Photo 83

Photo 84

Photo 85

Photo 86

Photo 87

Photo 88

Photo 89

Photo 90

Photo 91

Photo 92

Photo 93

Photo 94

Photo 95

Photo 96

Photo 97

Photo 98

Photo 99

Photo 100

Photo 101

Photo 102

Photo 103

Photo 104

Photo 105

Photo 106

Photo 107

Photo 109

Photo 110

Photo 111

Photo 112

Photo 113

Photo 114

Photo 115

Photo 116

Photo 117

There are flood gates on the culvert (Photo 118) which were shut on the day of the inspection. It was not possible to tell whether this is because they are rusted and would not open or that there was insufficient head upstream to hold them open. It is noted that the bottom of one gate is rusted and would form an imperfect seal against the ingress of floodwaters.

The other channel in this investigation area enters the main channel from the south. It starts as a deep, relatively wide channel in paddocks north of Dight Street (Photo 119) and heads east under a series of closely spaced crossing with pipes of various sizes under them (Photo 120). The water is ponded in this section of the channel by the invert of a pipe at the second of two closely spaced crossings (Photo 121 and Photo 122).

Downstream there are another two piped crossings (Photo 123 and Photo 124) but these do not appear to be controlling the water level in the channel. Downstream of this crossing there is considerable reed growth within the channel and in places this appears to be restricting flow and controlling upstream water levels (Photo 125 and Photo 126). Woody debris across the channel would also restrict flow at higher water levels (Photo 127). Reed growth is blocking flow at other points further downstream (Photo 128 and Photo 129). Just downstream of this point it turns north and flows to the main channel and is vegetated with another form of reed (Photo 130).

7.1.1 Probable causes

The most extensive issue along IA1SC which is causing drainage problems is the choking of the channel with sediment and vegetation. This is causing water to pond in channels a considerable distance upstream and in some locations is leading to elevated water levels which, if not directly inundating paddocks, are causing elevated watertables which inhibits the drainage of paddocks.

There are also some other location specific issues which need to be addressed including:

- paddock which cannot drain into the channel because the paddock is lower than the top bank of the drain (Photo 93)
- a disused channel crossing (Photo 105) which has substantially blocked flow and is causing ponding a long way upstream
- flood gates under Cupitts Lane would appear to not be working properly (Photo 118)

7.1.2 Possible solutions

The choking of the channel with silt and vegetation can only be dealt with by using an excavator to remove them. The terrain is quite flat and the channel is not particularly wide or deep where most of the choke points occur. Along most of the channel length there are cleared paddocks. Where there are trees or shrubs preventing direct access to the channel the are mostly introduced species so their removal should not be an impediment to gaining access to the channel. If the work is to be done by Council then access will need to be arranged with property owners. The same earth moving equipment could be used to remove the disused channel crossing which is blocking flow. As the crossing is clearly no longer used this should not create a problem. If access needs to be maintained or restored at a later date then a bridge should be used.

Where paddocks are lower than the bank of the drain, drainage points could be cut through the bank or the entire bank and paddock regraded so that it drains to the channel.

A detailed inspection and testing of the flood gates would be needed before deciding on whether they need to be repaired or replaced.

Possible solutions are displayed in Figure 56.

Photo 118

Photo 119

Photo 120

Photo 121

Photo 122

Photo 123

Photo 124

Photo 125

Photo 126

Photo 127

Photo 128

Photo 129

Photo 130

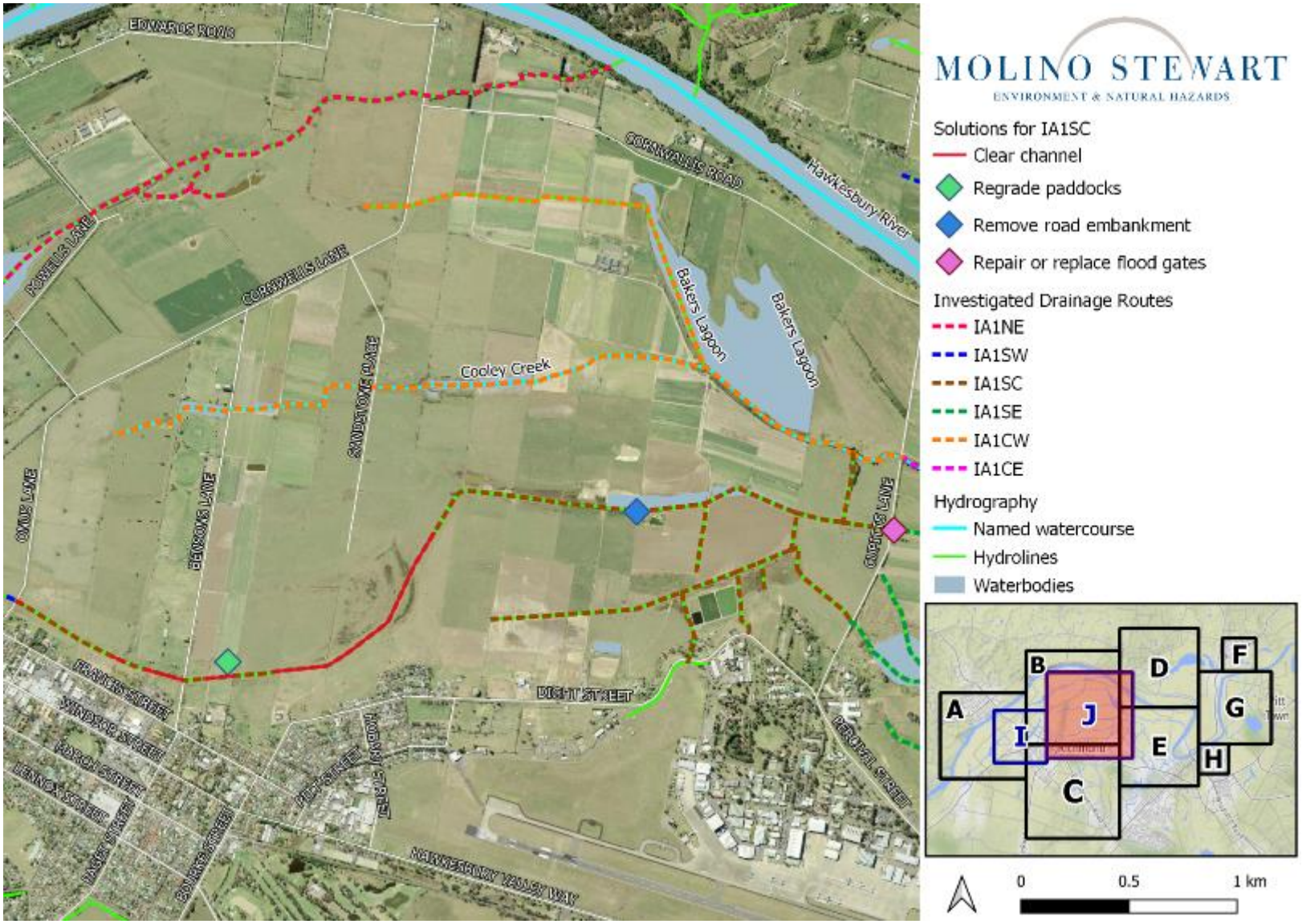


Figure 56: Solutions for IA1SC

7.2 Environmental Constraints

a) Zoning

IA1SC solely traverses land zoned as RU2 – Rural Landscape, with a small segment of the northern bank being zoned RE1 – Public Recreation west of Bensons Lane (Figure 57).

Maintenance of existing drainage channels, including clearing of the channel, is permitted without consent for zones RU2 and RE1, while reinstating or rectifying drainage lines where they have been modified over time requires development consent. Therefore, clearing the drainage channel and replacing the existing flood gates is permissible without consent, while removing the road embankment and adjusting the landscape form by regrading the paddocks is subject to development approval.

b) Contamination

Environment Protection Authority (EPA) contaminated land records of notices for the Hawkesbury LGA are shown in Table 1. Notified contaminated sites on or near the Hawkesbury Floodplain are shown in Figure 4. There are no known EPA contaminated sites within the vicinity of IA1SC.

The majority of drainage route IA1SC is within the off-site PFAS Management Area for Richmond RAAF Base, and small sections of it are within, or run adjacent to, the on-site management areas (Figure 58). Part of the drainage channel is also within the Bakers Lagoon Management Area. Some of the suggested solutions for this section are within the off-site management areas, therefore consultation with Department of Defence is required prior to commencing any works.

c) Acid Sulphate Soils

IA1SC runs entirely through Class 4 land on the Acid Sulphate Soils Map (Figure 59). According to the LEP Development consent in Class 4 land is required where the works are more than 2m below the natural ground surface or the works are likely to lower the watertable by more than 2m below the natural ground surface. None of the suggested works would do that.

d) Heritage

i) HLEP Heritage Items

The IA1SC channel runs along the northern boundary of 87A Francis Street, Richmond which is a listed heritage item of local significance in the HLEP. The house is at elevation and a considerable distance from the channel.

The drain also passes through land associated with 96 Dight Street, Richmond which is listed as "Clarendon" (servants' quarters). The channel passes well north of the building.

These are both shown in Figure 60.

ii) AHIMS Heritage Items

An AHIMS Basic Search of constraints extent J returned 5 Aboriginal sites but none are near the drainage line (Figure 61). However, the exact location and nature of these sites is not known from a Basic Search.

Therefore, for any works which are likely to result in ground disturbance on IA1SC (such as the regrading of the drain bank), 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 in R&H SEPP along IA1SC (Figure 62). However, at the time of the field work there was no discernible wetland in this location as evidenced by Photo 108, Photo 109 and Photo 110.

The mapped section of wetland appears to include the location where the disused crossing needs to be removed.

Before development consent can be granted for any works conducted within the extent of this wetland the provisions set out in Part 6.5 (3) and (4) of the HLEP as well 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 may mean that an EIS will be required for the removal of the disused crossing.

f) Ecology

i) Plant Community Type Mapping

Most of the mapped wetland area is mapped as PCT 781 – Coastal Freshwater Lagoons (Figure 63). This is not consistent with field observations. As can be seen from Photo 107 through to Photo 111. The terrestrial vegetation is all introduced species dominated by a Honey Locust canopy and kikuyu ground cover. There are some native reeds within the channel. However, this section of channel does not appear to be ecologically distinct from those upstream and downstream.

This PCT is referrable 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'. This means that ecological field work will be required to establish whether the mapping is accurate and whether it is a constraint on the works.

ii) Terrestrial Biodiversity

The mapped wetland is shown as Significant Vegetation and the whole of the length of IA1SC is within a zone mapped as Connectivity Between Significant Vegetation (Figure 64). While this mapping is questionable, any works would need to take this into consideration.

iii) Biodiversity Values

The mapped wetland is shown as 'Biodiversity Value' on the DPE Biodiversity Values Map (Figure 65). This too is questionable but it places controls on the removal of vegetation in these areas so before the disused crossing can be removed it will need to be shown that there are no biodiversity values affected.

iv) Threatened Species Records

The Grey-headed Flying-fox and the Barking Owl are the only threatened species which have been seen within map extent J which covers IA1SC and these have mostly been sighted in the urban areas south of the drainage line (Figure 66).

v) Key Fish Habitat

There is no key fish habitat along IA1SC (Figure 67)

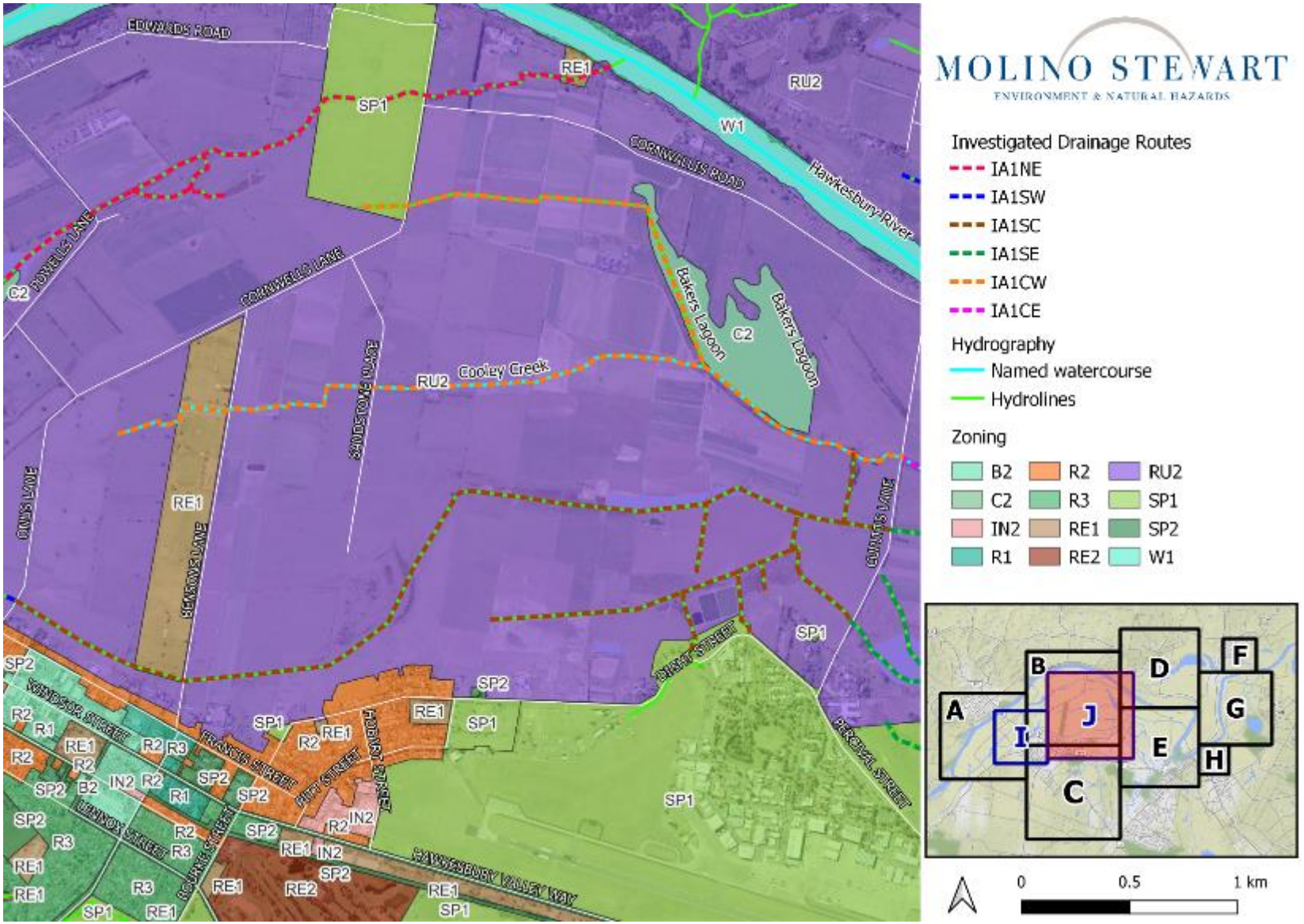


Figure 57: Land Zoning (Extent J)

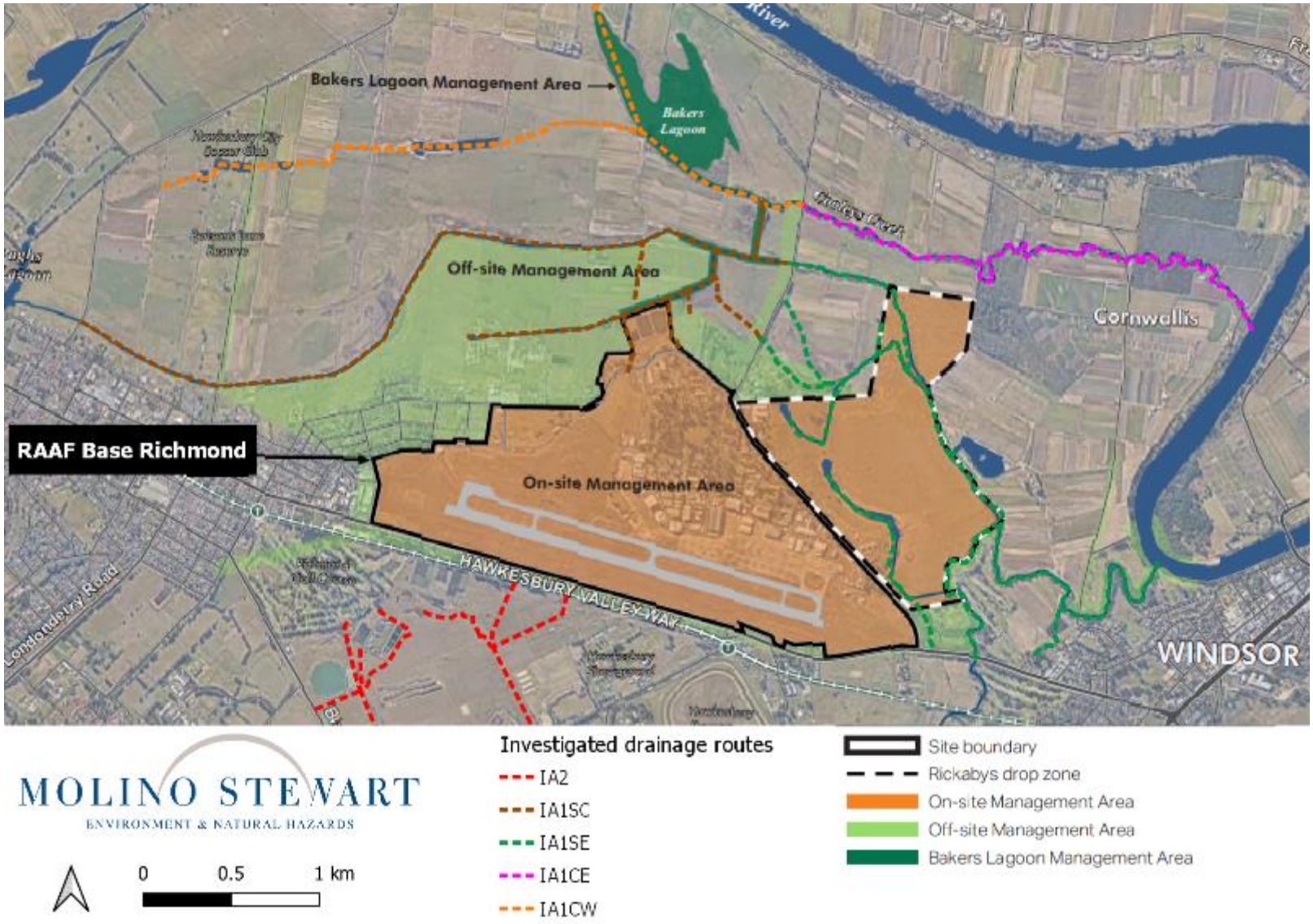


Figure 58: PFAS Management Areas

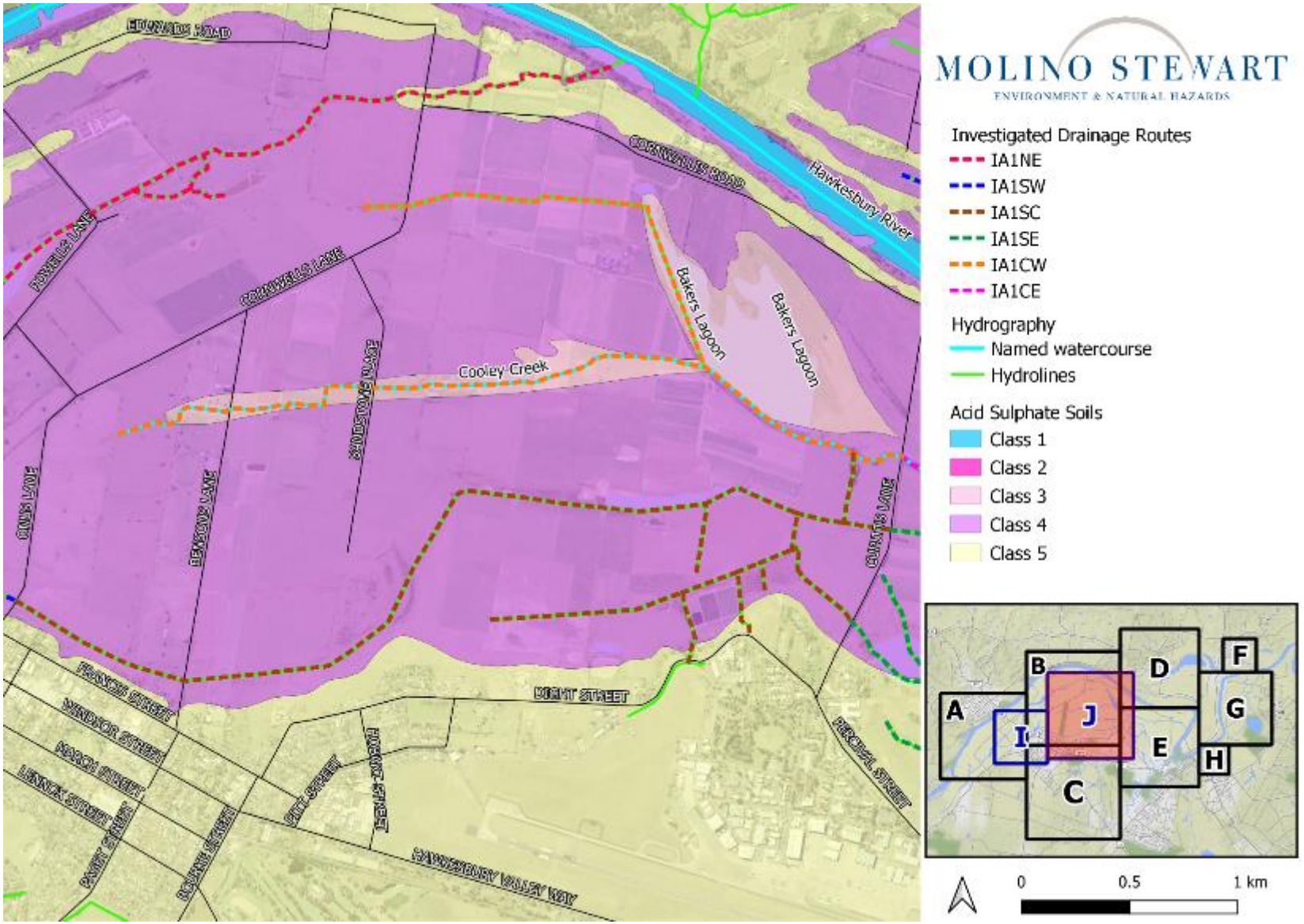


Figure 59: Acid Sulphate Soils (Extent J)

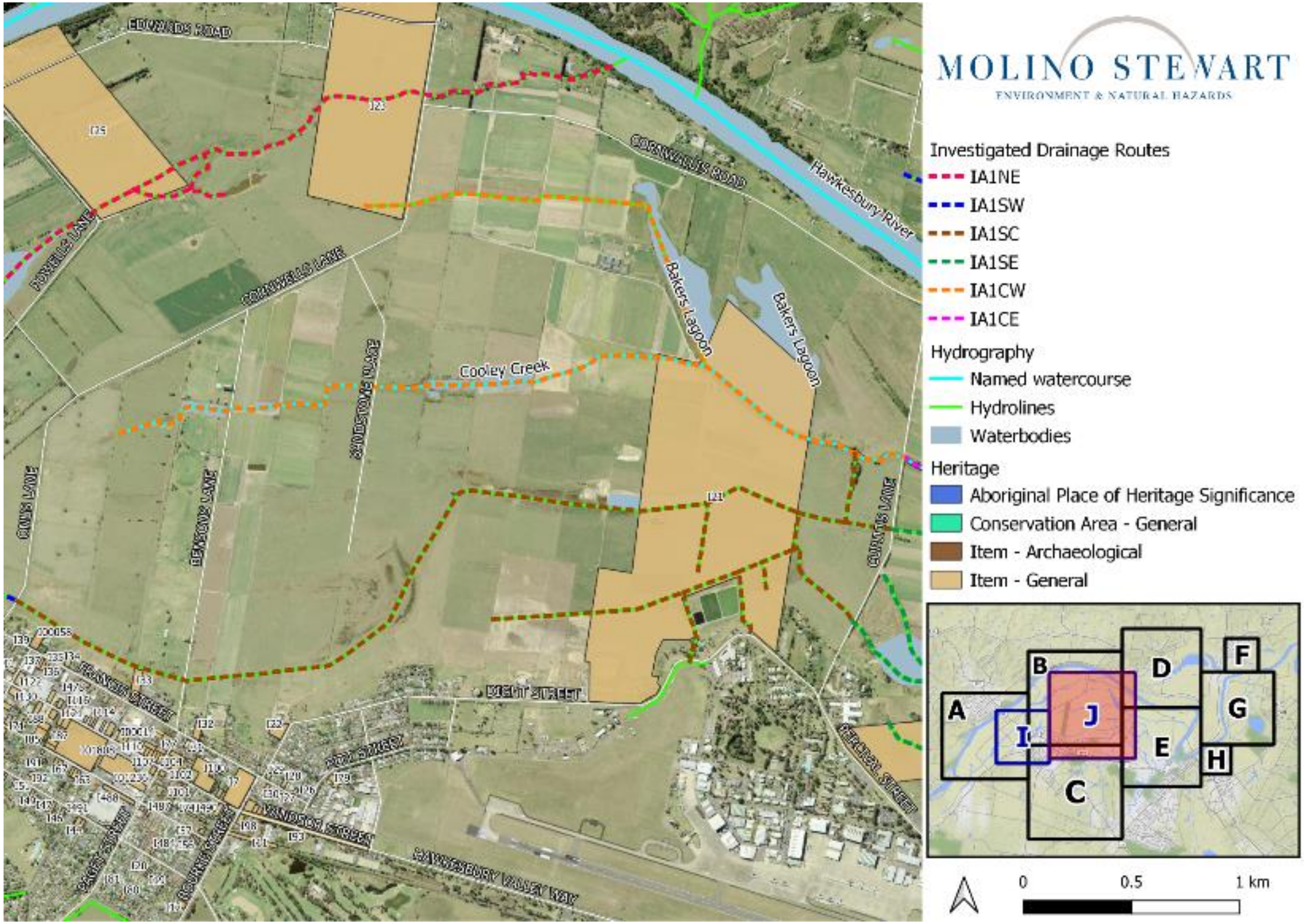


Figure 60: HLEP Heritage Places, Areas and Items (Extent J)

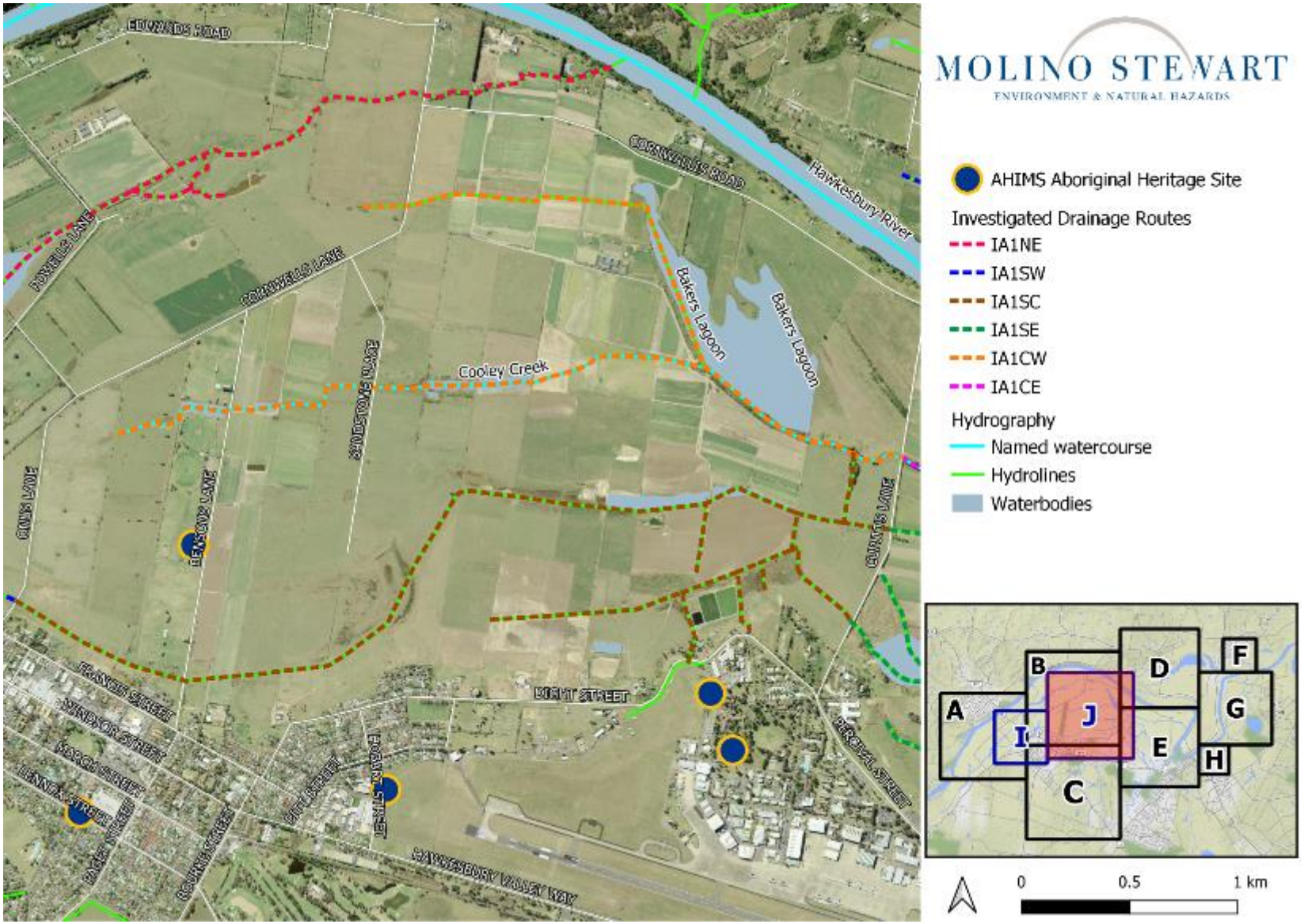


Figure 61: AHIMS Aboriginal Sites (Extent J)

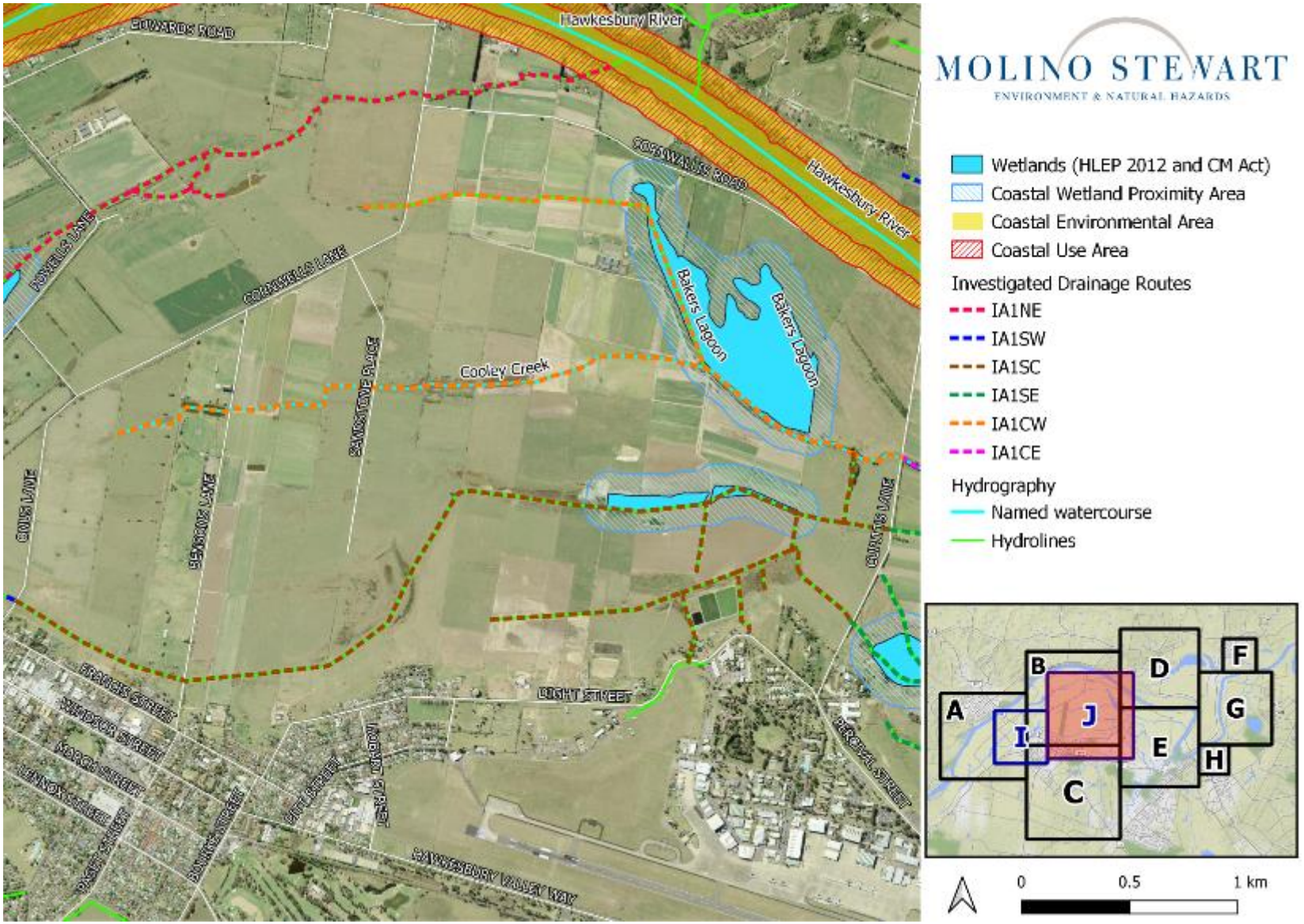


Figure 62: Wetlands and Coastal Management Areas (Extent J)

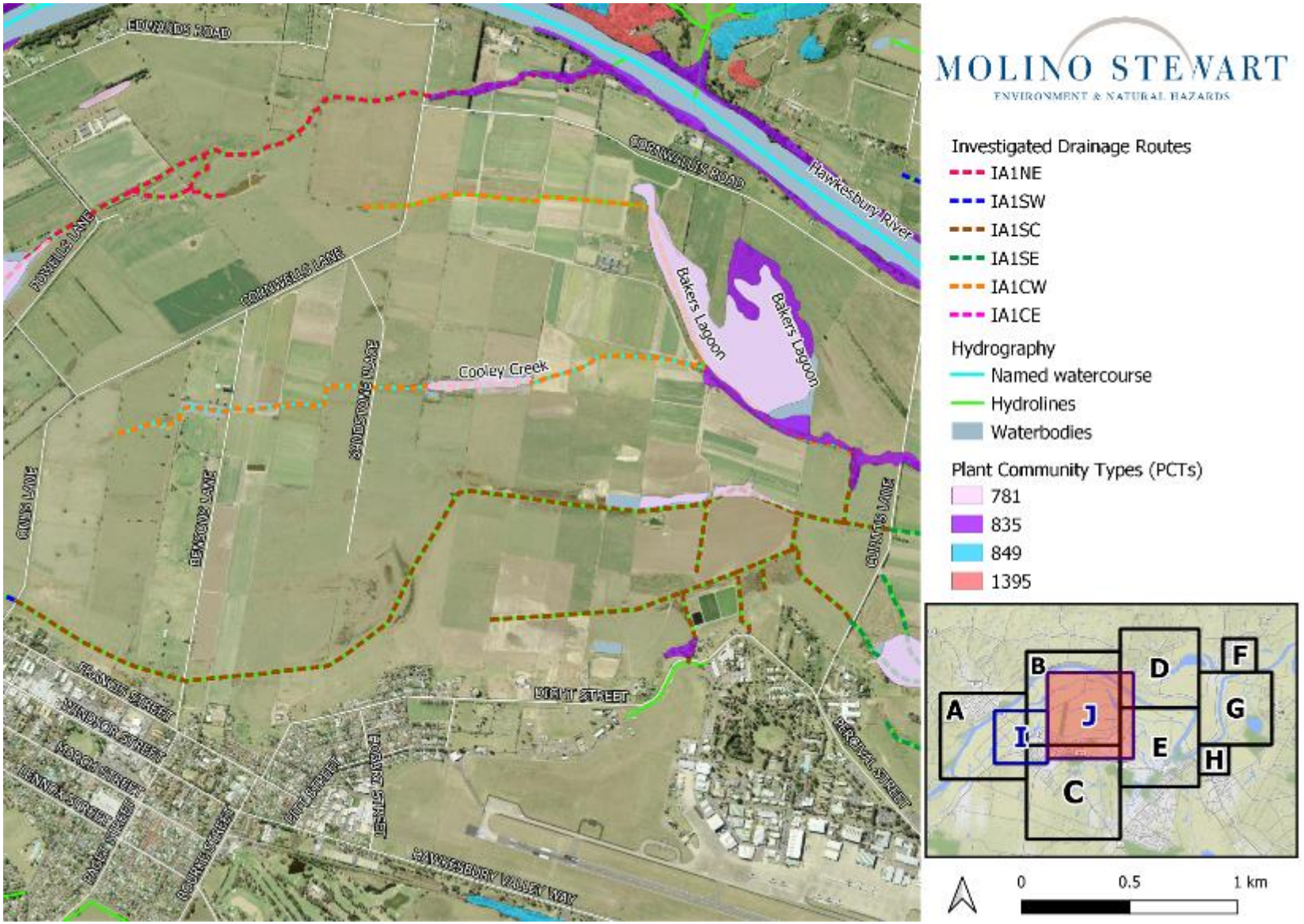


Figure 63: Plant Community Type Mapping (Extent J)

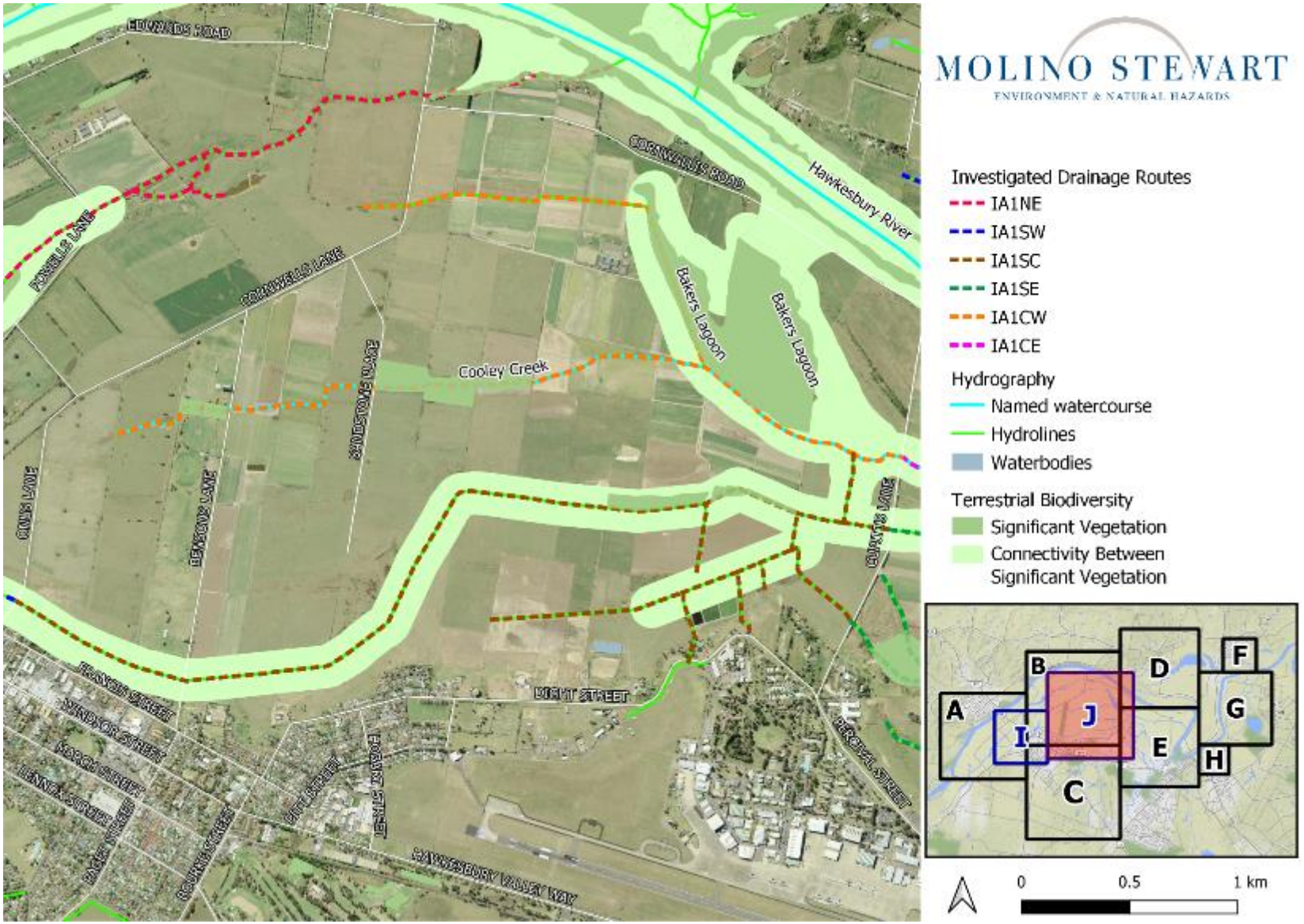


Figure 64: Terrestrial Biodiversity (Extent J)

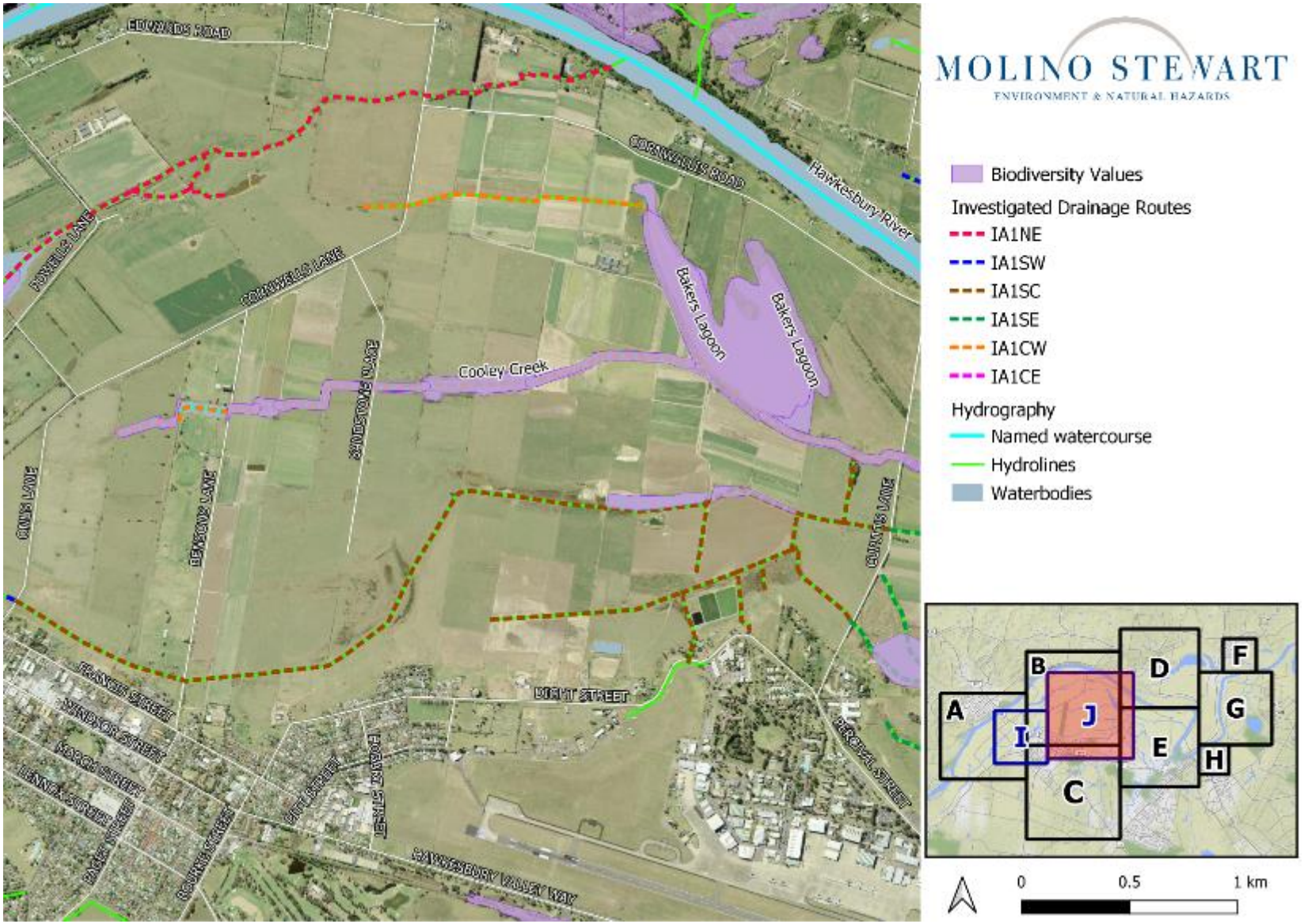


Figure 65: Biodiversity Values (Extent J)

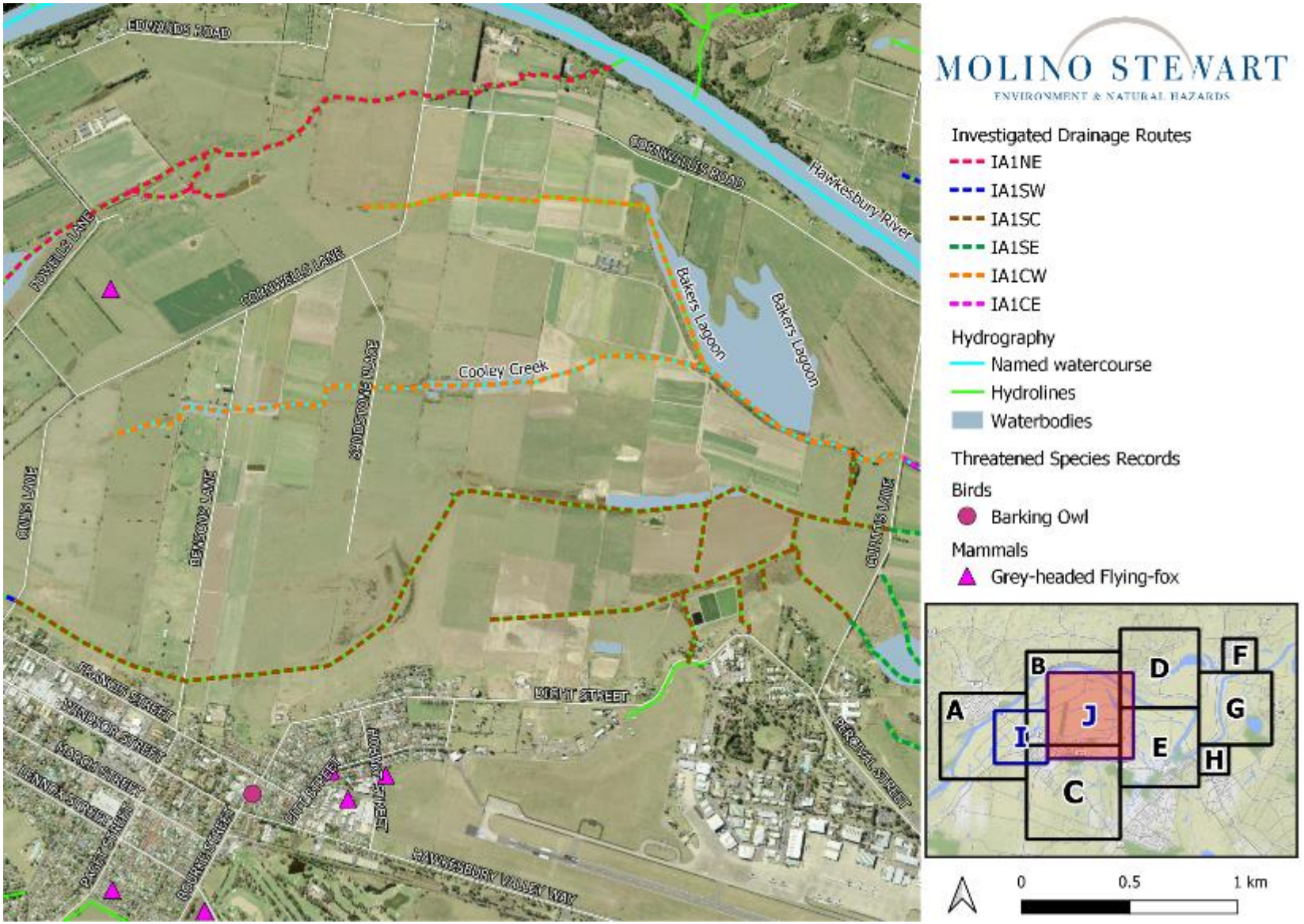


Figure 66: Threatened Species Records (Extent J)

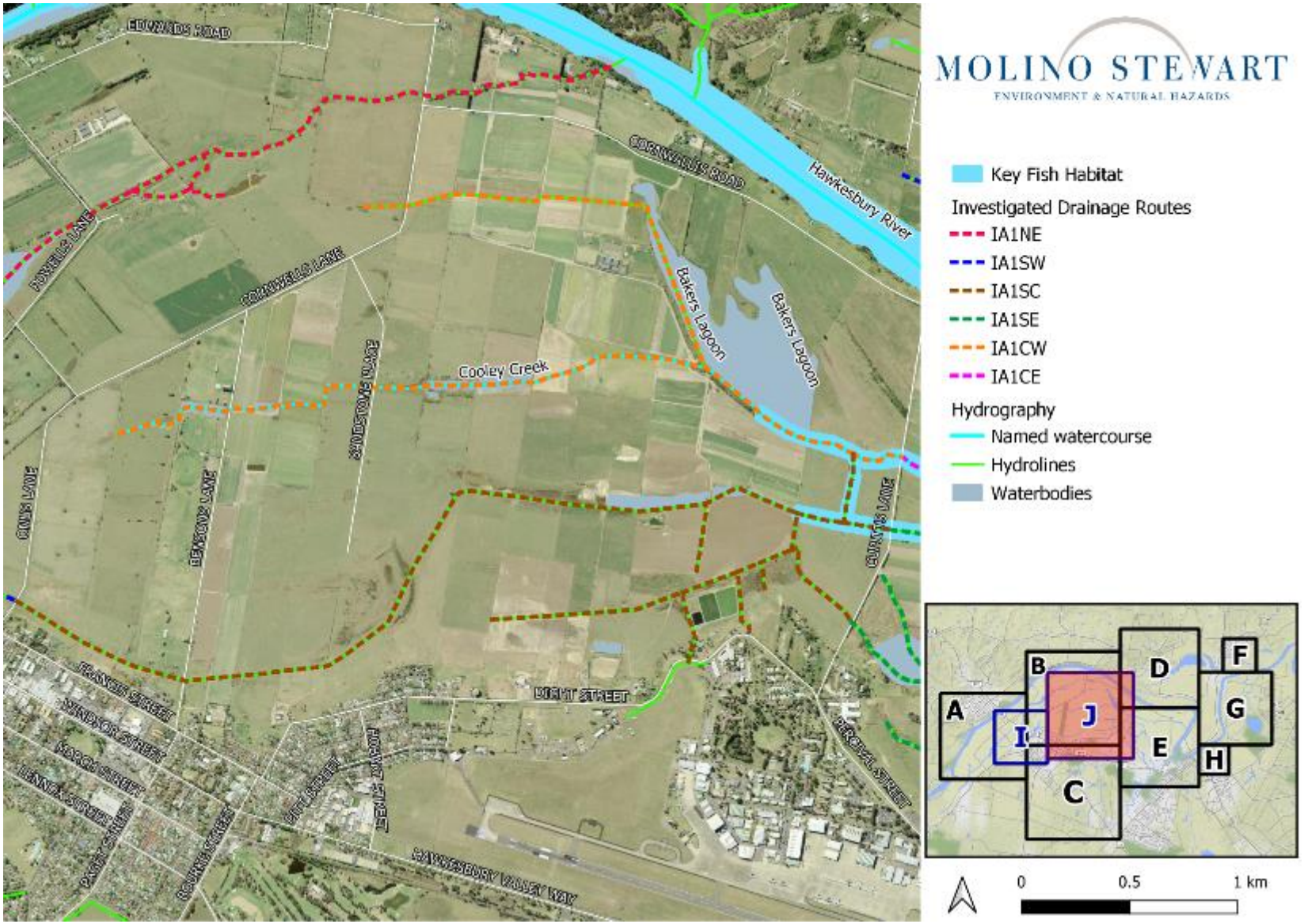


Figure 67: Key Fish Habitat (Extent J)

8| IA1 Southern Drainage Route East

8.1 Drainage Issues

The eastern section of the southern drainage route (IA1SE) is quite complex with three main branches, several tributary drains and two cross connections (Figure 68).

The main branch is a continuation of IA1SW and flows east from Bensons Lane, turning north, then heading east, then southeast until it flows into the lower reaches of Rickabys Creek which forms the final section of the drainage route to the Hawkesbury River.

Another branch starts in paddocks north of Dight Street and flows northeast before turning south east, then north east again and then south east again until it joins the main branch.

The shortest branch runs roughly southeast, parallel to Percival Street on its northern eastern side and is shown on the topographic maps as passing under Hawkesbury Valley Way and discharging into Rickabys Creek.

The locations of each photograph referred to in the text can be found in Figure 69.

8.1.1 Field observations

Downstream of Cupitts Lane the main channel is full of vegetation which is constricting flow (Photo 131) and further downstream there is plastic debris within the reeds which is further constricting the flow (Photo 132). The channel becomes deeper further along and there is evidence of numerous small bank slumps (Photo 133) which are pushing sediment into the channel.

Just before the channel turns south there is less vegetation within the channel but there is a lot of debris (Photo 134). It was difficult to inspect the next reach of the channel because the banks were dense with Small-leaf Privet, except where there was a dilapidated bridge which has collapsed into the channel (Photo 135). A clear view of the channel was not possible from this point all the way to its confluence with Rickabys Creek.

A few hundred metres downstream of the collapsed bridge another drainage line enters. This drainage line commences very close to the drain which enters the main channel much further upstream. It commences as a shallow drain which is heavily vegetated with reeds and continues in a south easterly direction as an ill defined depression through the paddocks and is vegetated with pasture grasses (Photo 136 and Photo 137). This part of the drain is actually within IA1SC.

It is only on the eastern side of Cupitts Lane where it enters IA1SE that there is a more clearly defined channel (Photo 138) which was full of standing water on the day of the inspection. It heads south along the eastern side of the road (Photo 139) before turning in a south easterly direction. It flows under a piped access road (Photo 140) and into a wider channel (Photo 141) which leads into a complex area of standing water

There is also another flow path starting further north on the eastern side of Cupitts Lane which also leads to the area of standing water. It is a shallow, channel which passes through some pipes (Photo 142) and is grassed lined until it becomes a wider area of open water (Photo 143) and flows into the complex area of standing water.

It would appear that the level in the body of standing water and the two flow paths entering it are controlled by a small outlet (Photo 144) but also by downstream water levels (Photo 145).

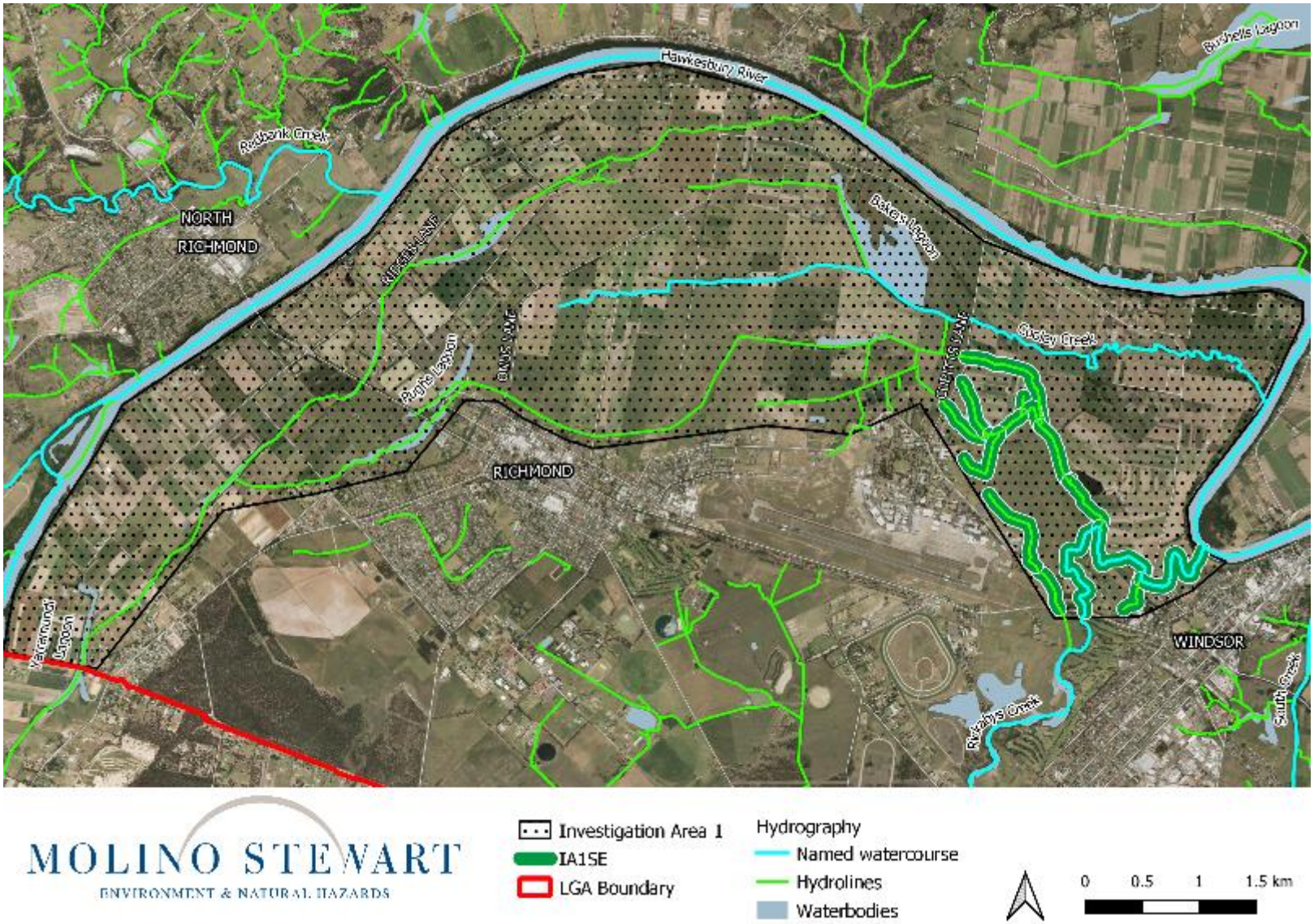
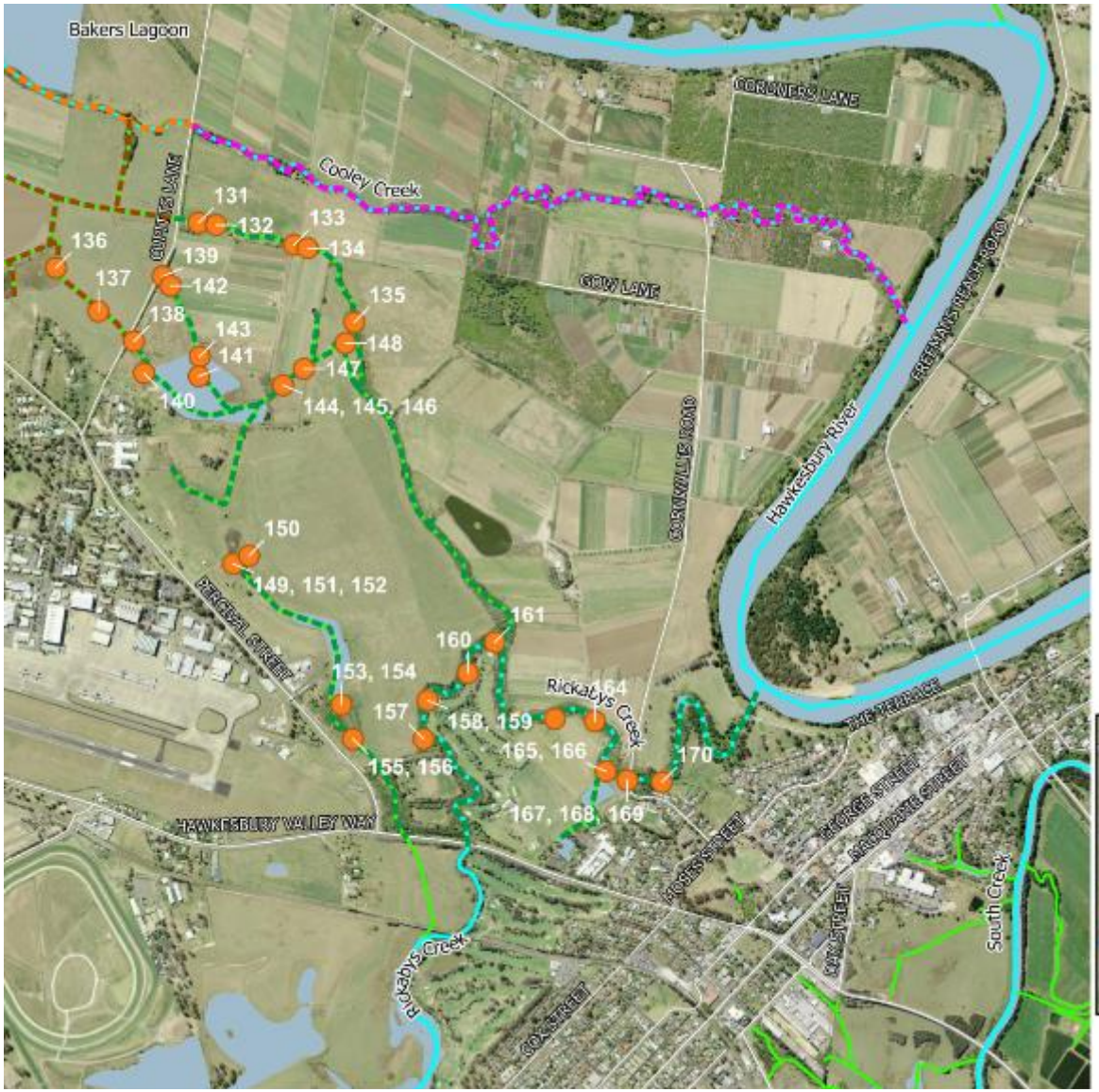


Figure 68: Investigation Area 1 Southern Drainage Route East (IA1SE)



MOLINO STEWART
ENVIRONMENT & NATURAL HAZARDS

Photo locations

Investigated Drainage Routes
- IA1SC
- IA1SE
- IA1CW
- IA1CE

Hydrography
- Named watercourse
- Hydrolines
- Waterbodies

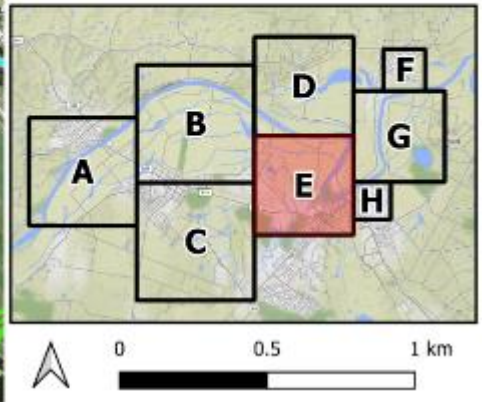


Photo 131

Photo 132

Photo 133

Photo 134

Photo 135

Photo 138

Photo 139

Photo 140

Photo 141

Photo 142

Photo 143

Photo 145

Water is ponded in the channel leading out of the area and despite passing through a pipe under a crossing (Photo 146), the level appears to be controlled by siltation in the channel further downstream (Photo 147). The channel appears to be clear (Photo 148) but ponded from this point to it confluence with the main channel.

The drainage line which runs parallel to Percival Street starts in a large pond (Photo 149) which has an overflow path (Photo 150) leading to another pond (Photo 151). This pond has a wide overflow path into yet another pond (Photo 152). This overflows along a channel (Photo 153) which passes into and out of an area fenced off with a high cyclone fence (Photo 154 and Photo 155). In then reaches a small pond before overflowing through a pipe (Photo 156) which heads east towards Rickabys Creek rather than south across country as suggested by the topographic map. What was suspected to be the pipe outlet, which includes a v-notch weir, was observed from the opposite bank of Rickabys Creek (Photo 157).

Rickabys Creek was inspected from where it passes under Hawkesbury Valley Way to where it joins the Hawkesbury River. The banks are heavily weed infested, particularly with privet and honey locust. Downstream as far as Cornwallis Road there were several obstructions to flow at the observed water level including:

- a large bank collapse which has deposited sediment in the channel which in turn has snagged woody debris (Photo 158 and Photo 159)
- large woody debris across the creek (Photo 160 and Photo 161 and Photo 162)
- a smaller bank collapse which has narrowed the channel (Photo 163)
- a causeway across the creek (Photo 164)
- another small bank collapse which has narrowed the channel (Photo 165)

The latter causeway had the most significant impact on upstream water levels, not only because of the causeway itself but the low flow pipe under the causeway appeared to be blocked at its upstream end and did not appear to be passing any flow (Photo 166). This created a 1.5m drop in level across the causeway.

Debris and coarse sediment was blocking the creek immediately upstream of Cornwallis Road (Photo 167) where major repairs had recently been completed on the left bank of the creek downstream of the bridge (Photo 168). Slumping from the right bank has placed sediment in the creek which has constricted its capacity (Photo 169). Slumping of the high creek banks continued further downstream (Photo 170).