



Photo 371



Photo 372



Photo 373



Photo 374



Photo 375



Photo 376



Photo 377



Photo 378



Photo 379



Photo 380



Photo 381



Photo 382



Photo 383



Photo 384



Photo 385



Photo 386



Photo 387



Photo 388



Photo 389



Photo 390



Photo 391



Photo 392



Photo 393



Photo 394



Photo 395



Photo 396



Photo 397



Photo 398



Photo 399



Photo 400



Photo 401



Photo 402

14.1.2 Probable causes

There was no evidence of damage caused by inhibited drainage through IA5N. The new drainage infrastructure which discharges into Bardenarang Creek via the new gated pipes should provide rapid draw down of the floodwaters ponded on this section of the floodplain.

While the floodgates which pass under the northern section of Pitt Town Bottoms Road appear to be poorly maintained and non-functioning, they are no longer needed now that the embankment and diversion channel has been constructed further south.

With regards to IA5S, there are several problem areas which have various causes.

On the upper reaches of the northern most arm the flooding of market gardens upstream of the reedbeds appears to be caused by the reed beds inhibiting flow and the lowest parts of the paddocks not being much higher than the reed beds (Photo 372).

Further downstream, paddocks opposite the model airplane club grounds (Photo 375) appear to be unable to drain because they are lower than the top of the channel. This may have been caused by the gradual stripping of the soil through turf farming.

The main problem with the drain in the middle branch appears to be siltation. There are two contributing factors to this problem:

1. Erosion is feeding silt into the system
2. The bottom end of the terrain is very flat and so flow velocities in the drain are low which means that sediment drops out before arriving at the lagoon.

The fact that most of this subcatchment is used for turf farming could be exacerbating both of these contributing factors. Having areas stripped of ground cover makes those areas susceptible to erosion. As layers of turf are stripped soil is taken with it and so over many years the ground level is lowered and the drainage slope adjacent to Pitt Town Bottoms Road increases which accelerates erosion and the slope further from the road becomes flatter which slows drainage and increases siltation.

Similar problems occur throughout the southern most sub catchment for the same reasons. However, there is an additional problem in this subcatchment where an embankment across the drain (Photo 398 and Photo 399) essentially dams the area upstream with only a 600mm pipe as an outlet. As there is minimal fall on this part of the floodplain the water would take considerable time to drain through the pipe and so the upstream paddock will be under water for a prolonged period, killing the grass (Photo 399 and Photo 400). If the upstream paddock is continued to be used for turf farming then over time it level will be lowered and the time it takes to drain will increase. If it is lowered too far its level will be below the bottom of the pipe and it will need to rely upon evaporation for the last of the standing water to be removed.

All 3 subcatchments in IA5S drain into Pitt Town Lagoon and the water level in the lagoon sets the elevation to which these catchments drain.

14.1.3 Possible solutions

Nothing really needs to be done for the IA5N catchment.

Removing sediment from drains, which appears to have been undertaken by some farmers already, will improve drainage. However, if this is the only measure undertaken then it will need to be done regularly to maximise the flow in the drains.

The sedimentation of drains in the IA5S subcatchments could be reduced if erosion is reduced. This could include vegetating the batters of road and other embankments on the farms, applying rubber

matting, sand, asphalt, cement or rubble to high traffic areas and leaving turf strips around the downhill edge of paddocks when turf is stripped (DPI, 2014).

The problem remains, however, that ongoing turf farming in these areas gradually reduces the ground level. This can only be overcome by raising the ground level with soil or changing to other forms of agricultural production which do not lower the ground level.

Lowering the water level at the downstream end of these catchments may improve their drainage. However, this is not an option because they flow into Pitt Town Lagoon which is a protected wetland and nature reserve and lowering its water level would have detrimental environmental impacts. This is discussed further in Section 14.2.

Where the level in paddocks has been lowered to below the top of the drains the landform needs to be regraded so that the paddocks drain into the drains.

The purpose of the embankment across the drain which was damming water on the upstream paddock was not clear. If it does not perform an important function then cutting a gap in the embankment, or removing it altogether, would improve the drainage of that paddock.

There may be sufficient fall through the reed beds such that if a channel were cut through the reeds the market gardens would drain more efficiently. The environmental impacts of such a measure would need to be considered. Here too, agricultural practices which reduce soil erosion would assist in preventing drains from silting up and slowing drainage.

Possible solutions for IA5S are shown in Figure 133.



- Solutions for IA5
- Regrade paddock
 - Keep channel clear
 - ◆ Regrade paddock
 - ◆ Remove road embankment
- Investigated Drainage Routes
- IA5N
 - IA5S
- Hydrography
- Named watercourse
 - Hydrolines
 - Waterbodies

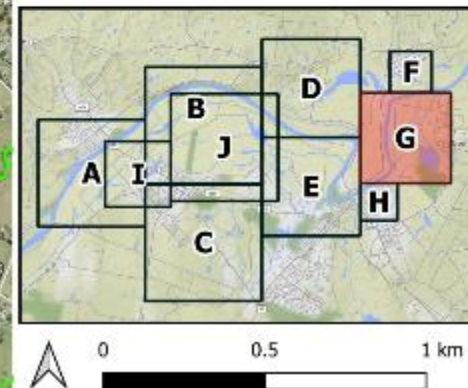


Figure 133: Solutions for IA5

14.2 Environmental Constraints

a) Zoning

The drainage network in Investigation Area 5 predominantly traverses land zoned as RU2 – Rural Landscape with the single exception being Pitt Town Lagoon which is zoned as C2 – Environmental Conservation (Figure 134).

Maintenance of existing drainage channels is permitted without consent the RU2 zone while reinstating or rectifying drainage lines requires development consent. Removing a road embankment and regrading paddocks would be considered reinstating and rectifying a drainage line and would therefore be subject to development approval. Clearing the existing drainage channel would however be permissible without consent.

b) Contamination

Notified contaminated sites on or near the Hawkesbury Floodplain are shown in Figure 4.

There are no contaminated sites within the vicinity of the Investigation Area 5 drainage network.

c) Acid Sulphate Soils

The Investigation Area 5 drainage network is surrounded by Class 2, 3 and 4 land on the Acid Sulphate Soils Map (Figure 135). The majority of the drainage channels are surrounded by Class 4 land however segments cross into Class 3 and Class 2 land surrounding Pitt Town Lagoon.

According to HLEP 2012 Part 6.1, development consent in Class 2 land is required for works below the natural ground surface or by which the watertable is likely to be lowered. As these areas are in and around Pitt Town Lagoon and drainage works in these areas or steps to lower the water level in Pitt Town Lagoon would need development approval.

For Class 3 land development consent is required for works more than 1 m below the natural ground surface or by which the watertable is likely to be lowered more than 1 m below the natural ground surface. For Class 4 land development consent is required where the works are more than 2m below the natural ground surface or are likely to lower the watertable by more than 2m below the natural ground surface. Any of the suggested works would not require excavation of such depths.

d) Heritage

i) HLEP Heritage Items

There are several heritage items in *HLEP 2012* Schedule within IA5 however none are traversed by drains (Figure 137).

ii) AHIMS Heritage Items

An AHIMS Basic Search of constraints extent G returned 8 Aboriginal Sites, none of which appears to be near the drains in IA5 (Figure 137). However, the exact location and nature of Aboriginal sites is not known from a Basic Search. Therefore, for any works on IA5, a Basic Search of the specific works extent should be conducted to confirm whether any Aboriginal Sites are nearby. If an initial basic search returns any Aboriginal Sites, an AHIMS Extensive Search is required.

e) Wetlands and Coastal Areas

There is one wetland identified on the HLEP Wetlands Map, and two coastal wetlands as per the R&H SEPP located in the IA5S drainage network connecting to Pitt Town Lagoon (Figure 138). Pitt Town Lagoon is mapped as a coastal wetland in as per the R&H SEPP.

Before development consent can be granted for any works conducted within the extent of these wetlands and their proximity areas the provisions set out in Part 6.5 (3) and (4) of the HLEP and



sections 2.7 and 2.8 of the R&H SEPP must be satisfied. These provisions are quoted in sections 3.5 and 3.6 of this report. This is a constraint to any proposal to cut a channel through the reeds. IA5N and IA5S do not intersect with any coastal environment and coastal use areas.

f) Ecology

i) PCT Mapping

There are two PCTs mapped along the IA5 Drainage Network: PCT 781 and PCT 835 (Figure 139). PCT 835 is mapped along most of Bardenarang Gully, two patches west of Bardenarang Gully, as well as an approximate 600 m segment of drainage channel which forms the northern arm of the IA5S drain (Figure 126). This latter section is questionable as there is nothing but ground cover along this length of drain (Photo 360). Pitt Town Lagoon and the reed beds to its northwest are mapped as PCT 781 (Figure 139). As this PCT is equivalent to endangered ecological communities which are protected under the Biodiversity Conservation Act, obtaining approval to cut a channel through the reeds may prove to be problematic.

ii) Terrestrial Biodiversity

Pitt Town Lagoon, the reed beds, Bardenarang Gully and the southern half of the IA5N drainage line are mapped as 'Significant Vegetation' (Figure 140). A buffer zone around Pitt Town Lagoon and Bardenarang Gully are mapped as 'Connectivity Between Significant Vegetation'. This would need to be taken into account when undertaking any works which clears vegetation in these areas.

iii) Biodiversity Values

Pitt Town Lagoon, the reed beds and Bardenarang Gully are mapped as 'Biodiversity Value' on the DPE Biodiversity Values Map (Figure 141). This would need to be addressed in any assessment of drainage works through these areas

iv) Threatened Species

Fork-tailed Swift, Freckled Duck and White-bellied Sea-Eagle have all been observed in Pitt Town Lagoon, downstream of IA5S (Figure 142). However, the area has very limited habitat for these species, being predominantly farmland. There have been no threatened species recorded in the vicinity of the recommended works and none were observed during the inspection.

v) Key Fish Habitat

The only Key Fish Habitat near the investigation area is Hawkesbury River (Figure 143).







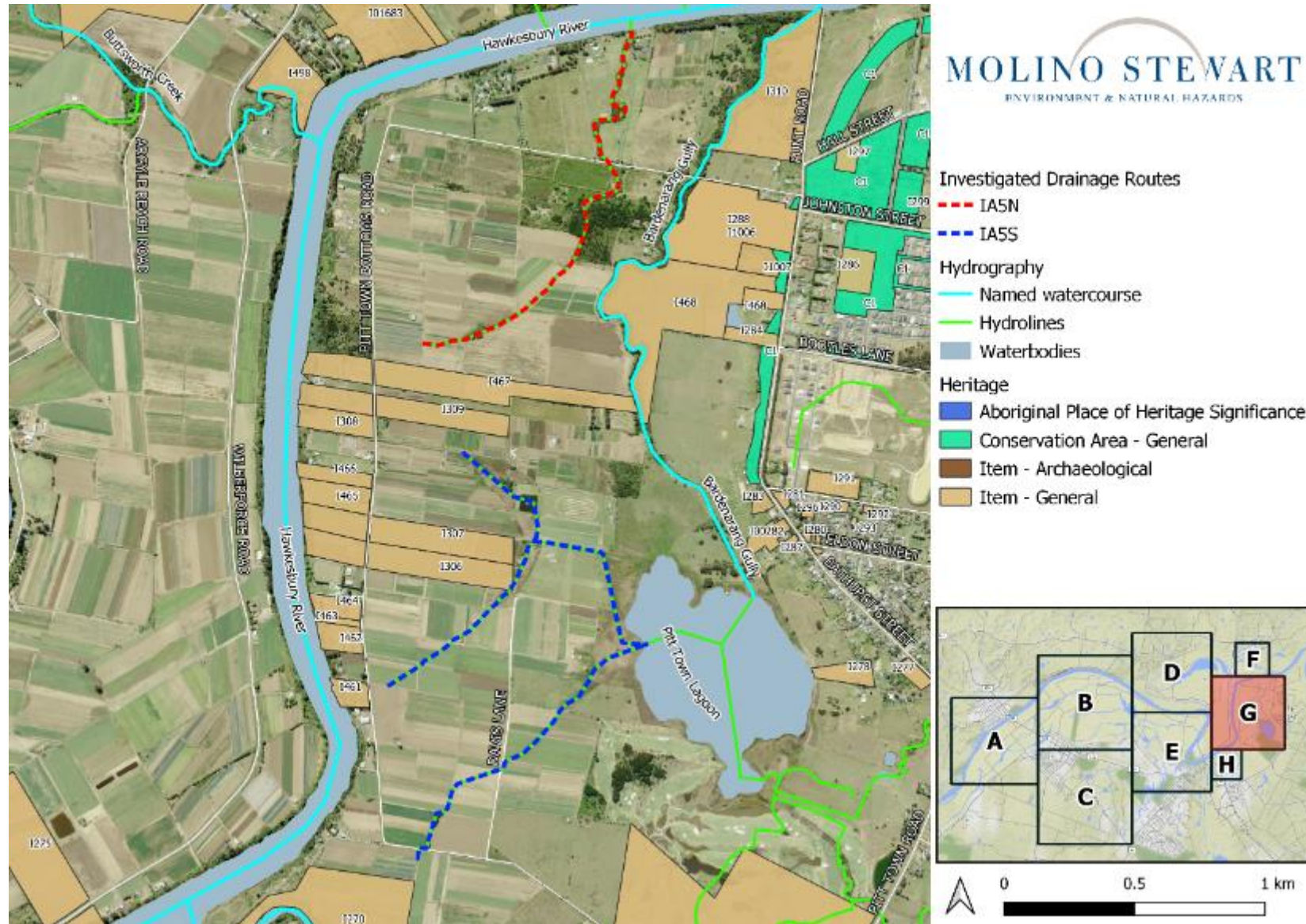


Figure 136: HLEP Heritage Places, Areas and Items (Extent G)

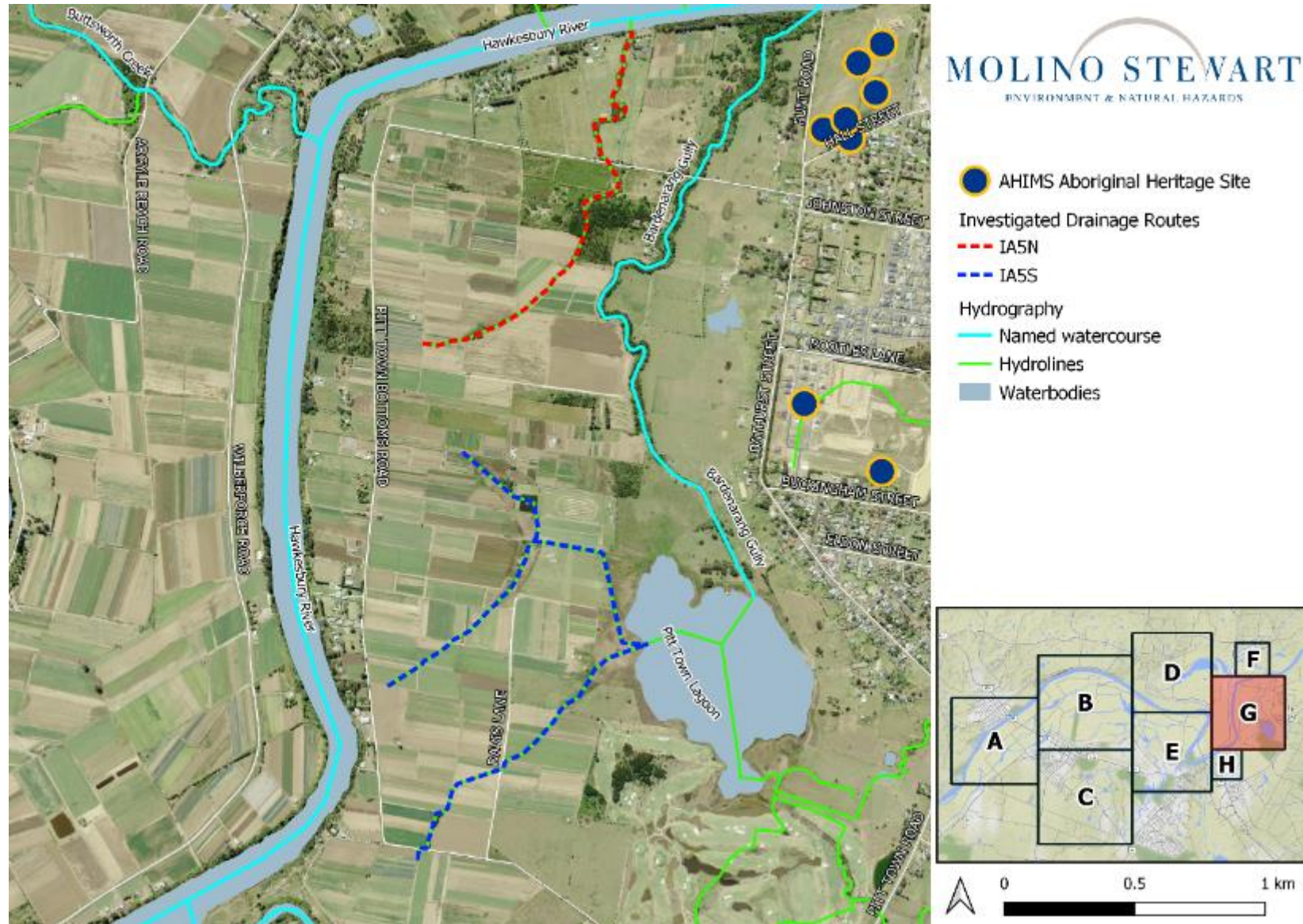


Figure 137: AHIMS Aboriginal Sites (Extent G)

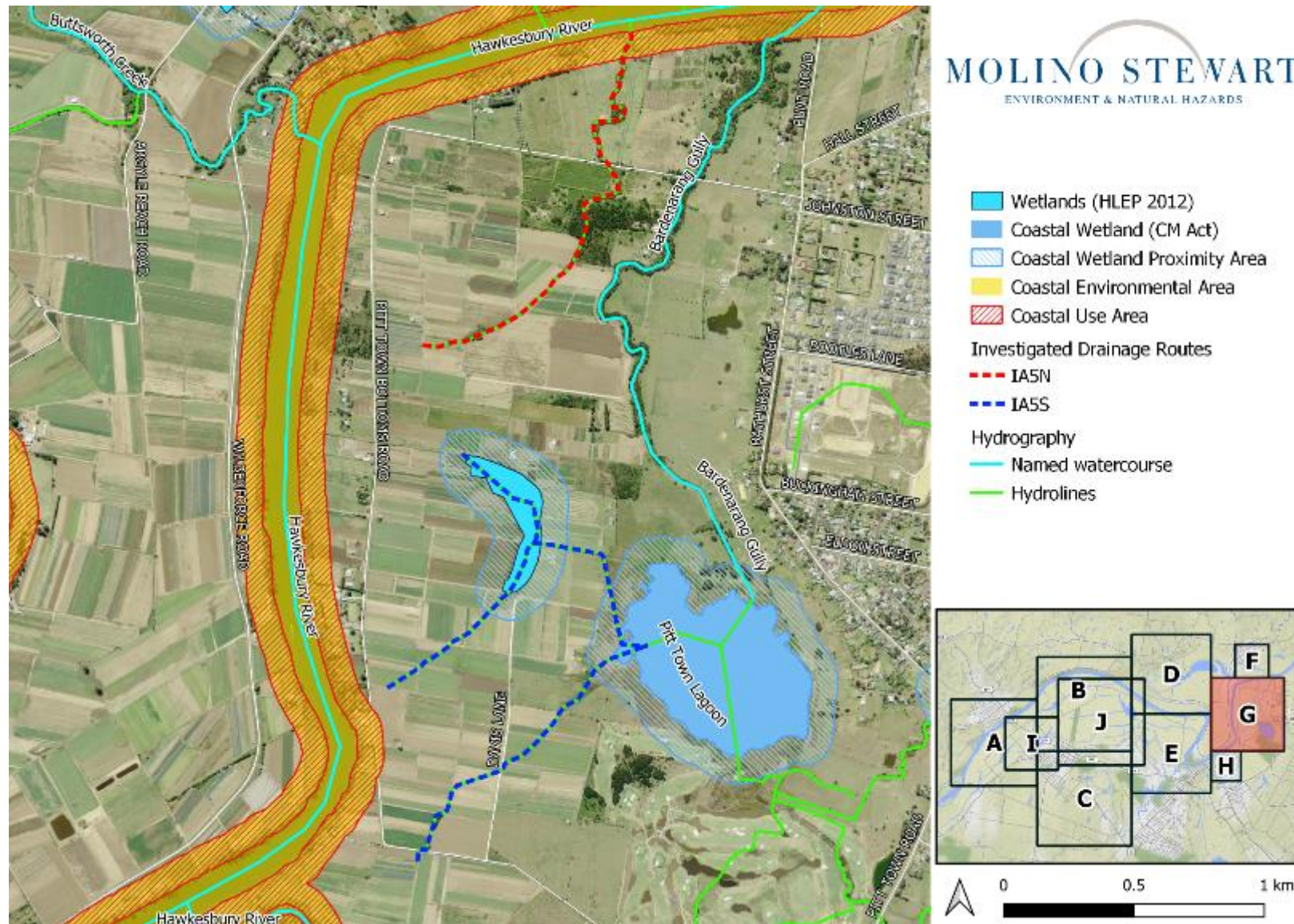


Figure 138: Wetlands and Coastal Management Areas (Extent G)

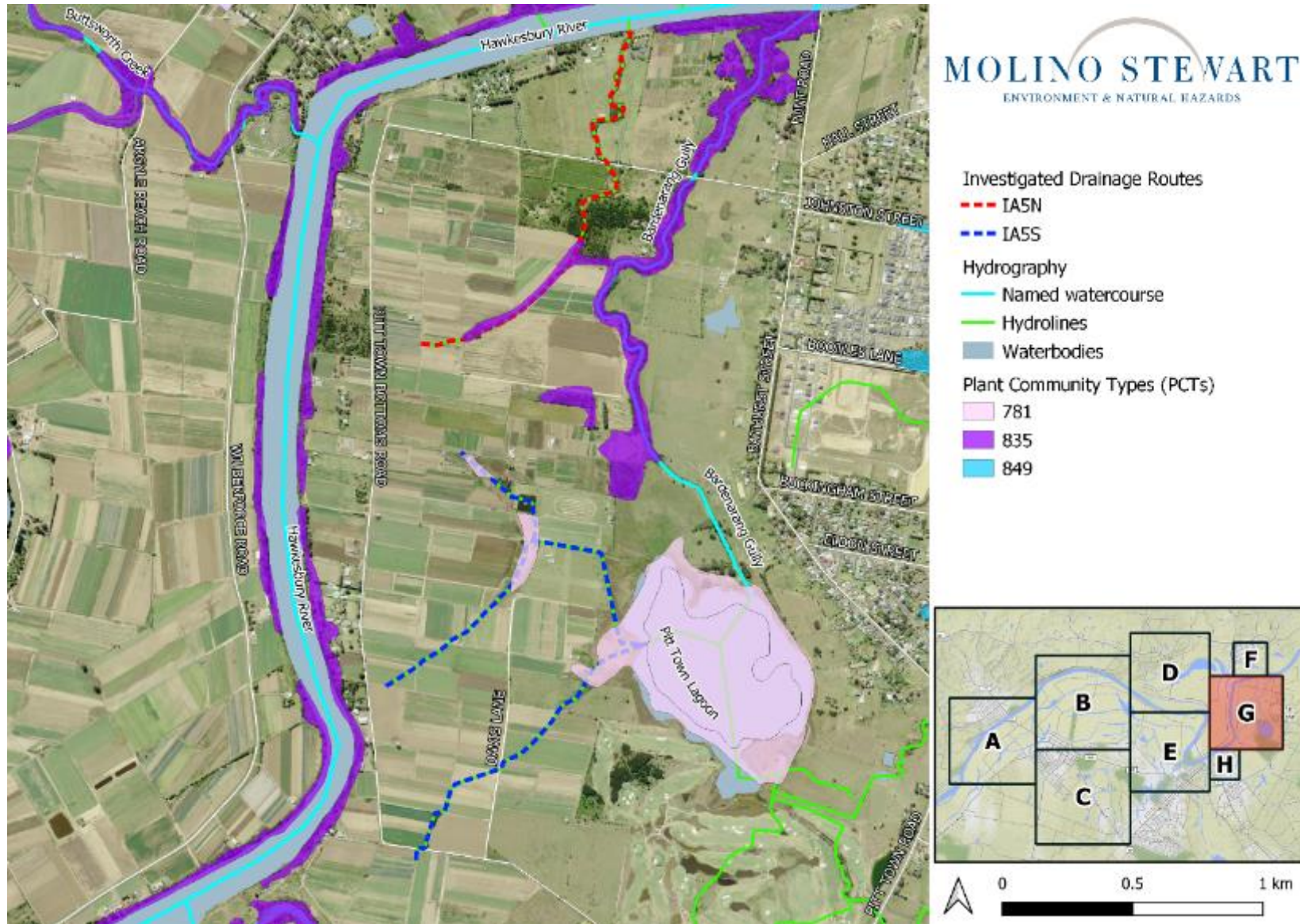


Figure 139: Plant Community Types (Extent G)

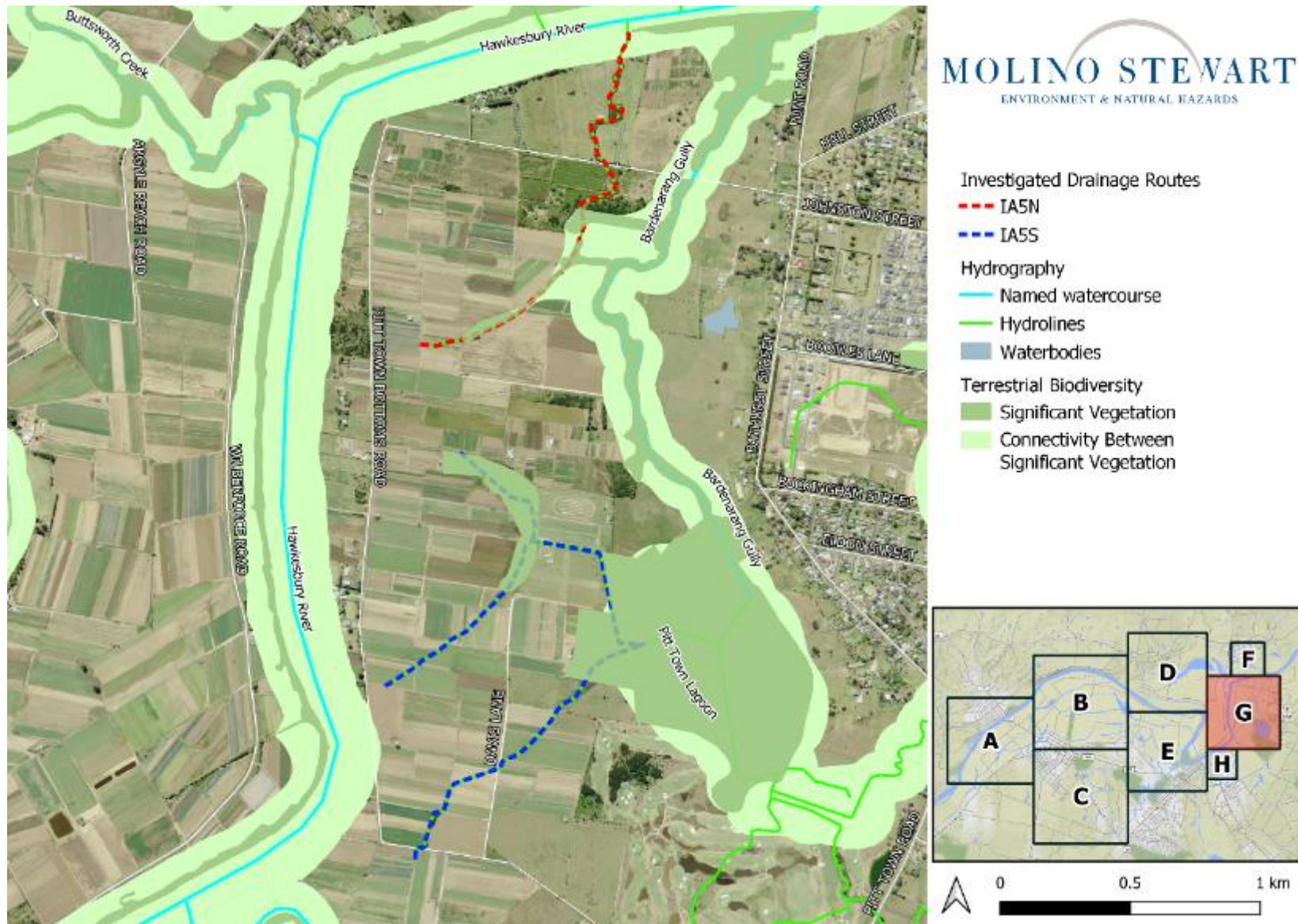


Figure 140: Terrestrial Biodiversity (Extent G)

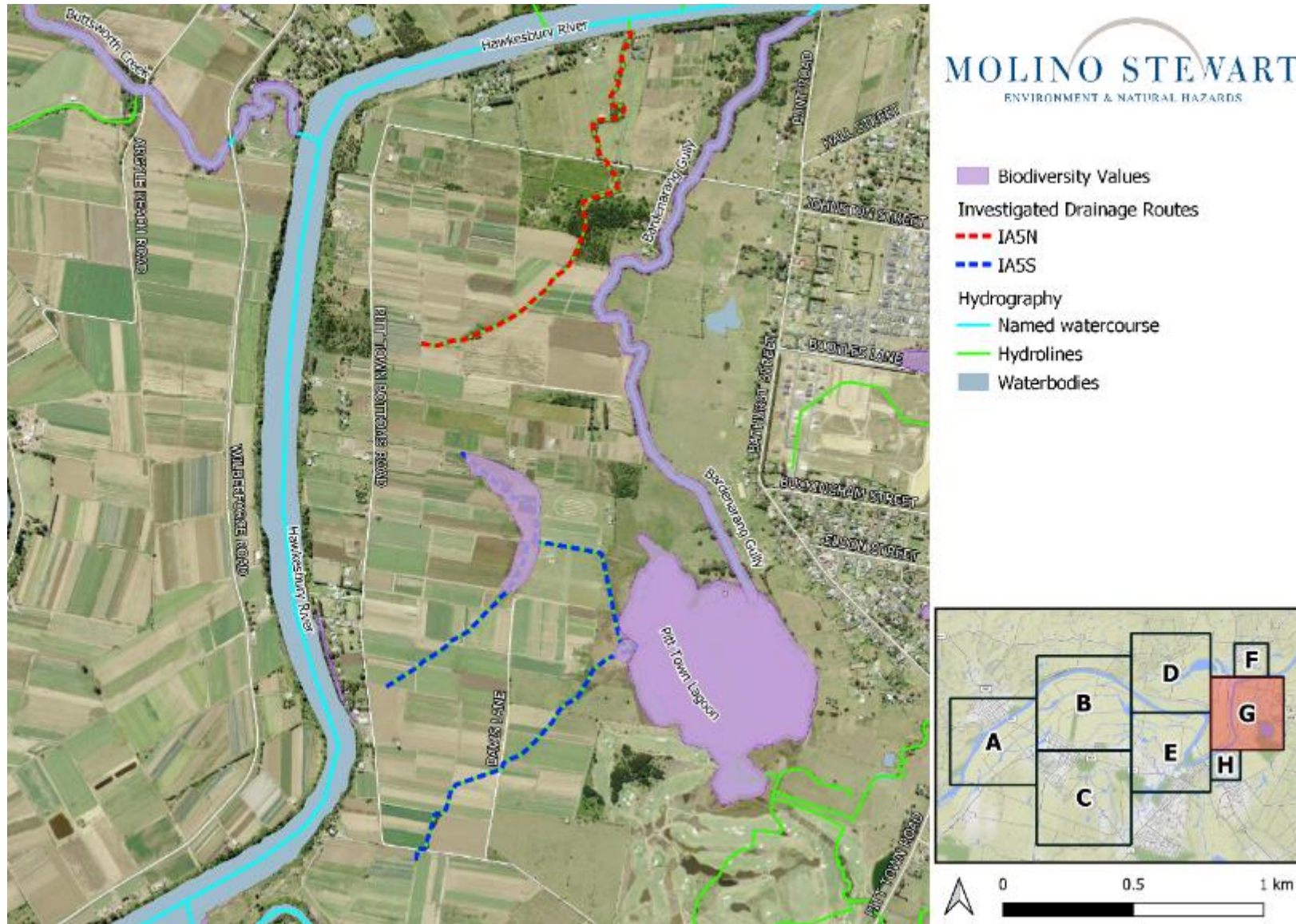


Figure 141: Biodiversity Values (Extent G)

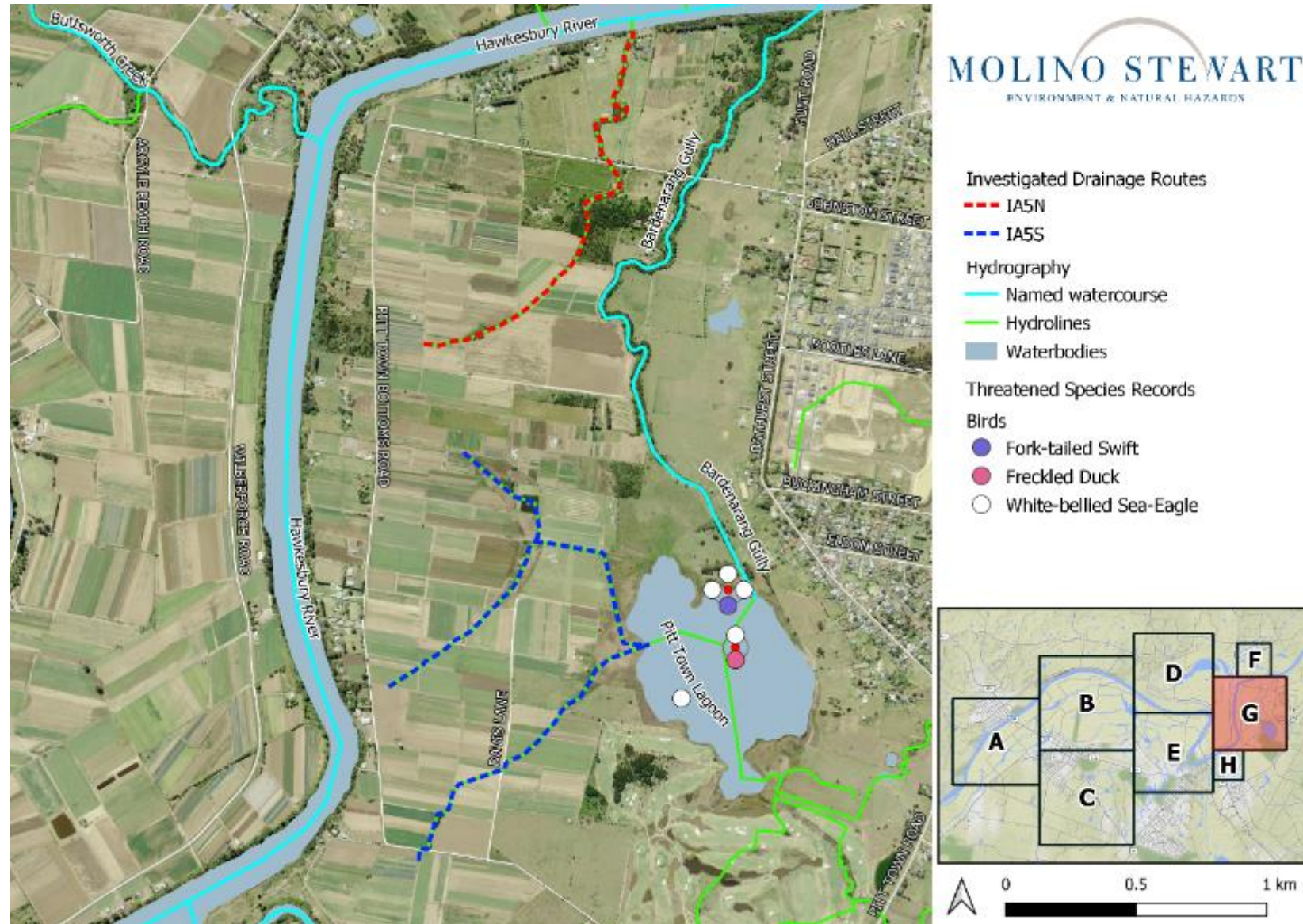


Figure 142: Threatened Species Records (Extent G)

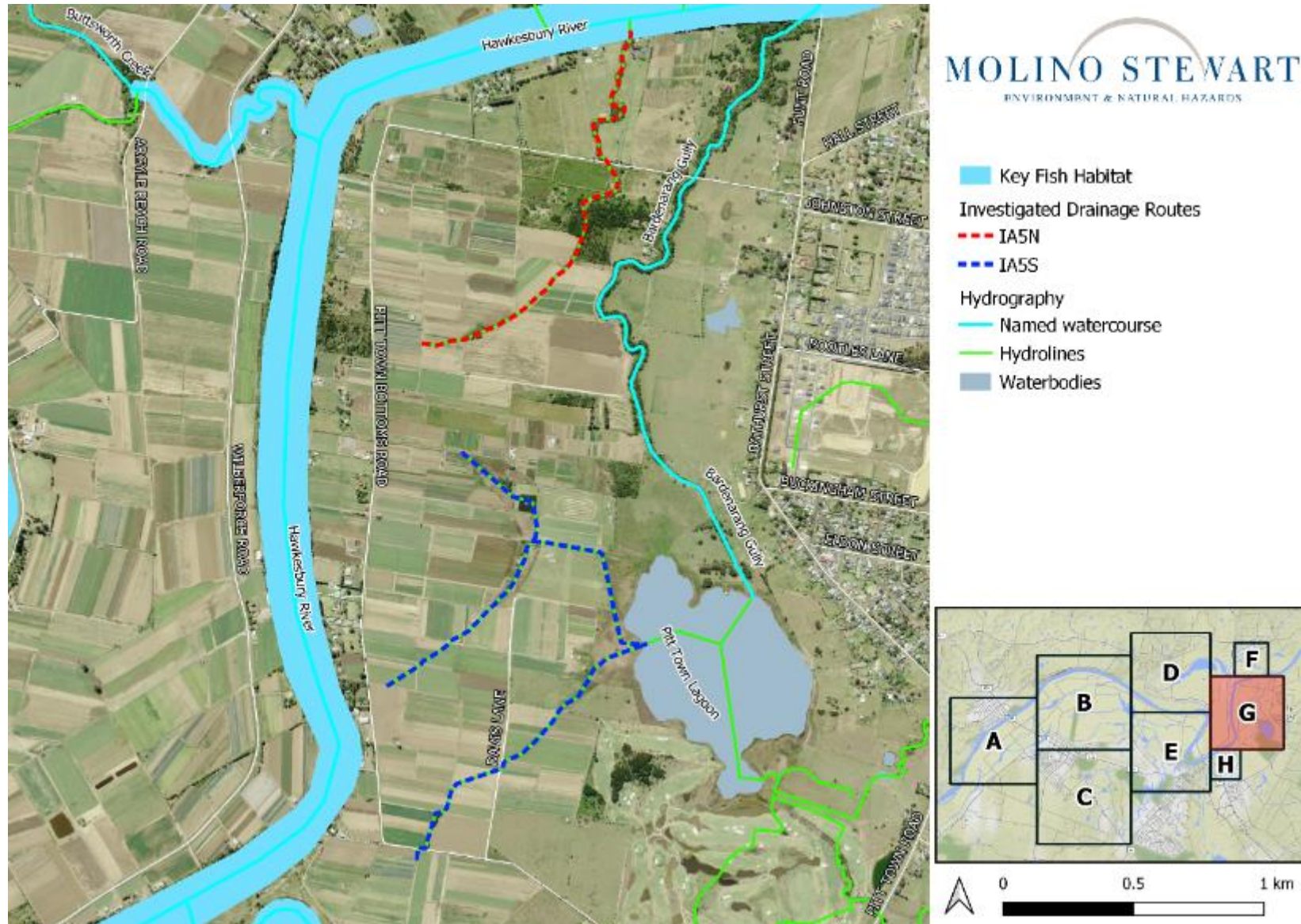


Figure 143: Key Fish Habitat (Extent G)

15 | Investigation Area 6

15.1 Drainage Issues

Area 6 is a small network of drains between the southern bank of The Hawkesbury River and the northern bank of South Creek and discharges into South Creek at two points (Figure 144). The locations of each photograph referred to in the text can be found in Figure 145.

15.1.1 Field observations

The topographic maps show a drain running along the northern side of Pitt Street and flowing east into South Creek. Field observations showed that this drain does not exist. Rather, there are two drains which drain the western and eastern ends of Pitt Street and converge before entering South Creek. There is also an overflow channel from the western drain which would appear to provide a second drainage path into South Creek when the water levels are high on the floodplain.

At the western end of Pitt Street there is a drain running south from the road (Photo 403) before turning sharply east (Photo 404). The corner of the paddock is at about the same level as the invert of the drain at this point and does not drain efficiently (Photo 405). There is a parallel drain in the paddock but the water was standing in it and now draining discernibly (Photo 406 and Photo 407). The drain again turns south but is very shallow and barely flowing and the surrounding paddocks are saturated.

Further downstream there is a crossing where no pipe under the crossing could be observed (Photo 408). The channel adjacent to the crossing (Photo 408) and immediately upstream of that (Photo 409) was very badly silted. It is possible that if there is a pipe under the crossing it is mostly silted up.

Downstream of the crossing the channel is choked with reeds (Photo 410 and Photo 411). The channel becomes progressively deeper but is remains very silted up and the next pipe under a crossing appears to be mostly blocked with silt (Photo 412). Downstream of here the channel is choked with reeds and water is ponding (Photo 413). It is more difficult to see the bottom of the channel further downstream as it becomes deeper and the banks become more heavily weed infested but there is standing water in the channel (Photo 414). The channel passes through the natural levee bank on South Creek through a flood gated culvert (Photo 415).

The flood gate is badly damaged. It is rusted across the bottom (Photo 416) so would no longer seal the culvert when flood waters are rising and therefore water would leak into the areas behind the levee. There has been significant bank collapse around the culvert head wall (Photo 415 and Photo 417) and the headwall itself is at a point of imminent collapse. It was assessed to be too hazardous to climb down to the floodgate but it is quite possible that the floodgate has rusted shut and therefore has significantly slowed the draining of the paddocks behind the levee.

At the eastern end of Pitt Street there is an embankment along its northern side (Photo 418) which does not appear to have a clear purpose. There is a pipe through the embankment (Photo 419) which allows the paddocks to drain but the pipe for conveying this outflow under Pitt Street is considerably smaller so it is likely that most of the drainage would flow across the road surface.

The pipe under the road discharges into a small drainage channel (Photo 420) which peters out to have no depth (Photo 421) and its invert is higher than the adjoining paddock. Immediately downstream of this is another low lying portion of paddock with standing water (Photo 422). There is no discernible channel from this point about 120m south (Photo 423) where a pipe passes under and access road (Photo 424).



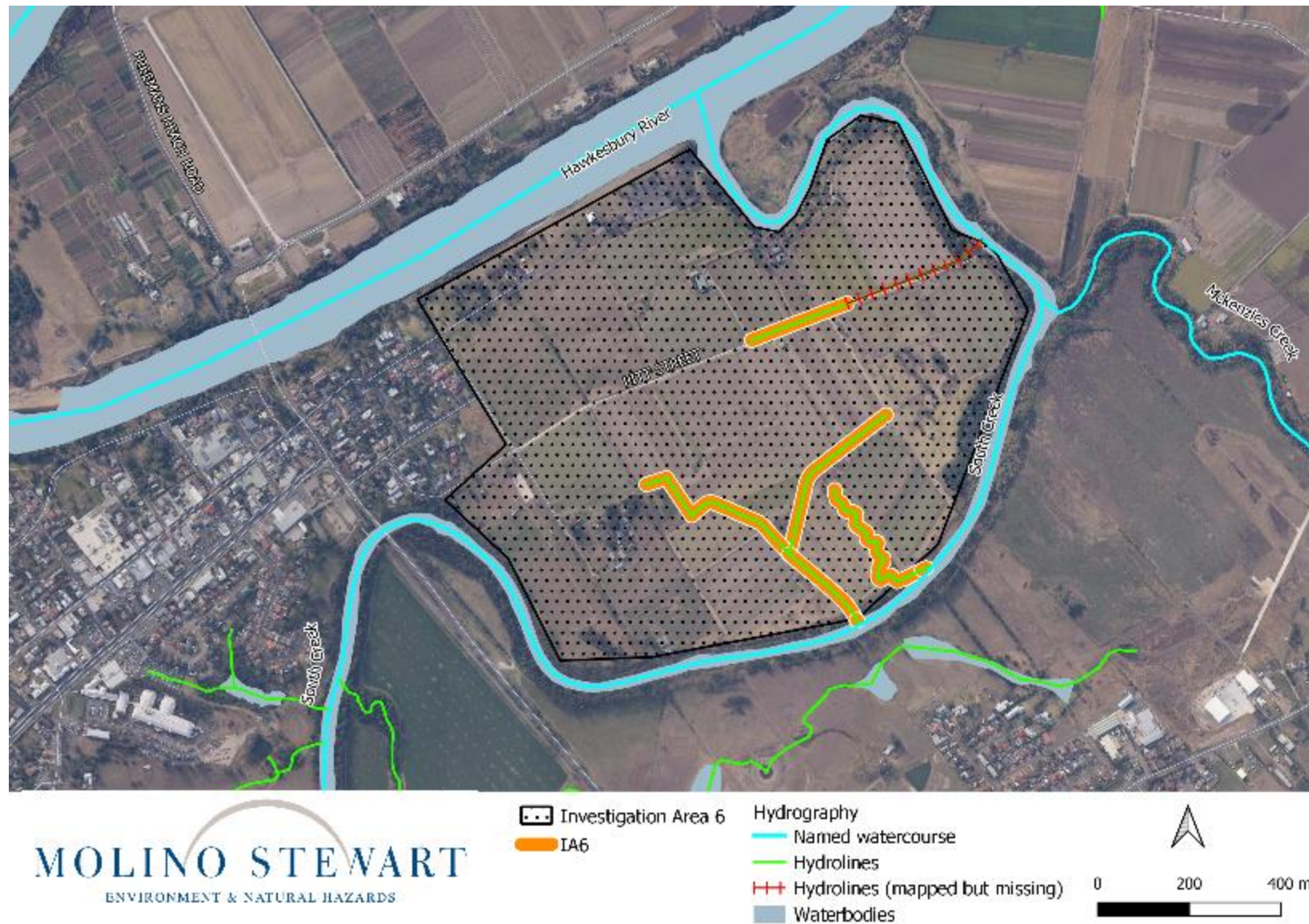


Figure 144: Investigation Area 6 Drainage Route (IA6)

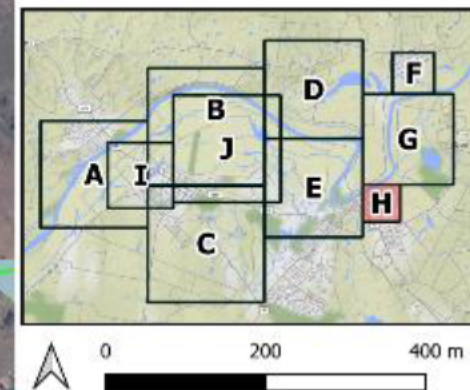


Figure 145: Photo locations for IA6



Photo 403



Photo 404



Photo 405



Photo 406



Photo 407



Photo 408



Photo 409



Photo 410



Photo 411



Photo 412



Photo 413



Photo 414



Photo 415



Photo 416



Photo 417



Photo 418



Photo 419



Photo 420



Photo 421



Photo 422



Photo 423



Photo 424

Downstream of the road the channel is clearly defined and relatively with but was almost full (Photo 425) down to the next crossing where the water level was almost to the obvert of the pipe under the road. Downstream of this point the channel is choked with reeds (Photo 426) almost to the point where it joins the other channel from the west (Photo 427).

About 50m to the south of this reach of channel there is what appears to be an overflow channel excavated through the levee (Photo 428). It has a concrete apron at its northern end (Photo 429) and is grass lined and sinuous (Photo 430). It ends at a saddle in the levee (Photo 431)



Photo 425



Photo 426



Photo 429



Photo 430



Photo 428



Photo 427



Photo 431

15.1.2 Probable causes

There is considerable ponding with poor drainage at the upper ends of both subcatchments where the ground is flat and at a similar elevation to the invert of the drains. It is possible that in these locations the stripping of turf over decades (one of the farmers said he had been working on the turf farm since the late 1970s) has lowered the ground level to a point where it has insufficient elevation above the adjacent drain to drain into it.

However, in both locations the shallow drains are draining into deeper drains with standing water in them suggesting they are blocked further downstream.

The bank slumping around the flood gate has been caused by the same process observed throughout the floodplain. Steep banks of unconsolidated sediments become saturated during prolonged flooding and then cannot dissipate the pore water pressure quickly enough as the river level drops, resulting in material which slumps under its own weight and that of the water it holds.

The deteriorated condition of the flood gate is due to lack of maintenance.

15.1.3 Possible solutions

The flood gate needs to be replaced otherwise it will let floodwaters in as the flood rises and inhibit drainage behind the levee as the floodwaters drop. This should be undertaken in conjunction with repair and stabilisation of the levee. If this is not done then it is possible that there could be a breach of the levee as occurred at Cornwallis in 2021 and the size of the repair will become much greater.

Cleaning sediment and reeds from the drains may improve drainage from the paddocks upstream but the longer term solution for those paddocks may be to regrade them and possibly lift them with imported material.

Possible Solutions for IA6 are shown in Figure 146.

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ENVIRONMENT & NATURAL HAZARDS



- Solutions for IA6
- ◆ Regrade paddocks
 - ◆ Repair or replace flood gates
 - Clear channel
- Investigated Drainage Routes
- - - IA6
- Hydrography
- Named watercourse
 - Hydrolines
 - ++ Hydrolines (mapped but missing)
 - Waterbodies

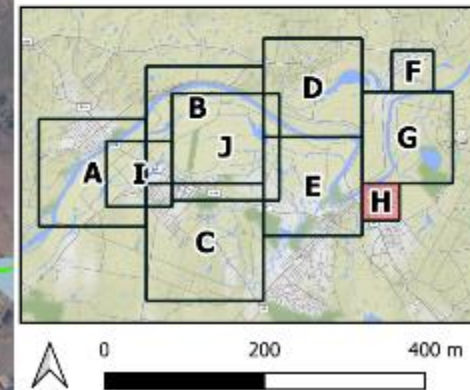


Figure 146: Solutions for IA6

15.2 Environmental Constraints

a) Zoning

The drainage network in Investigation Area 6 traverses land zoned as RU2 – Rural Landscape (Figure 147).

Maintenance of existing drainage channels is permitted without consent for zone RU2, while reinstating or rectifying drainage lines requires development consent. Therefore, clearing the drainage channel and repairing or replacing the existing flood gate is permissible without consent. Regrading the paddocks on the other hand would be considered reinstating and rectifying a drainage line and would therefore be subject to development approval.

b) Contamination

Notified contaminated sites on or near the Hawkesbury Floodplain are shown in Figure 4.

There are no contaminated sites within the vicinity of the Investigation Area 6 drainage network.

c) Acid Sulphate Soils

The Investigation Area 6 drainage network is principally Class 4 land on the Acid Sulphate Soils Map (Figure 148). According to HLEP 2012 Part 6.1, development consent in Class 4 land is required for works more than 2m below the natural ground surface or are likely to lower the watertable by more than 2m below the natural ground surface. Any of the suggested works are unlikely to do that.

A strip of land along the banks of South Creek is mapped as Class 1 land. Before works are undertaken to repair the bank around the flood gate, soil testing should be undertaken to determine whether ASS is likely to be disturbed.

d) Heritage

i) HLEP Heritage Items

IA6 does not traverse any heritage items, although General Heritage Item I00028 is in close proximity (Figure 149). The details of this heritage item are shown in Table 10 (HLEP 2012 Schedule 5).

Table 10: HLEP Heritage Items (IA6)

Item Number	Item Name	Address	Significance
I00028	“Peninsula House” and observatory	51 Palmer Street, Windsor	State

ii) AHIMS Heritage Items

An AHIMS Basic Search of constraints extent H returned no Aboriginal Sites near IA6 (Figure 150). However, the exact location and nature of Aboriginal sites is not known from a Basic Search. Therefore, for any works on IA6, a Basic Search of the specific works extent should be conducted to confirm whether any Aboriginal Sites are nearby. If an initial basic search returns any Aboriginal Sites, an AHIMS Extensive Search is required.

e) Wetlands and Coastal Areas

The lower reaches of the separate drainage routes of IA6 all intersect the coastal environmental and coastal use areas (Figure 151). Any proposed works undertaken within the coastal environment area and the coastal use area must follow the provisions set out in sections 2.10 and 2.11 of the R&H SEPP respectively, as outlined in section 3.6.

There are no wetlands identified on the HLEP Wetlands Map along the Investigation Area 6 drainage network.

f) Ecology

i) *PCT Mapping*

PCT 835 is the only PCT mapped along the IA6 Drainage Network (Figure 152). It is mapped for the two outlets of the drainage channels into South Creek and extending back along the channels approximately 50 m. This needs to be considered in any bank repair and rehabilitation works around the flood gates as this PCT is a threatened ecological community under both the BC Act and the EPBC Act.

ii) *Terrestrial Biodiversity*

Figure 153 shows that only the part where IA6 connects with South Creek are mapped as 'Significant vegetation' or 'Connectivity between significant vegetation'.

iii) *Biodiversity Values*

None of IA6 is mapped as 'Biodiversity Value' on the DPE Biodiversity Values Map (Figure 154).

iv) *Threatened Species Records*

No threatened species have been observed in close proximity to IA6 (Figure 155).

Swift parrot has been sighted along South Creek downstream of IA6, However, as the drainage route does not provide much in the way of suitable habitat it is unlikely to be a constraint to the works.

v) *Key Fish Habitat*

The Hawkesbury River and South Creek are mapped as Key Fish Habitat, but this does not extend up to any sections of IA6 (Figure 156).



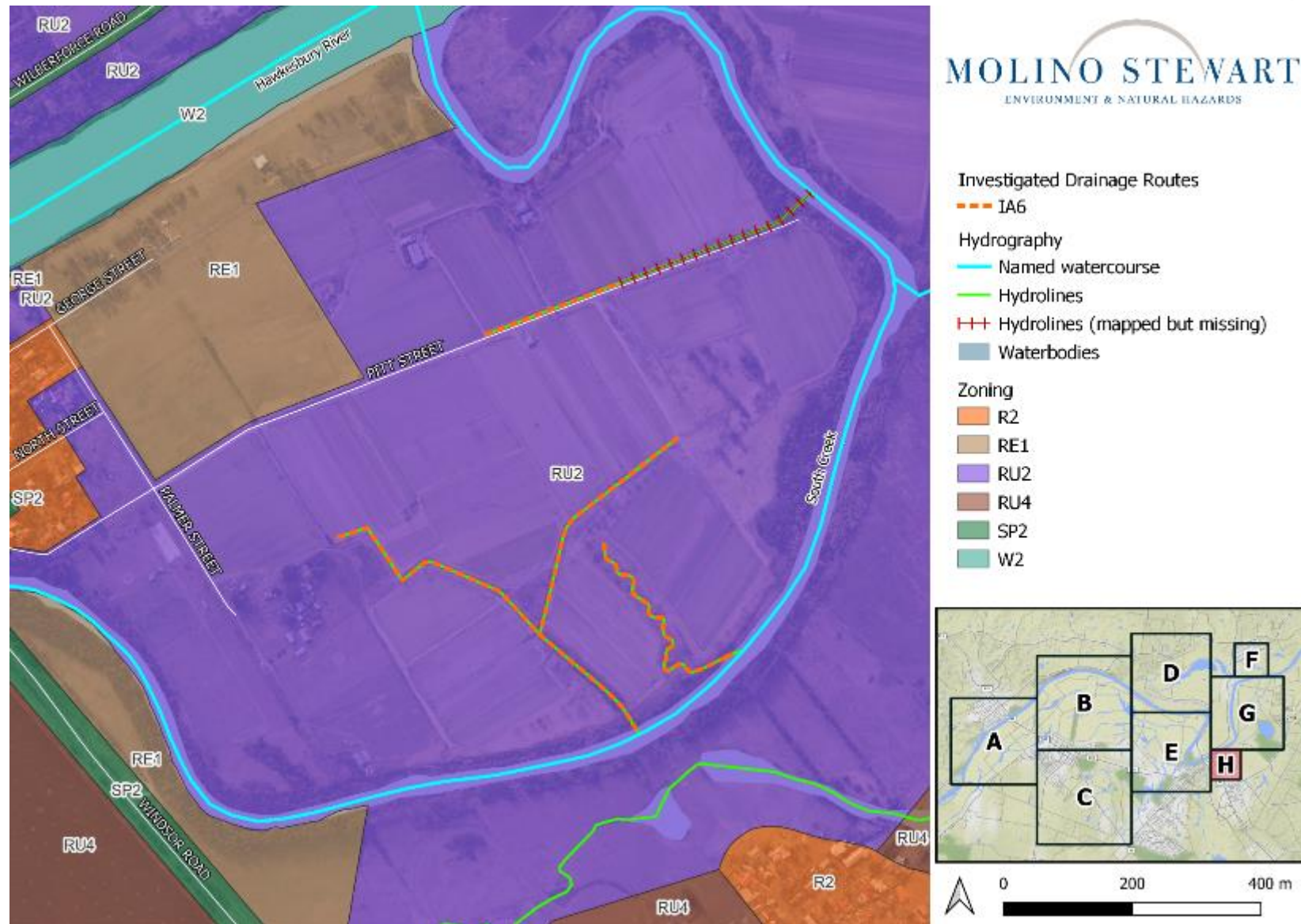


Figure 147: Zoning (Extent H)

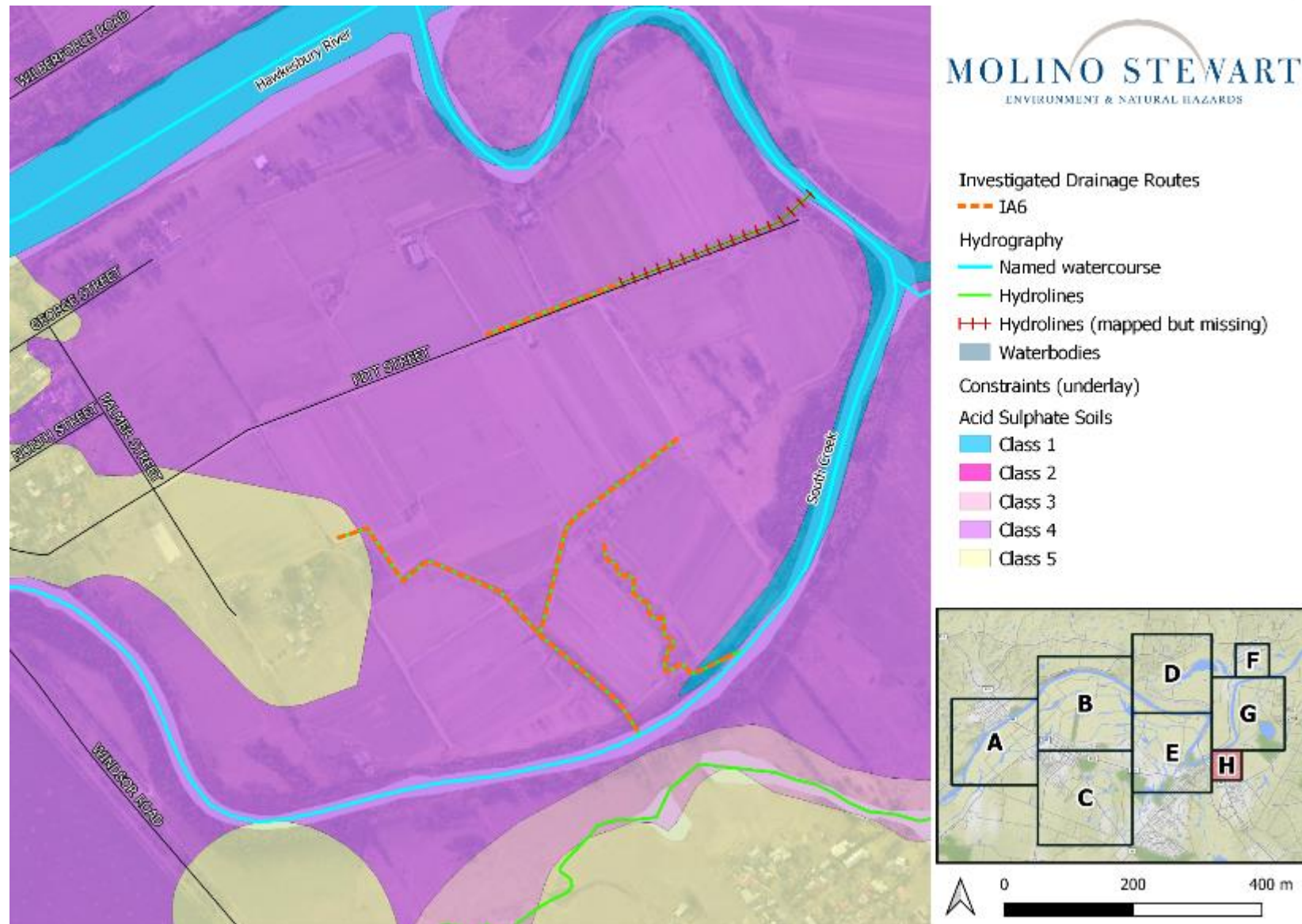


Figure 148: Acid Sulphate Soils (Extent H)

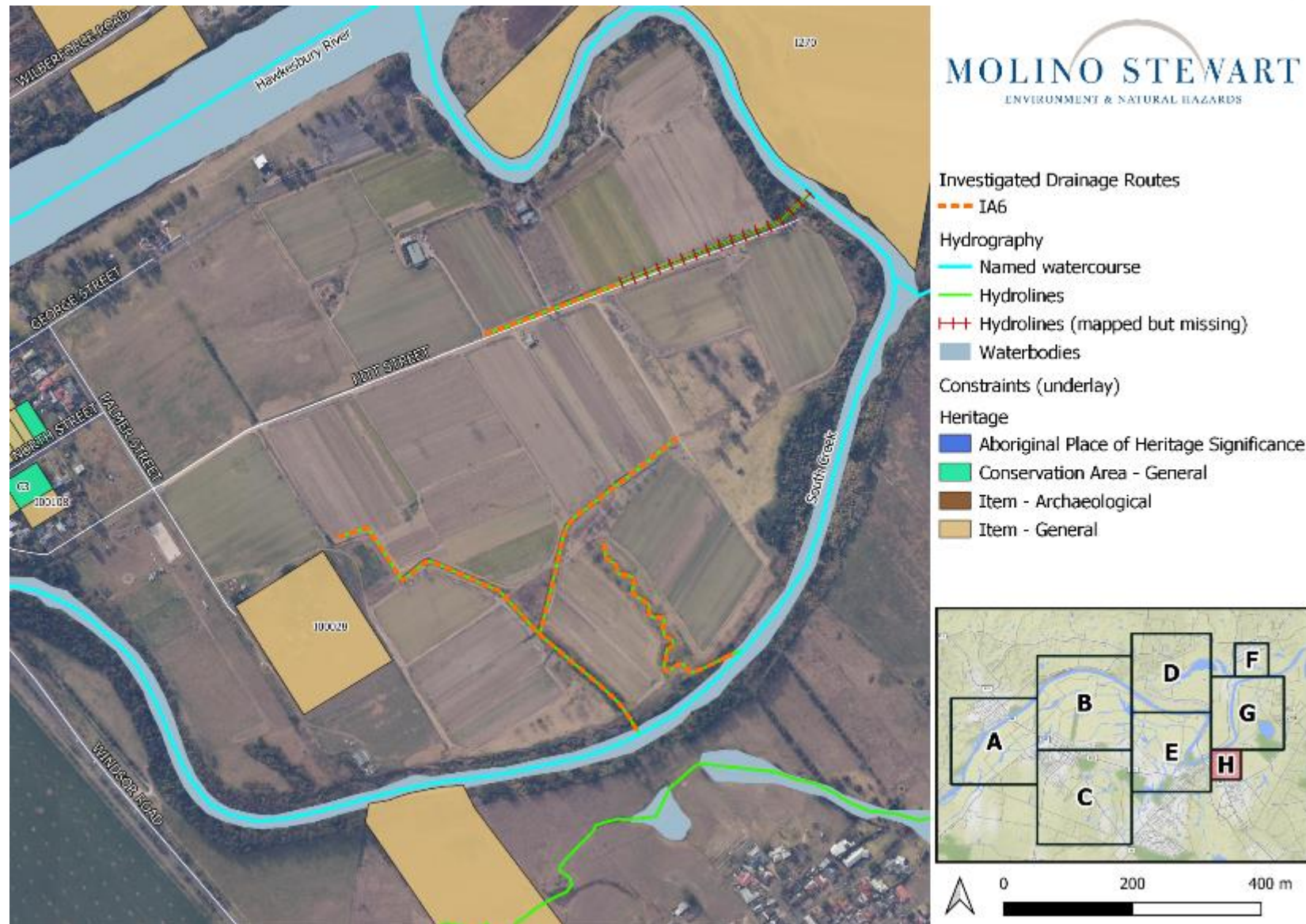


Figure 149: HLEP Heritage Places, Areas and Items (Extent H)



- AHIMS Aboriginal Heritage Site
- Investigated Drainage Routes
- IA6
- Hydrography
- Named watercourse
- Hydrolines
- Hydrolines (mapped but missing)
- Waterbodies

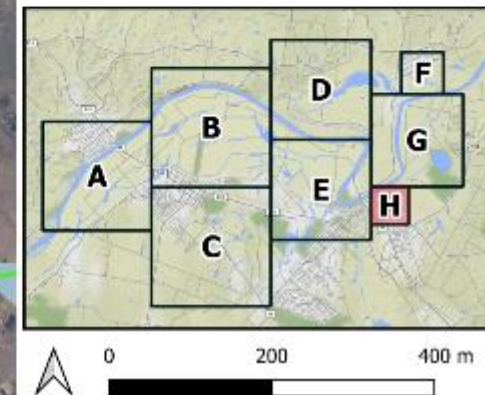


Figure 150: AHIMS Aboriginal Sites (Extent H)

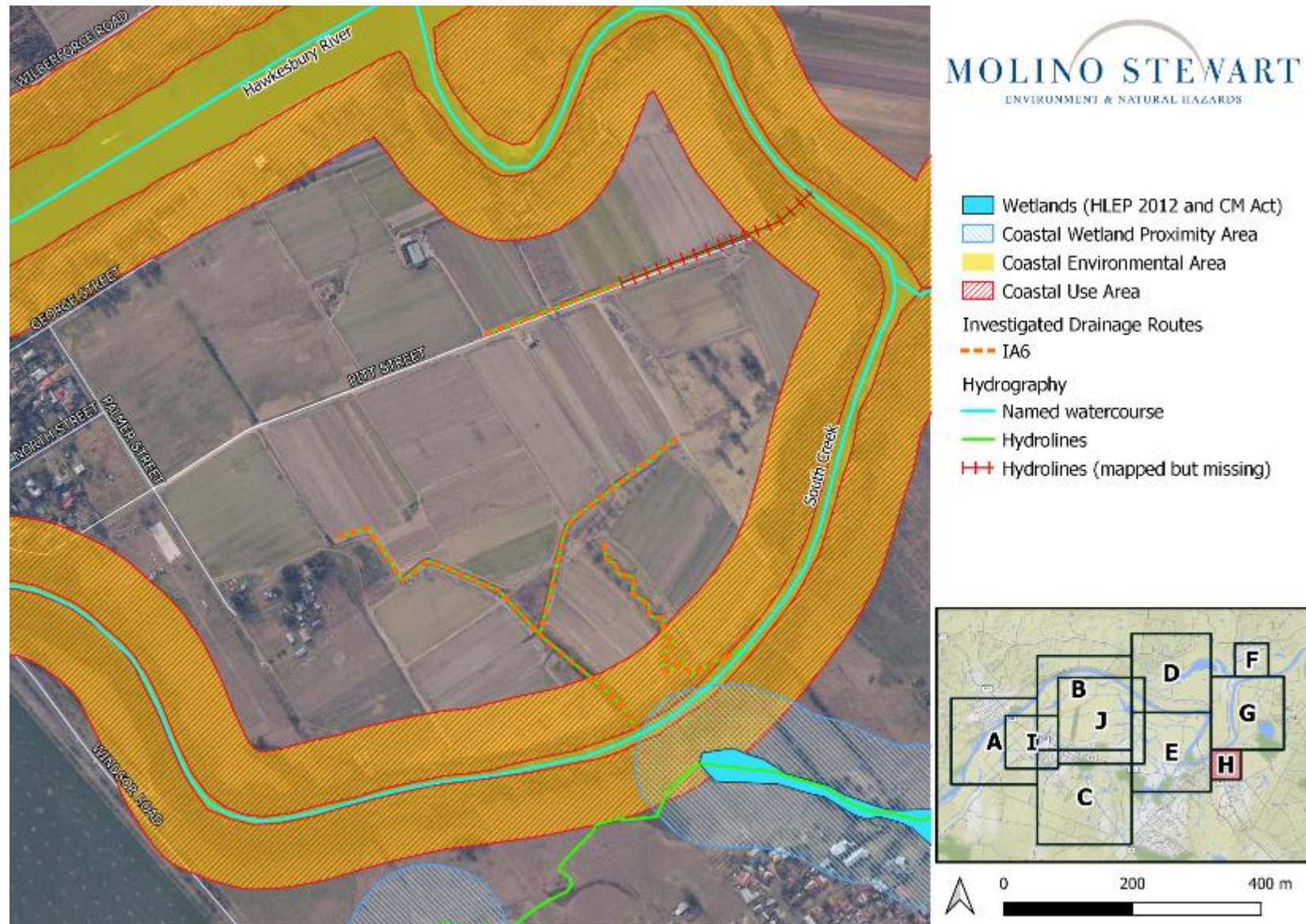


Figure 151: Wetlands and Coastal Management Areas (Extent H)

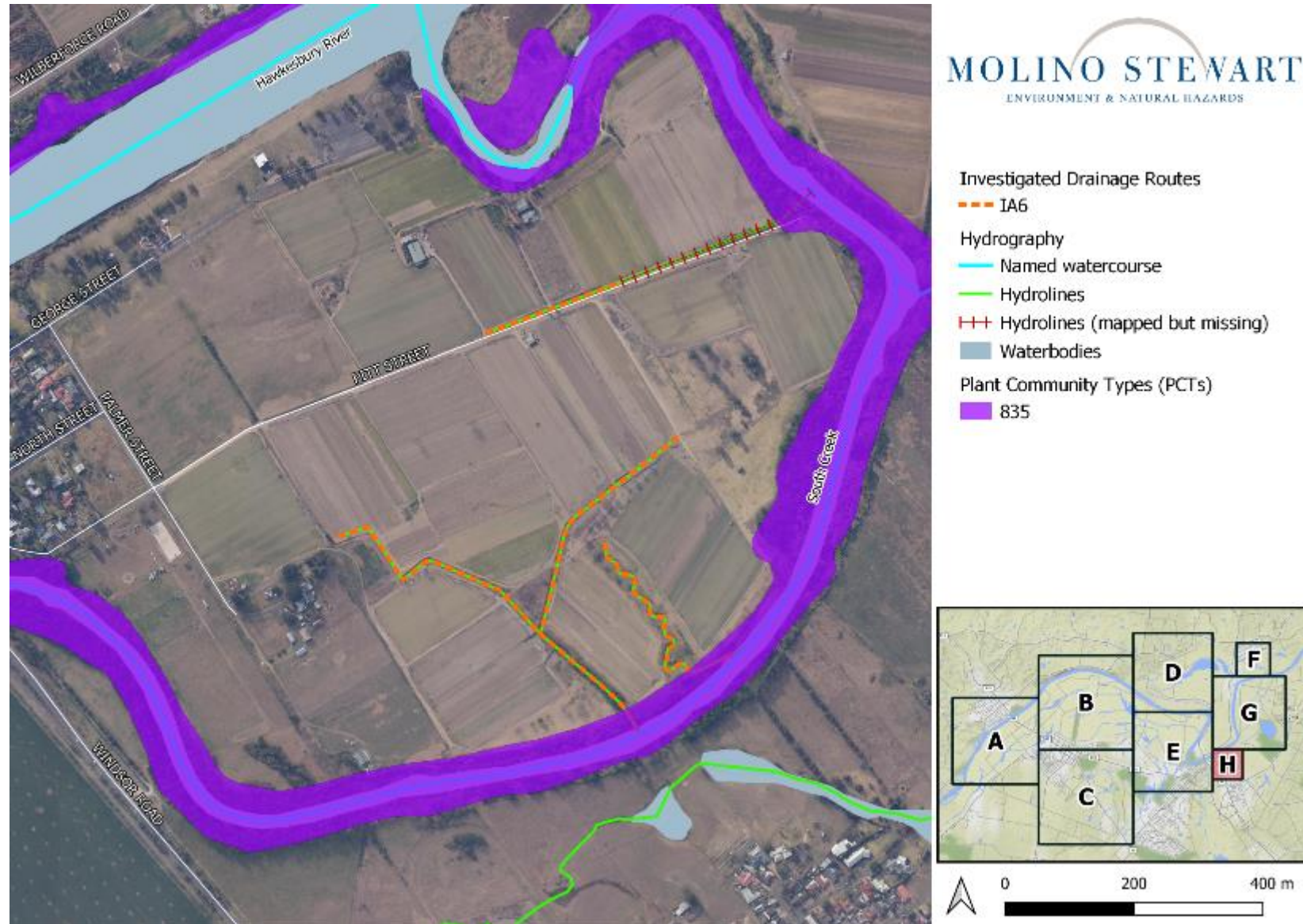


Figure 152: Plant Community Types (Extent H)

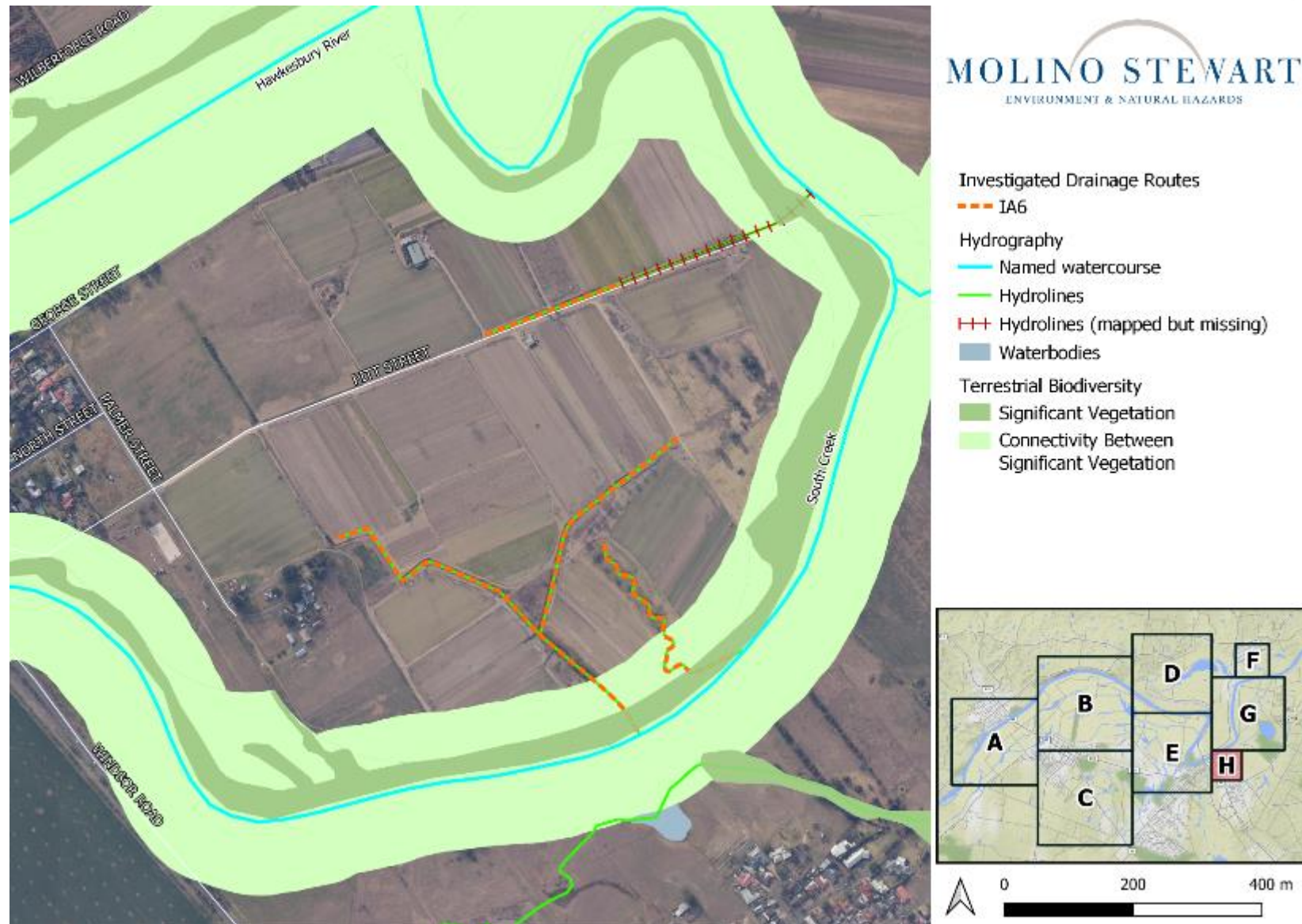


Figure 153: Terrestrial Biodiversity (Extent H)

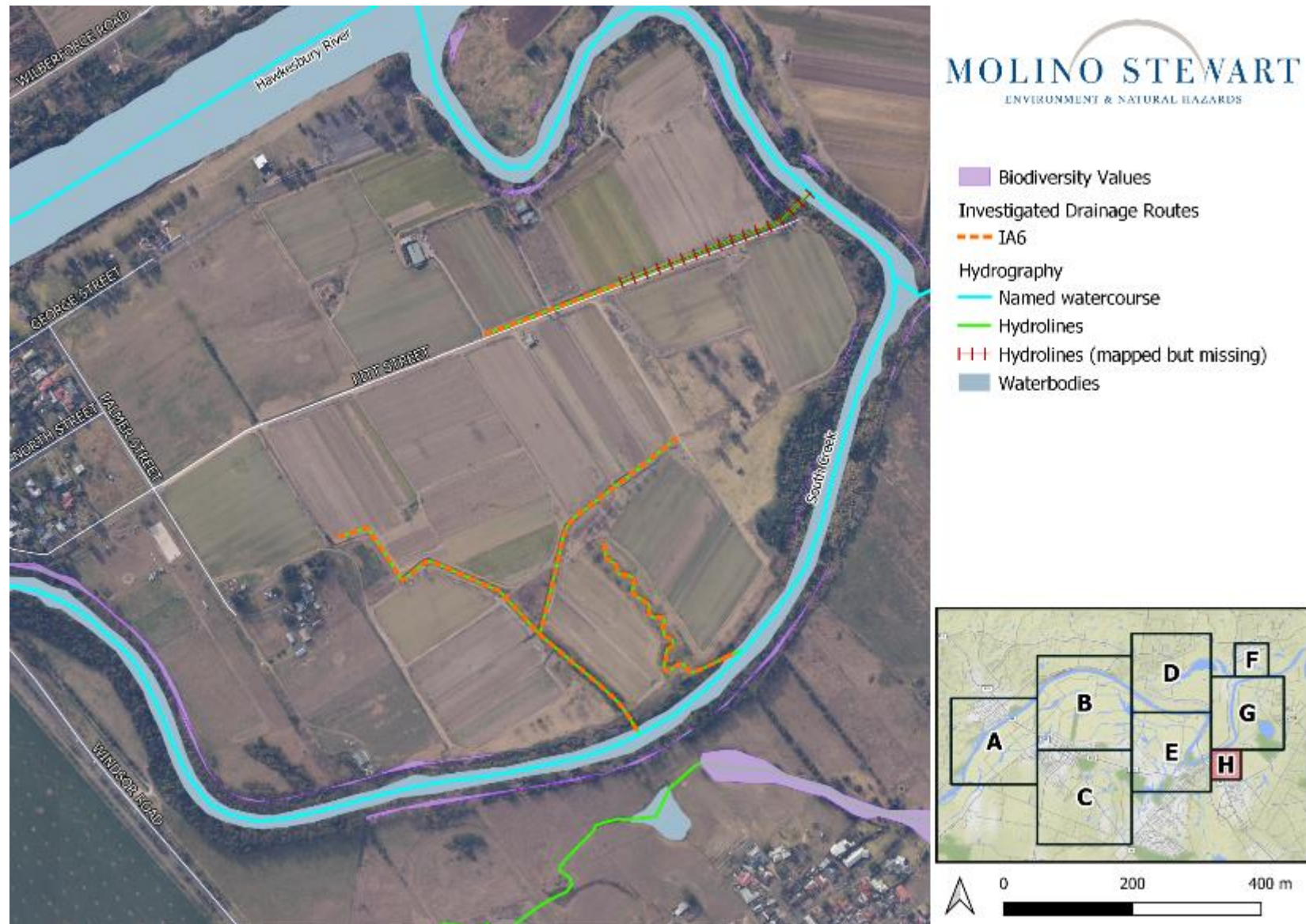


Figure 154: Biodiversity Values (Extent H)

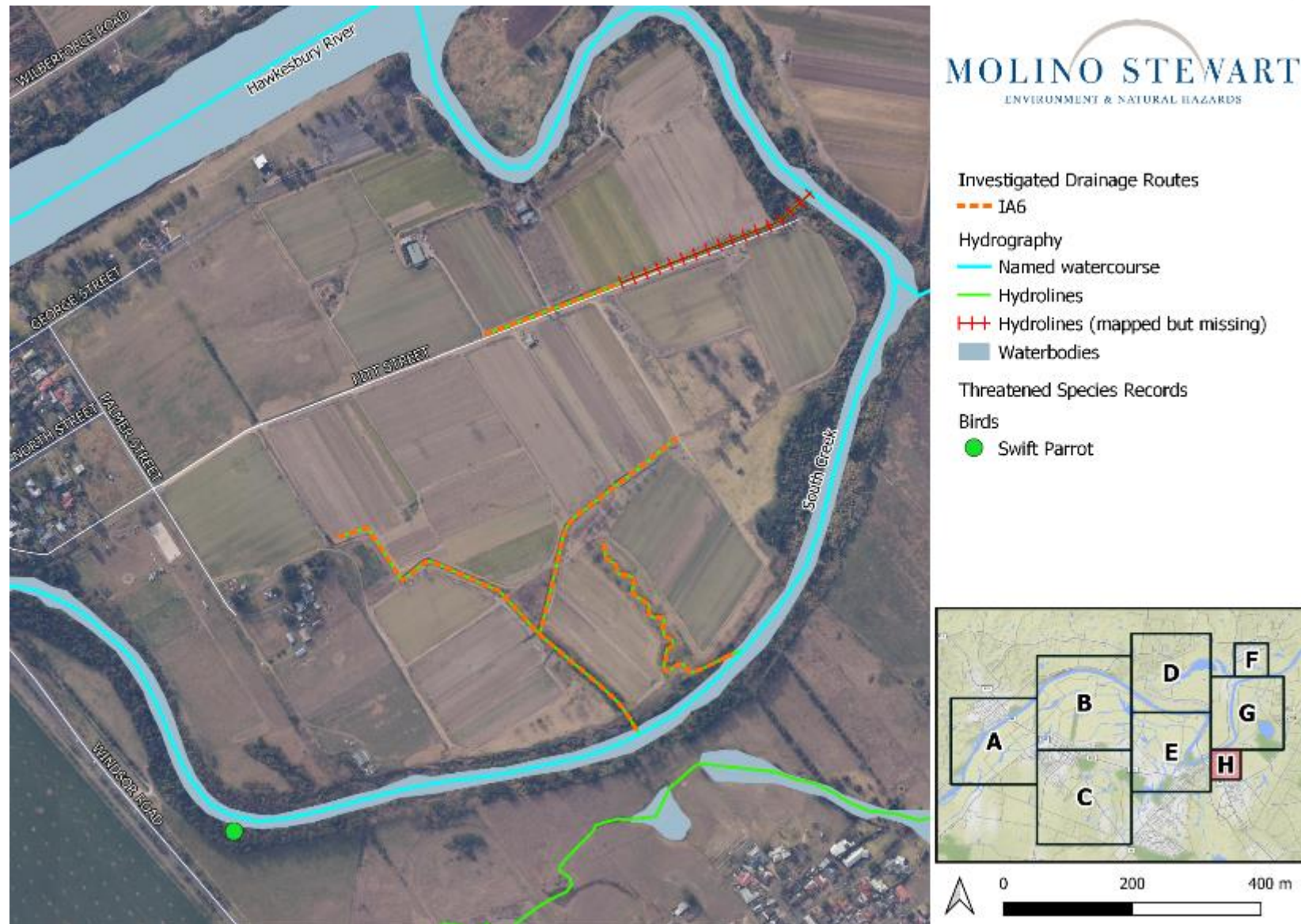


Figure 155: Threatened Species Records (Extent H)

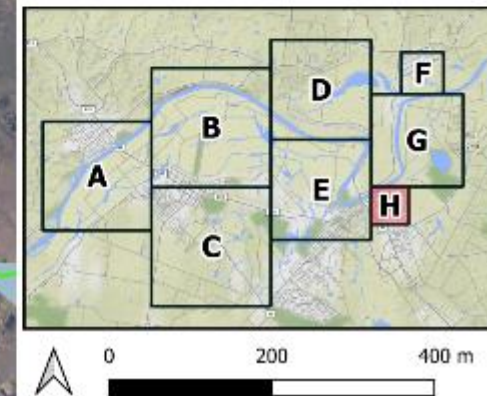


Figure 156: Key Fish Habitat (Extent H)

16 | Planning Approval Pathways

The planning approval pathway differs significantly depending on whether the nature of the works and whether they are to be completed by or on behalf of Council (a public authority), or whether they are completed by landowners. This section discusses the approval pathways generally for different types of works and what additional external licences, permits and approvals may be required to complete the works.

16.1 Environmental Planning & Assessment Act 1979 (EP&A Act)

The EP&A Act defines development as:

- 1) *For the purposes of this Act, development is any of the following—*
 - a. *the use of land,*
 - b. *the subdivision of land,*
 - c. *the erection of a building,*
 - d. *the carrying out of a work,*
 - e. *the demolition of a building or work,*
 - f. *any other act, matter or thing that may be controlled by an environmental planning instrument.*
- 2) *However, development does not include any act, matter or thing excluded by the regulations (either generally for the purposes of this Act or only for the purposes of specified provisions of this Act).*

Therefore, any works being undertaken will require development consent under Part 4 of EP&A Act unless a regulation, which includes planning instruments such as State Environmental Planning Policies (SEPP) and Local Environment Plans (LEP), excludes them from requiring consent.

Section 3.3(g) of the Hawkesbury LEP states that works cannot be considered exempt or complying development if it is within an ‘environmentally sensitive area’ which is defined as ‘*land identified in this or any other environmental planning instrument as being of high Aboriginal cultural significance or high biodiversity significance*’.

While there is no definition of ‘high biodiversity significance’, any areas which are mapped as ‘significant vegetation’, a PCT or as having biodiversity values would be considered to have high biodiversity significance. This applies to several areas where potential actions may need to be taken.

The works which are proposed are either normal agricultural practices, environmental protection works or are flood mitigation works. Agriculture activities are permissible without consent in agricultural zones, environmental protection works are permissible without consent in all zones and flood mitigation works are permissible with consent in most zones.



The HLEP includes the following definitions:

agriculture means any of the following—

- (aaa) agritourism,
- (a) aquaculture,
- (b) extensive agriculture,
- (c) intensive livestock agriculture,
- (d) intensive plant agriculture

‘Environmental protection works means works associated with the rehabilitation of land towards its natural state or any work to protect land from environmental degradation, and includes bush regeneration works, wetland protection works, erosion protection works, dune restoration works and the like, but does not include coastal protection works.’

‘Flood mitigation work means work designed and constructed for the express purpose of mitigating flood impacts. It involves changing the characteristics of flood behaviour to alter the level, location, volume, speed or timing of flood waters to mitigate flood impacts. Types of works may include excavation, construction or enlargement of any fill, wall, or levee that will alter riverine flood behaviour, local overland flooding, or tidal action so as to mitigate flood impacts.’

This means that:

- anything which fits the definition of agriculture will be permissible without consent in the rural zoned land
- any environmental protection works will be permissible without consent in any land
- flood mitigation works will be permissible with consent

There is another planning instrument which needs to be considered. In accordance with the Transport and Infrastructure SEPP (2021) Division 7, Clause 50, ‘*development for the purpose of flood mitigation work may be carried out by or on behalf of a public authority without consent on any land*’. This means that if the works are undertaken by or on behalf of Council, no development consent is required but if they are undertaken by the land owners they will need to submit a development application to Council accompanied by a statement of environmental effects.

This does not mean that Council can undertake the works without any approval under the EP&A Act. Works undertaken by Council which don’t require development consent under Part 4 of the EP&A Act are defined as activities and their environmental impacts must be assessed under Part 5 of the EP&A Act. Council would need to document their assessment via a Review of Environmental Factors (REF).

16.2 Fisheries Management Act 1994 (FM Act)

In accordance with the FM Act, various Part 7 permits are required for dredging and excavation works (as defined by the FM Act) which impact Key Fish Habitat including vegetation clearing, dredging, and earthworks. No areas suggested for drainage improvement works are identified as Key Fish Habitat so permits under Part 7 of the FM Act are not required.



16.3 Water Management Act 2000 (WM Act)

Under the WM Act, a Controlled Activity Approval (CAA) is required when carrying out a controlled activity on any waterfront land (as defined by the WM Act). This includes the removal of vegetation, excavation, installation of buildings/structures etc within 40m of the top of the banks of a water course. Exemptions to obtaining a CAA include:

- The removal of detritus (organic matter including woody debris as defined by the DPI fact sheet) deposited on waterfront land as a result of the storm is an acceptable exemption. This does not cover vegetation clearing on banks or within the waterbody. It would be necessary to be able to prove that the detritus was deposited as a result of the storm.
- Removal of vegetation is considered exempt if:
 - it does not remove large woody debris (as defined by the DPI fact sheet);
 - does not disturb soil.

Public authorities are exempt from obtaining a CAA, therefore this would only be required if the works are being completed by landowners under Part 4 of the EP&A Act.

It is also an offence to construct flood works (such as levee banks and drains) anywhere on a floodplain without a flood work approval under the WM Act.

16.4 Biodiversity Conservation Act 2016 (BC Act)

Section 7.2 (1) of the BC Act states:

For the purposes of this Part, development or an activity is likely to significantly affect threatened species if —

- a. *it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3, or*
- b. *the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, or*
- c. *it is carried out in a declared area of outstanding biodiversity value.*

If the development or activity is determined as ‘likely to significantly affect threatened species’ then the Biodiversity Offset Scheme (BOS) will be triggered. Some of the recommended works are within areas mapped as PCTs which are equivalent to listed endangered ecological communities and/or are in areas mapped as containing biodiversity values. Works in these areas trigger the need to consider the BOS. This would have different implications depending on whether the works would be conducted under Part 4 or 5 of the EP&A Act.

For works conducted under Part 4 of the EP&A Act a Biodiversity Development Assessment Report (BDAR) would be required to be submitted with the development application. The BDAR must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM). The outcome of the BDAR would be to either purchase ‘biodiversity offset credits’ or allocate a fee into the NSW Biodiversity Conservation Trust fund.

For works conducted by Council under Part 5 of the EP&A Act the application of the BOS is optional. Nevertheless, the impacts of the works on threatened species must be assessed. If the impacts are likely to be significant then a Species Impact Statement (SIS) must be prepared.



Furthermore, if in any of these areas there is also the potential for threatened species to be present, a Threatened Species Test of Significance will need to be completed to determine if the works are *'likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3 [of the BC Act]'*.

Some works are recommended in areas which are mapped as Plant Community Type (PCT) 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (DPE, 2018). This PCT is equivalent to the endangered River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is a Threatened Ecological Community under the BC Act. Field observations suggest that this mapping is questionable in the areas where it intersects with locations of recommended works but this would need to be subject to more detailed investigation.

Other works are recommended in areas mapped as 781 which is referable to TECs under the BC Act as equivalent to the endangered 'Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions' and 'Sydney Freshwater Wetlands in the Sydney Basin Bioregion'. Again, the accuracy of the mapping needs to be checked as part of the investigations for the recommended options in these locations.

The only way to accurately determine whether any of the above mentioned biodiversity features are likely to occur within the subject site, or whether there is suitable habitat for threatened species within the subject site is for an ecologist to undertake an extensive site specific survey. A site inspection should occur prior to any works being undertaken to assess the potential environmental impact of the development on existing flora and fauna. At that point, the site would also be assessed to consider if the BOS would be triggered.

16.5 Environmental Protection and Biodiversity Conservation Act 1999

Under the Commonwealth Environment Protection and *Biodiversity Conservation Act 1999* (EPBC Act), Commonwealth approval is required for actions which have or may have or are likely to have a significant impact on Matters of National Environmental Significance (MNES). MNES include nationally threatened species or endangered ecological communities. Under the EPBC Act an assessment of the impact of a proposal on a MNES must be undertaken to determine whether there is likely to be a significant impact. If the assessment concludes there is a significant impact, then it will become a controlled action under the EPBC Act and the proposal must be referred to the Commonwealth. Approval from the relevant Federal Minister is also required for any actions that may have a significant impact on matters of National Environmental Significance, except in circumstances which are set out in the EPBC Act.

Approval from the Commonwealth is in addition to any approvals under NSW legislation.

The potential ecological impacts of the proposed works are discussed in the constraints analysis for each section. It is concluded that the proposed works are not likely to have a significant impact on any EPBC listed threatened species, populations or communities and would not require referral to the Commonwealth under the EPBC Act.

PCT 835 is equivalent to River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria which is listed as critically endangered under the EPBC Act. Field observations suggest that this mapping is questionable in the areas where it intersects with locations of recommended works but this would need to be subject to more detailed investigation. Nevertheless, the environmental assessments for any works should include a site specific ecological investigation to determine whether a MNES is affected and EPBC Act referral is required.



16.5.1 Heritage Act 1977

The *Heritage Act 1977* provides for the protection of non-Aboriginal heritage in NSW.

Items listed on the State Heritage Register, including archaeological heritage, require consent of the Heritage Council to undertake work or development which alters, moves, despoils or damages any part of the heritage item, place, precinct, land, its relics or any vegetation.

While works are recommended on some properties which are listed heritage items, it is unlikely that they will impact on heritage values. Nevertheless, this would need to be confirmed by more detailed investigations.

16.5.2 National Parks and Wildlife Act 1974

This Act provides, amongst other things, for the protection of Aboriginal heritage. All Aboriginal objects are protected under Section 90 of the *National Parks and Wildlife Act 1974* (NPW Act).

Under Section 90, it is an offence to destroy, deface, damage or desecrate an Aboriginal object or Aboriginal place without the prior issue of an Aboriginal Heritage Impact Permit (AHIP) by the Office of Environment and Heritage (OEH). The amended Act requires that reasonable precautions and due diligence must be taken to avoid impacts on Aboriginal objects which includes:

- identifying whether there are, or likely to be any listed Aboriginal objects present in the area;
- determining whether the proposed activities are likely to harm Aboriginal objects (if present);
- determining whether an Aboriginal Heritage Impact Permit (AHIP) is required.

If an AHIP is required, then consultation must be undertaken with Aboriginal stakeholder groups in accordance with the requirements in cl.80C of the NPW Regulation and the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales, Department of Environment, Climate Change and Water NSW, 2010.

AHIMs searches have shown that there are no known items of Aboriginal heritage significance in the areas of any of the recommended works. Nevertheless, a due diligence assessment should be undertaken before works are carried out and works should cease, and an archaeologist consulted, if items of Aboriginal heritage value are disturbed during the works.

16.6 Coastal Management Act 2016

The NSW Government has established a modern and integrated coastal management framework to better equip coastal communities to respond to existing and future coastal management challenges and opportunities. This included the introduction of the Coastal Management Act 2016 (CM Act). The purpose of the CM Act is to manage the use and development of the coastal environment in an ecologically sustainable way, for the social, cultural and economic well-being of the people of New South Wales.

The objectives of the CM Act included protecting and enhancing the natural coastal processes and environmental values, supporting the social and cultural values, acknowledging Aboriginal peoples' spiritual, social, customary and economic use of the coast, recognizing the economic value of the coastal zone, facilitating and promoting sustainable use and land planning, and mitigating coastal hazard risks.

17 | Conclusions and Recommendations

There are many areas on the Hawkesbury Floodplain which are poorly drained and suffered significant damage due to the slow rate at which water has drained from the floodplain following the flood peak. The prolonged wet weather in 2022 following the two floods has meant that areas have been slow to dry out, particularly where they have large local catchments which contribute runoff to the lowest lying areas.

The causes of the inhibited drainage are many and varied but fall into two broad categories:

- Failure by landowners or Council to maintain flood mitigation and drainage infrastructure such that its function has been impaired
- On farm works or practices which have changed the topography or drainage pathways

Both of these sets of contributors include actions or inactions which have taken decades to incrementally create the current situation. This includes the gradual deterioration of infrastructure or the lowering or raising of paddocks, principally through turf farming.

Other actions, such as the construction of an access track embankment across a paddock or the redirection of a drain may have taken place as a single event over a short space of time.

In either case, the absence of major flooding between August 1990 and March 2020 has meant that the consequences of these changes have not been detected until the series of four floods from March 2020 to July 2022 has repeatedly revealed their impacts.

It is possible that some of the changes to the landscape cannot practically be reversed or mitigated and so the impacts that have been sustained following the recent floods will continue after every flood. However, even in these areas changes in agricultural practices may be possible to ensure drainage problems don't get worse in the future.

Table 11 provides a summary of the recommended actions set out in this report along with who is likely to be responsible for carrying those out, what environmental constraints need to be considered and what environmental approvals are needed. For some actions it is not entirely clear who is responsible and this may need to be negotiated between landowners and Council. Who undertakes the actions may determine what environmental approval process needs to be followed.

Some of the actions are recommendations for more detailed investigations because accurate ground level surveys will be needed and various drainage concept designs modelled to determine the best drainage improvements and whether they are practical to implement.

Figure 157 shows the location and types of actions recommended on a single map. Their locations can be viewed in more detail by going to the relevant maps earlier in the report as listed in Table 11.

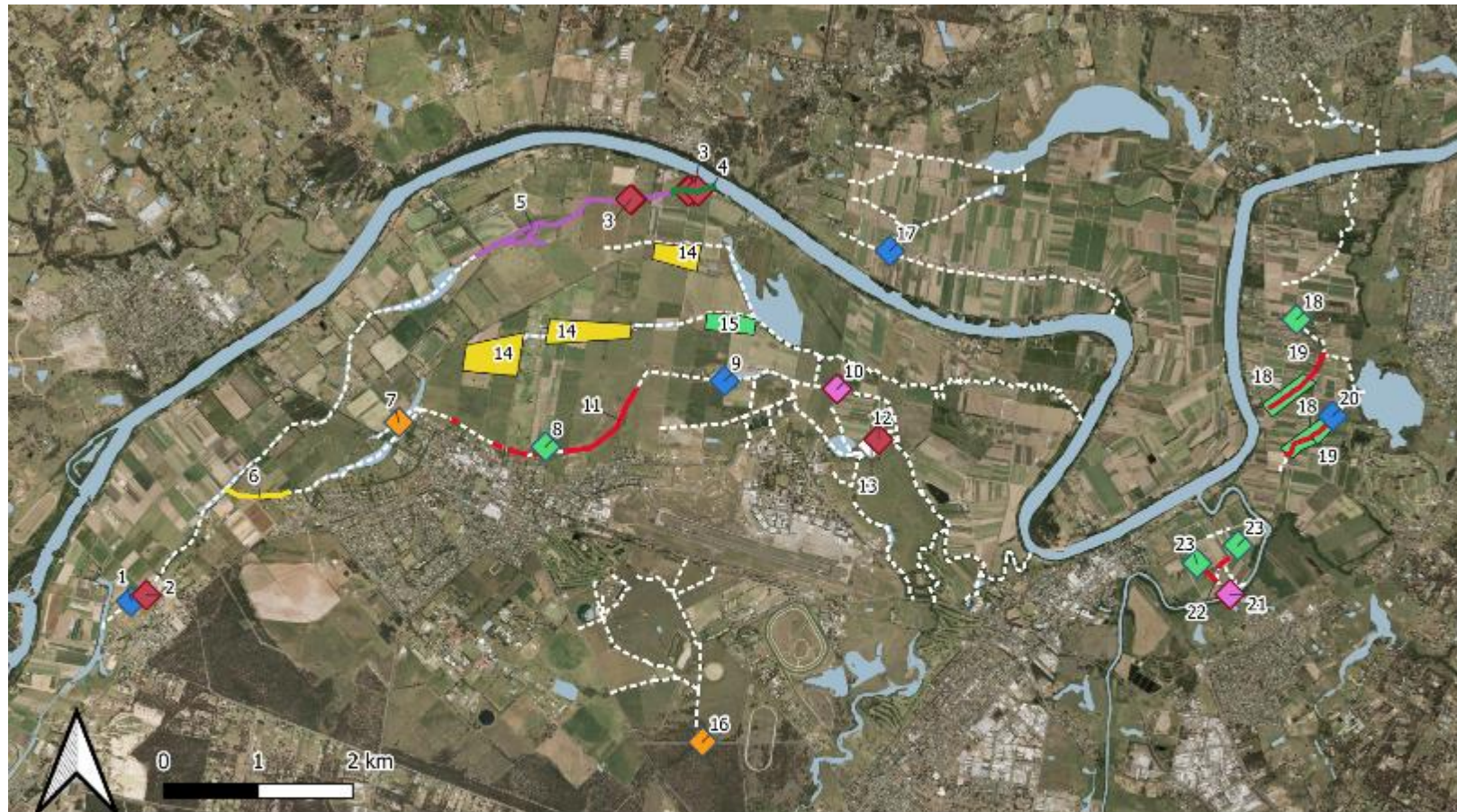


Table 11: Summary of Recommended Actions

Action Number	Figure Number	Photo number(s)	Recommended action	Responsibility	Definition of Action	Zoning	Ecological Values	Heritage Values	ASS Class	Assessment/Approval needed	Comments
IA1NW											
1	7	8	Remove sediment, vegetation and collapsed bridge from channel	Landowner	Flood mitigation	RU2	Connectivity	Nil	5	SEE, CAA	
2	7	6 & 7	Remove road embankment from channel	Landowner	Flood mitigation	RU2	Connectivity	Nil	5	SEE, CAA	
IA1NE											
3	23	62-67	Remove sediment from channel	Unclear	Flood mitigation	RU2, RE1	PCT 835, Sig Veg	Nil	5	If owner – SEE, CAA, BOS If council – REF	Ecological mapping questionable
4	23	61-64	Stabilise banks	Unclear	Flood mitigation	RU2, RE1	PCT 835, Sig Veg	Nil	5	If owner – SEE, CAA, BOS If council – REF	Ecological mapping questionable
5	23	41-59	Check for further choke points upstream once water level has dropped from implementing action 3	Council	Investigation	RU2 SP1	PCT 835, Sig Veg	General item	4 & 5	Nil	Ecological mapping questionable
IA1SW											
6	36	Fig 37-40	Investigate whether drainage improvements can be made	Council	Investigation	RU2, RU4	Connectivity	General item	5	Nil	

Action Number	Figure Number	Photo number(s)	Recommended action	Responsibility	Definition of Action	Zoning	Ecological Values	Heritage Values	ASS Class	Assessment/Approval needed	Comments
7	36	74-78	Keep pipes clear of debris	Council	Flood mitigation	C2	Wetland, PCT 835, Sig Veg, BV	Nil	4	REF	
IA1SC											
8	53	92 & 93	Regrade paddocks	Landowner	Agriculture	RU2	Connectivity	Nil	4	Nil	
9	53	105-108	Remove road embankment from channel	Unclear	Flood mitigation	RU2	Wetland, PCT 781, Sig Veg, BV	Nil	4	If owner – SEE, CAA, BOS If council – REF	Ecological mapping questionable
10	53	118	Repair or replace floodgates	Council	Flood mitigation	RU2	Connectivity, KFH	Nil	4	REF	
11	53	83, 86, 87-90, 92, 96-100	Remove sediment and vegetation from channel	Unclear	Flood mitigation	RU2	Connectivity	General items	4	If owner – SEE, CAA, BOS If council – REF	
IA1SE											
12	66	147	Remove sediment and vegetation	Unclear	Flood mitigation	RU2	Sig Veg	Nil	4	If owner – SEE, CAA If council – REF	
13	66	144 & 145	Increase outlet capacity	Unclear	Flood mitigation	RU2	Wetland, PCT 781, Sig Veg, BV	Nil	4	If owner – SEE, CAA, BOS If council – REF	
IA1CW											
14	79	172-175, 176-191, 214-217	Investigate whether drainage improvements can be made	Council	Investigation	RU2, RE1	Sig Veg, BV	Nil	3, 4	Nil	Reconsider sustainability of turf farming in certain areas
15	79	204	Regrade paddocks	Landowner	Agriculture	RU2	Nil	General item	4	Nil	
IA2											
16	85	243	Keep culvert crossing clear	Unclear	Flood mitigation	SP1	PCT 835, Sig Veg	Nil	5	If electricity easement owner - REF	

Action Number	Figure Number	Photo number(s)	Recommended action	Responsibility	Definition of Action	Zoning	Ecological Values	Heritage Values	ASS Class	Assessment/Approval needed	Comments
IA3											
17	101	345	Remove road embankment, install pipe, reinstate drain	Landowner	Flood mitigation	RU2	Nil	Nil	4	SEE, CAA	
IA5											
18	126	371, 375, 376, 379-388, 396-400	Regrade paddocks to improve drainage	Landowner	Agriculture	RU2	Nil	General item	3, 4	Nil	Reconsider sustainability of turf farming in certain areas
19	126	371, 375, 376, 379-388, 396-400	Clear channels	Landowner	Flood mitigation	RU2	Nil	Nil	3, 4	SEE, CAA	
20	126	398	Remove embankment	Landowner	Flood mitigation	RU2	Nil	Nil	4	SEE, CAA	
IA6											
21	139	415 & 416	Replace floodgate and repair and stabilise levee	Council	Flood mitigation	RU2	PCT 835, Sig Veg, KFH	Nil	4	REF	
22	139	410, 411, 412 & 413	Clear channel of reeds and sediment	Unclear	Flood mitigation	RU2	Nil	Nil	4, 5	If owner – SEE, CAA If council – REF	
23	139	405, 406 & 407	Regrade paddocks	Landowner	Flood mitigation	RU2	Nil	Nil	4, 5	Nil	Reconsider sustainability of turf farming in certain areas



Solutions colour coding		
— Stabilise bank	◆ Remove road embankment	◇ Increase outlet capacity
— Check for chokepoints	◆ Clear channel	◆ Repair or replace flood gates
— Keep channel clear	◆ Keep pipes clear	■ Investigate improvements
		■ Regrade paddocks

Figure 157: Locations of Recommended Actions

18 | References

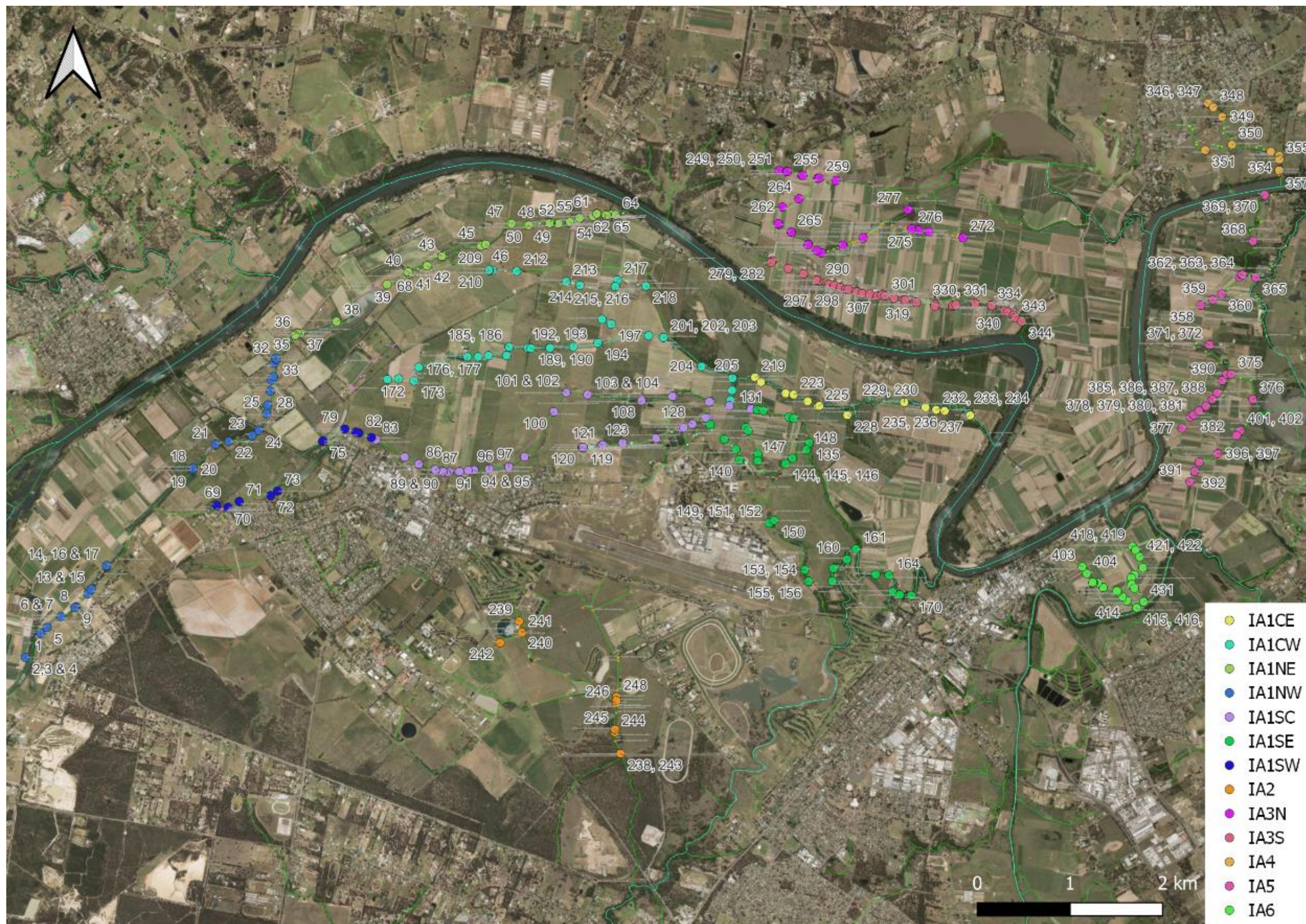
- AECOM, on behalf of Department of Defence. 2018. Ecological Risk Assessment November 2018, RAAF Base Richmond PFAS Investigation.
https://web.archive.org.au/awa/20230427172918mp_/https://defence.gov.au/Environment/PFAS/docs/Richmond/Reports/201811EcologicalRiskAssessmentReportBody.pdf
- AECOM, on behalf of Department of Defence. 2021. Annual Interpretive Report – 2020. PFAS OMP – RAAF Base Richmond.
https://web.archive.org.au/awa/20230427114644mp_/https://defence.gov.au/Environment/PFAS/docs/Richmond/Reports/202111RAAFBaseRichmond2020AnnualInterpretiveReport.pdf
- AECOM, on behalf of Department of Defence. 2018. Human Health Risk Assessment November 2018, RAAF Base Richmond PFAS Investigation.
https://web.archive.org.au/awa/20230427172904mp_/https://defence.gov.au/Environment/PFAS/docs/Richmond/Reports/201811HumanHealthRiskAssessmentReportBody.pdf
- Department of Environment, Climate Change and Water (DCCEE). 2010. Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales. Department of Environment, Climate Change and Water.
<https://www.environment.nsw.gov.au/research-and-publications/publications-search/due-diligence-code-of-practice-for-the-protection-of-aboriginal-objects-in-new-south-wales>
- Department of Planning and Environment (DPE). 2022a. Environmental Planning Instrument – Acid Sulphate Soils. State Government of NSW and Department of Planning and Environment.
<https://datasets.seed.nsw.gov.au/dataset/epi-acid-sulphate-soils>
- Department of Planning and Environment (DPE). 2022b. Environmental Planning Instrument – Land Zoning. State Government of NSW and Department of Planning and Environment.
<https://datasets.seed.nsw.gov.au/dataset/environment-planning-instrument-local-environmental-plan-land-zoning>
- Department of Planning and Environment (DPE). 2018a (Updated 2022). Biodiversity Values Map (Edition 13.4). State Government of NSW and Department of Planning and Environment.
<https://datasets.seed.nsw.gov.au/dataset/biodiversity-values-map>
- Department of Planning and Environment (DPE). 2018b (Updated 2022). Environmental Planning Instrument – Heritage (HER). State Government of NSW and Department of Planning and Environment.
<https://datasets.seed.nsw.gov.au/dataset/environmental-planning-instrument-heritage-her>
- Department of Planning and Environment (DPE). 2018c. (Updated 2022). Remnant Vegetation of the western Cumberland subregion, 2013 Update (VIS_ID 4207). State Government of NSW and Department of Planning and Environment.
<https://data.nsw.gov.au/data/dataset/e35ceadb-ed88-4012-a335-97ddb443a582>
- Department of Planning and Environment (DPE). 2014. Environmental Planning Instrument – Wetlands. State Government of NSW and Department of Planning and Environment.
<https://datasets.seed.nsw.gov.au/dataset/epi-wetlands>
- Department of Planning and Environment (DPE). 2010 (Updated 2022). NSW BioNet Species Sightings Data Collection. State Government of NSW and Department of Planning and Environment. [Accessed on 3 August 2022].
<https://datasets.seed.nsw.gov.au/dataset/nsw-bionet-species-sightings-data-collection8a9c4>
- Department of Primary Industries (DPI). 2014. Planning for Turf Farms - primefact



- Department of Primary Industries (DPI). 2020. Key Fish Habitat - Hawkesbury-Nepean. State Government of NSW and Department of Primary Industries.
https://spatial.industry.nsw.gov.au/arcgis/rest/services/Fisheries_Portal/KeyFishHabitat/MapServer/1
- Environment Protection Authority (EPA). 2022a. List of Notified Sites. State Government of NSW and Environment Protection Authority.
<https://www.epa.nsw.gov.au/your-environment/contaminated-land/notified-and-regulated-contaminated-land/list-of-notified-sites> [Accessed on 10 August 2022].
- Environment Protection Authority (EPA). 2022b. Record of Notices (Hawkesbury City Council Local Government Area). State Government of NSW and Environment Protection Authority.
<https://app.epa.nsw.gov.au/prclmapp/searchresults.aspx?&LGA=65&Suburb=&Notice=&Name=&Text=&DateFrom=&DateTo=> [Accessed on 10 August 2022].
- Hawkesbury Local Environmental Plan (HLEP) 2012
- Gallant, J., Wilson, N., Dowling, T., Read, A., Inskeep, C. 2011. SRTM-derived 1 Second Digital Elevation Models Version 1.0. Record 1. Geoscience Australia, Canberra.
<http://pid.geoscience.gov.au/dataset/ga/72759>
- Spatial Services (Department of Customer Service). 2018a (Updated 2022). NSW Hydrography. Spatial Services (Department of Customer Service).
<https://data.nsw.gov.au/data/dataset/nsw-hydrography>
- Spatial Services (Department of Customer Service). 2018b (Updated 2022). NSW Imagery. Spatial Services (Department of Customer Service).
<https://data.nsw.gov.au/data/dataset/nsw-imagery>



Appendix A | Photo Map of Investigation Area



Appendix A: Photomap of the study area. The map includes all photos in this report, however not all numbers are shown due to the high level of detail in the map.