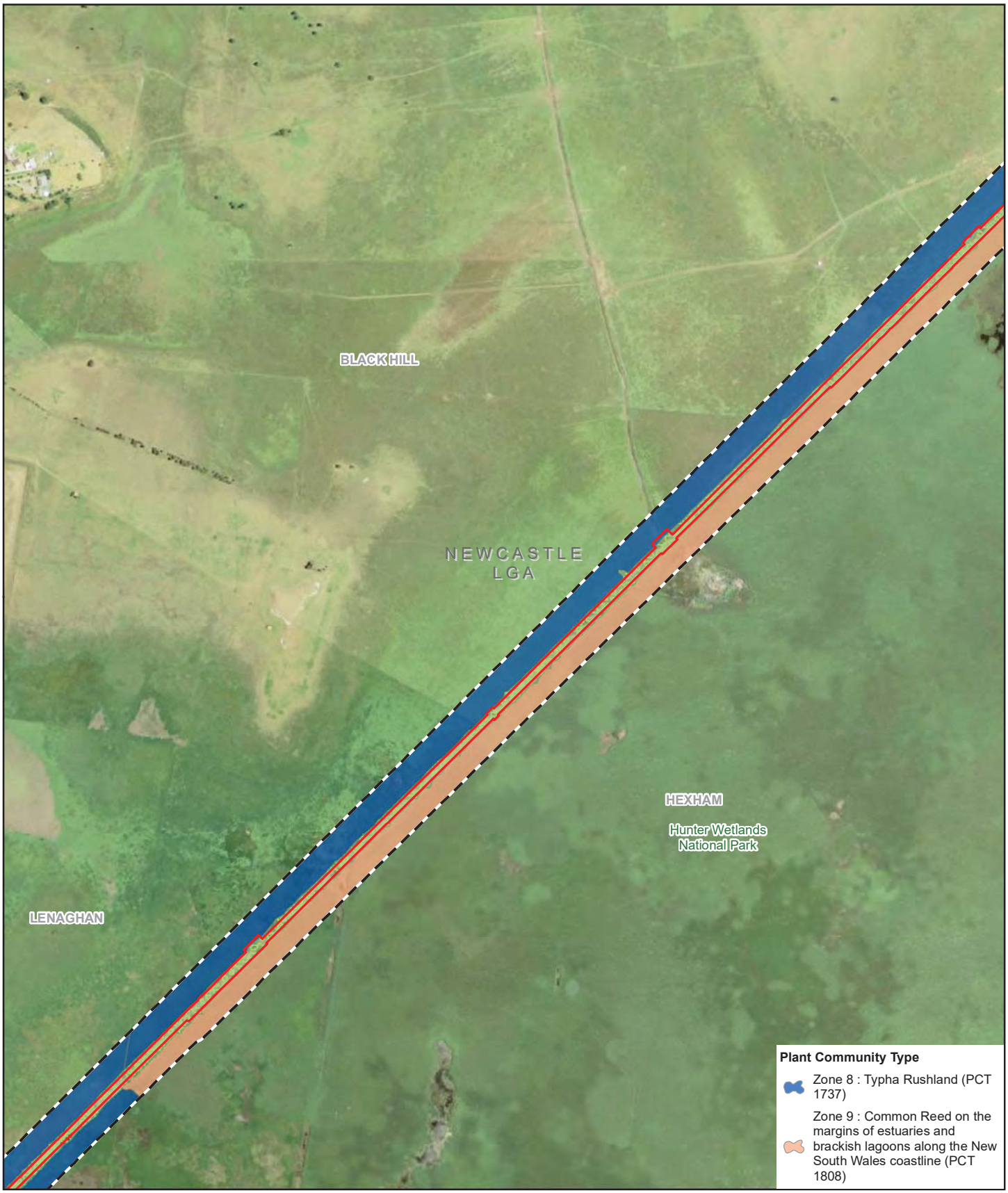
Job Number 22-18317
Revision 0
Date 23 Sep 2019

Figure 5-1d

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR013_Vegetation_DDP_0.mxd

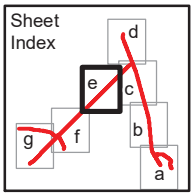
Data source: LPI: DTDB / DCDB, 2017, Aerial Imagery, 2012. Created by: fmackay



LEGEND

- Subject site
- Study Area
- Exotic grassland

Sheet Index



Paper Size A4

0 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Plant community types and vegetation zones within the study area

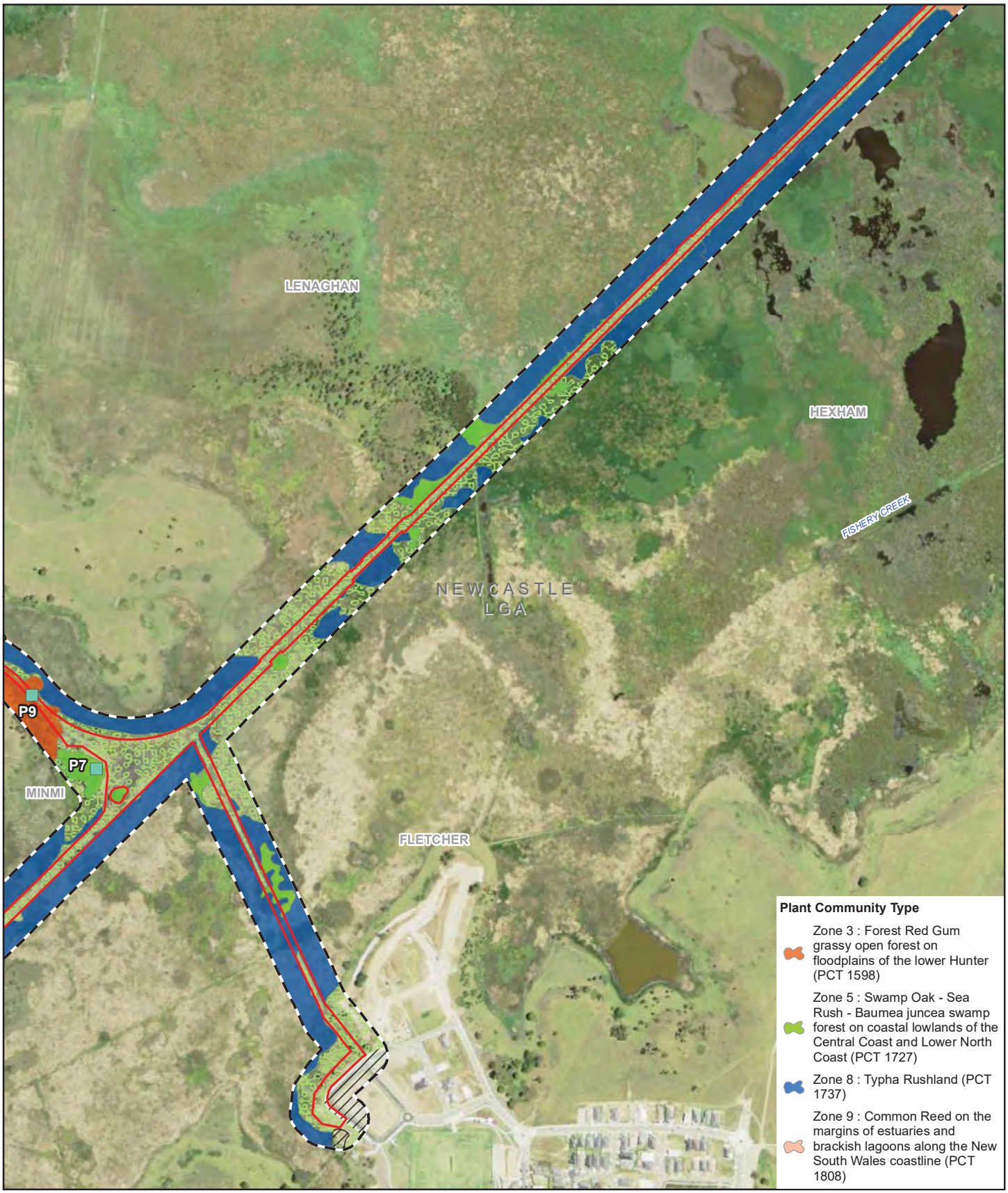
Figure 5-1e

Job Number	22-18317
Revision	0
Date	23 Sep 2019

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR013_Vegetation_DDP_0.mxd

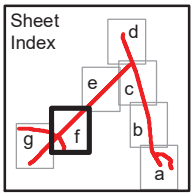
Data source: LPI: DTDB / DCDB, 2017, Aerial Imagery, 2012. Created by: fmackay



LEGEND

- Subject site
- Study Area
- BAM plot surveys (2019)
- Exotic grassland
- Cleared

Sheet Index



Paper Size A4

0 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newcastle City Council
Richmond Vale Rail Trail
Biodiversity Development Assessment Report

Plant community types and vegetation zones within the study area

Job Number 22-18317
Revision 0
Date 23 Sep 2019

Figure 5-1f

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\18317\GIS\Maps\Deliverables\BDAR_NewcLGA\2218317_BDAR013_Vegetation_DDP_0.mxd

Data source: LPI: DTDB / DCDB, 2017, Aerial Imagery, 2012. Created by: fmackay