HUGHES CREEK FISH SURVEYS 2016

Methods

In March 2016, 26 sites in Hughes Creek between Avenel and Tarcombe were surveyed for Macquarie perch (Figure 1, Table 1). Sites were selected based on previous surveys, and new additional sites were also surveyed in priority areas identified by Goulburn Broken Catchment Management Authority.

At previous fish monitoring sites, surveys consisted of single pass backpack electrofishing and single wing fyke netting (at two sites). Backpack electrofishing methods followed the Sustainable Rivers Audit protocol[1]. Fyke netting consisted of four single wing fyke nets (5 mm mesh) set overnight at each site, with an approximate soak time of 18 hours. Floats were used at the cod end of each net to ensure that any mammals or turtles captured would be safely held until release.

At the new monitoring sites, all wetted, accessible habitats within the channel were surveyed using single pass backpack electrofishing. Electrofishing effort (total seconds fished) and distance fished were recorded for each site, along with an assessment of key habitat attributes within the study reach. Specifically:

- *Mean and maximum depth:* recorded for each site
- *Instream woody habitat:* The location of each IWH mass, along with its estimated size and complexity were recorded using a Trimble® GeoExplorer® XT6000 series handheld Global Navigation Satellite System coupled with a laser range finder. Both size and complexity parameters were categorised into one of four categories, producing 16 possible combinations of size and complexity for any given IWH mass. This was then converted to volume (m^3) based on methods described in Kitchingman et al. (2015).
- *Riparian overhang:* generated remotely using the statewide LIDAR data set
- *Other instream structural habitat features:* Features such as rock works, boulders and undercut banks were recorded if present at a site.

An external t-bar tag and internal PIT tag was given to some Macquarie perch individuals greater than 200 mm total length. A small fin clip was taken from 30 Macquarie perch of various sizes for genetic analysis. All fish were released at the site of capture after being measured for total length (mm) and weight (g). Water quality (temperature, dissolved oxygen, turbidity, pH and electrical conductivity) was recorded at each site.

[1] MDBC. (2007). Sustainable Rivers Audit Protocols: Approved Manual for Implementation Period 4: 2007-2008. Murray-Darling Basin Commission, Canberra.

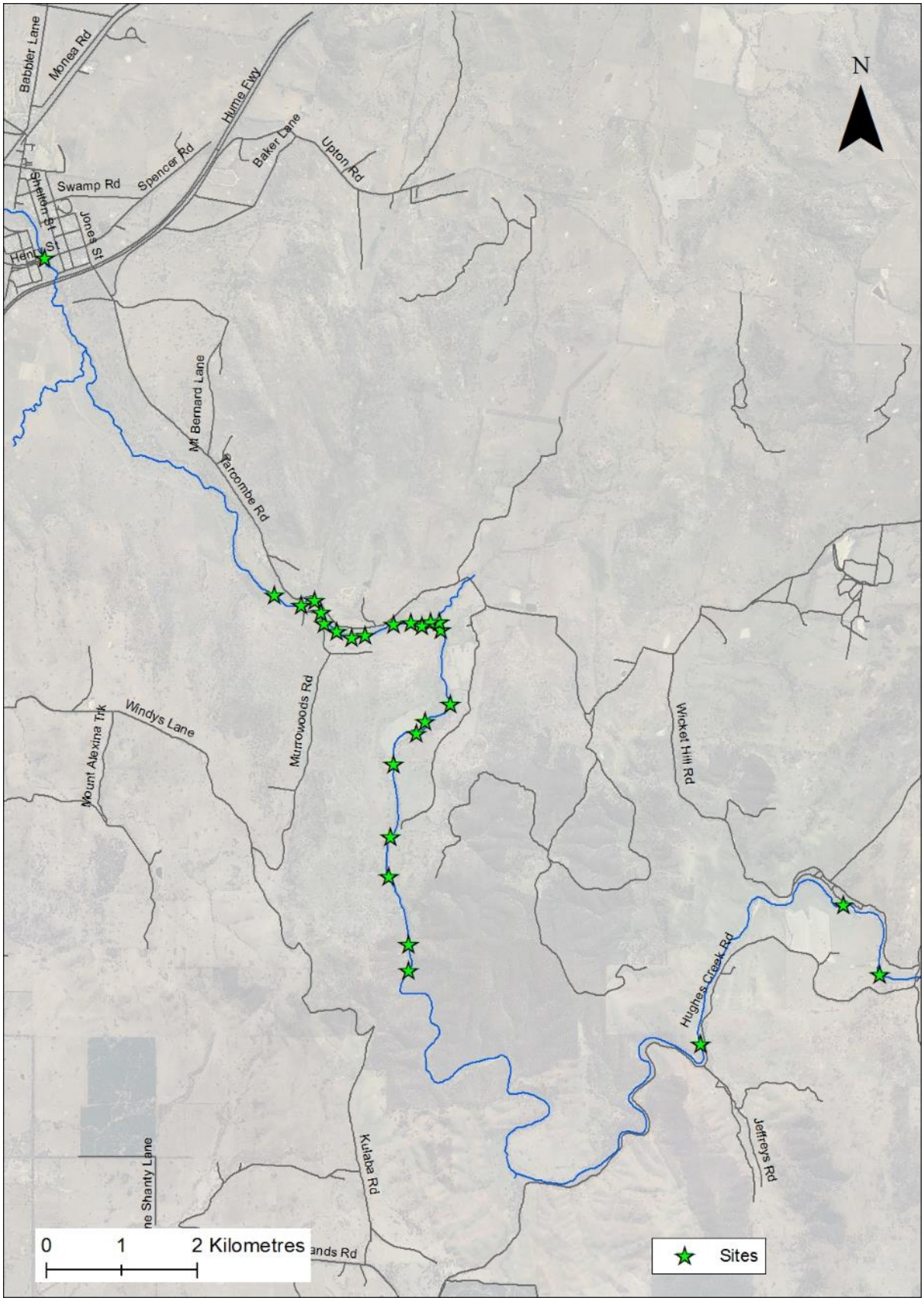

Figure 1. Map of survey sites in Hughes Creek (Table 2)

Table 1. Removed: Locations of fish surveys in Hughes Creek, March 2016, included 14 new survey sites.

Table 2. Species collected, abundance (*N*) and size range (total length, mm) per site surveyed in Hughes Creek, March 2016. * denotes introduced species.

SITE	G21	G20	G19	G18	GB_HUG101
SPECIES	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)
Macquarie perch *Macquaria australasica*	4 (128 – 152)	5 (135 – 205)	18 (111 – 356)	96 (136 – 393)	0
River blackfish *Gadopsis marmoratus*	12 (70 – 190)	6	12	188 (71 – 229)	17 (82 – 216)
Golden perch *Macquaria ambigua*	0	0	0	0	0
Murray cod *Maccullochella peelii*	0	0	0	0	0
Common galaxid *Galaxias olidus*	3 (54 – 64)	1 (60)	0	33 (39 – 91)	5 (59 – 107)
Carp gudgeon *Hypseleotris sp.*	0	0	0	0	0
Southern pygmy perch *Nannoperca australis*	35 (39 – 74)	6 (44 – 71)	1 (55)	0	0
Flat-headed gudgeon *Philypnodon grandiceps*	0	5 (78 – 104)	3 (73 – 82)	2 (99 – 100)	0
Carp * *Cyprinus carpio*	14 (76 – 226)	57 (76 – 246)	38 (145 – 565)	87 (82 – 550)	2 (80 – 102)
Goldfish * *Carassius auratus*	0	0	0	0	0
Eastern Gambusia * *Gambusia holbrooki*	0	3 (42 – 52)	41 (23 – 62)	8 (24 – 50)	1 (31)
Redfin * *Perca fluviatilis*	0	0	0	12 (109 – 138)	0
Tench * *Tinca tinca*	1 (66)	0	0	0	0
Common long-neck turtle *Chelodina longicollis*	0	0	0	0	0
Murray River turtle *Emydura macquarii macquarii*	0	0	0	0	0
Yabby *Cherax destructor*	15 (13 – 26)	6 (14 – 25)	8 (7 – 23)	2 (4 -12)	22 (13 – 70)
TOTAL	**84**	**89**	**121**	**428**	**47**

Table 2. continued

SITE	GB_HUG102	G23 and GB_HUG_103	HC1	HC4	HC3
SPECIES	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)
Macquarie perch *Macquaria australasica*	0	13 (120 – 315)	0	6 (177 – 237)	0
River blackfish *Gadopsis marmoratus*	13 (118 – 180)	34 (118 – 222)	15 (104 – 173)	11(76 – 170)	7 (141 – 187)
Golden perch *Macquaria ambigua*	0	0	0	0	0
Murray cod *Maccullochella peelii*	0	0	0	0	0
Common galaxid *Galaxias olidus*	3 (61 – 76)	6 (60 -78)	0	0	1 (60)
Carp gudgeon *Hypseleotris sp.*	0	1 (38)	0	0	0
Southern pygmy perch *Nannoperca australis*	0	0	0	0	0
Flat-headed gudgeon *Philypnodon grandiceps*	1 (56)	0	1 (40)	0	0
Carp* *Cyprinus carpio*	19 (95 – 590)	41 (70 – 485)	26 (58 – 468)	27 (64 – 600)	6 (68 – 500)
Goldfish * *Carassius auratus*	0	0	0		1 (268)
Eastern Gambusia * *Gambusia holbrooki*	1 (42)	4 (26 – 49)	0	1 (45)	5 (29 – 40)
Redfin * *Perca fluviatilis*	0	0	0	4 (100 – 108)	0
Tench * *Tinca tinca*	0	0	0	0	0
Common long-neck turtle *Chelodina longicollis*	0	0	0	0	0
Murray River turtle *Emydura macquarii macquarii*	0	0	0	0	0
Yabby *Cherax destructor*	16 (8 – 37)	19 (14 – 29)	2 (17 – 19)	4 (21 – 26)	8 (19 – 35)
TOTAL	**53**	**118**	**44**	**53**	**28**

Table 2. continued

SITE	HC2	G24	HC14	HC13	HC12
SPECIES	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)
Macquarie perch *Macquaria australasica*	0	11 (127 – 290)	0	0	1 (186)
River blackfish *Gadopsis marmoratus*	15 (71 – 180)	8 (125 – 202)	0	12 (125 -231)	6 (127 – 172)
Golden perch *Macquaria ambigua*	0	3 (84 – 220)	0	0	0
Murray cod *Maccullochella peelii*	0	0	0	0	0
Common galaxid *Galaxias olidus*	2 (45 – 68)	0	10 (53 – 76)	5 (55 – 74)	7 (64 – 96)
Carp gudgeon *Hypseleotris sp.*	0	0	0	0	1 (40)
Southern pygmy perch *Nannoperca australis*	0	0	0	0	0
Flat-headed gudgeon *Philypnodon grandiceps*	1 (87)	1 (75)	0	0	0
Carp * *Cyprinus carpio*	10 (62 – 550)	28 (52 – 510)	1 (149)	6 (145 – 580)	7 (74 – 565)
Goldfish* *Carassius auratus*	0	2 (220 – 360)	1 (57)	0	0
Eastern Gambusia * *Gambusia holbrooki*	10 (25 -37)	1 (45)	6 (22 - 28)	1 (29)	4 (25 – 40)
Redfin * *Perca fluviatilis*	1 (122)	0	0	0	0
Tench * *Tinca tinca*	0	0	0	0	0
Common long-neck turtle *Chelodina longicollis*	0	0	0	0	0
Murray River turtle *Emydura macquarii macquarii*	0	0	0	0	0
Yabby *Cherax destructor*	11 (15 – 25)	5 (12 – 35)	16 (16 – 33)	7 (15 – 25)	6 (11 – 27)
TOTAL	**50**	**59**	**34**	**31**	**32**

Table 2. continued

SITE	HC11	HC10	G15	HC9	HC8
SPECIES	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)
Macquarie perch *Macquaria australasica*	2 (170 – 200)	0	3 (172 – 198)	0	0
River blackfish *Gadopsis marmoratus*	16 (109 – 223)	7 (110 – 185)	30 (121 – 220)	3 (163 – 180)	0
Golden perch *Macquaria ambigua*	0	0	0	0	0
Murray cod *Maccullochella peelii*	0	0	0	1 (114)	0
Common galaxid *Galaxias olidus*	1 (62)	1 (70)	17 (50 – 90)	0	0
Carp gudgeon *Hypseleotris sp.*	0	0	0	0	1 (47)
Southern pygmy perch *Nannoperca australis*	0	0	0	0	0
Flat-headed gudgeon *Philypnodon grandiceps*	0	0	1 (75)	0	0
Carp * *Cyprinus carpio*	5 (61 – 199)	12 (117 – 545)	17 (61 – 485)	1 (151)	4 (164 – 490)
Eastern Gambusia * *Gambusia holbrooki*	2 (37 – 40)	2 (36 – 39)	9 (20 -70)	1 (35)	0
Goldfish * *Carassius auratus*	0	0	0	0	0
Redfin * *Perca fluviatilis*	0	0	0	0	0
Tench * *Tinca tinca*	1 (245)	0	0	0	0
Common long-neck turtle *Chelodina longicollis*	0	0	0	0	0
Murray River turtle *Emydura macquarii macquarii*	0	0	0	0	0
Yabby *Cherax destructor*	4 (12 – 18)	5 (11 – 25)	2 (28 – 29)	0	0
TOTAL	**31**	**27**	**79**	**6**	**5**

Table 2. continued

SITE	HC7	HC6	G29	HC5	G16
Species	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)	*N* Range (mm)
Macquarie perch *Macquaria australasica*	0	0	4 (195 – 375)	1 (71)	0
River blackfish *Gadopsis marmoratus*	1 (84)	0	1 (222)	4 (125 – 201)	4 (145 – 175)
Golden perch *Macquaria ambigua*	0	0	3 (167 – 218)	0	0
Murray cod *Maccullochella peelii*	0	0	0	0	0
Common galaxid *Galaxias olidus*	1 (58)	1 (55)	0	1 (74)	2
Carp gudgeon *Hypseleotris sp.*	0	0	0	1 (40)	0
Southern pygmy perch *Nannoperca australis*	0	0	0	0	0
Flat-headed gudgeon *Philypnodon grandiceps*	1 (50)	0	0	0	0
Carp * *Cyprinus carpio*	5 (115 – 510)	0	1 (262)	2 (400 – 430)	7 (136 – 425)
Eastern Gambusia * *Gambusia holbrooki*	1 (34)	5 (24 – 35)	0	0	13 (12 – 53)
Goldfish * *Carassius auratus*	1 (185)	0	0	0	0
Redfin * *Perca fluviatilis*	0	0	0	0	0
Tench * *Tinca tinca*	0	0	0	0	0
Common long-neck turtle *Chelodina longicollis*	0	0	3	0	0
Murray River turtle *Emydura macquarii macquarii*	0	0	1	0	0
Yabby *Cherax destructor*	3 (6 – 17)	1 (27)	0	2 (16 – 24)	3 (16 – 29)
TOTAL	**13**	**7**	**13**	**11**	**29**

Table 2. continued

SITE	G17	TOTAL
Species	*N* Range (mm)	***N*** **Range (mm)**
Macquarie perch *Macquaria australasica*	0	**164 (71 – 393)**
River blackfish *Gadopsis marmoratus*	0	**422 (70 – 231)**
Golden perch *Macquaria ambigua*	0	**6 (84 – 220)**
Murray cod *Maccullochella peelii*	0	**1 (114)**
Common galaxid *Galaxias olidus*	0	**100 (39 – 107)**
Carp gudgeon *Hypseleotris sp.*	0	**3 (38 – 56)**
Southern pygmy perch *Nannoperca australis*	0	**42 (39 – 74)**
Flat-headed gudgeon Philypnodon grandiceps	0	**17 (40 – 104)**
Carp * *Cyprinus carpio*	20 (42 – 580)	**443 (42 – 600)**
Eastern Gambusia * *Gambusia holbrooki*	33 (19 – 47)	**152 (12 – 70)**
Goldfish * *Carassius auratus*	1 (89)	**6 (57 – 360)**
Redfin * *Perca fluviatilis*	0	**17 (100 – 138)**
Tench * *Tinca tinca*	0	**2 (66 – 245)**
Common long-neck turtle *Chelodina longicollis*	0	**3 (144 – 195)**
Murray River turtle *Emydura macquarii macquarii*	0	**1 (45)**
Yabby *Cherax destructor*	16 (15 – 29)	**183 (6 – 70)**
TOTAL	**70**	**1562**

Results

- A total of 1375 fish, representing eight native and five introduced species, were recorded during surveys of Hughes Creek (Table 2). Native fish accounted for 55% of the total catch. Other fauna also recorded included common long-neck turtles, Murray River turtle and yabbies. In addition to these species collected, other species observed included spiny crayfish and rakali (native water rat).
- The most abundant species captured was the introduced species, common carp (*Cyprinus carpio N* = 443) followed by the native species, river blackfish (*Gadopsis marmoratus N* = 422; Table 2).
- Macquarie perch (*N* = 164) were collected from 12 sites surveyed. Distribution ranged from the most upstream site (G21) to HC5. Although this does not represent an increase in distribution compared to previous surveys, we now know that Macquarie perch occur at more locations within this distribution, such as at HC11, HC12, HC4 and G20. Macquarie perch were collected at three regular monitoring sites where they haven't been recorded during the past few surveys, i.e. G24, G15 and G20. Macquarie perch have not been recorded at G24 since 2013, G15 since 2007 and never during past surveys at G20. Four Macquarie perch were collected at the most upstream site (G21) this year; one individual was recorded there last year being the first record for this site.
- Macquarie perch ranged in size from 71 - 393 mm total length (average = 195 mm total length) (Figure 3). Two dominant size classes occurred. 39% of Macquarie perch collected were between 100 and 160 mm total length and 42% of Macquarie perch collected were between 170 and 220 mm (Figure 3). Only 1 young of year (YOY) Macquarie perch was collected at site HC5 (Table 2). Flash flooding on January 4, 2016 may have affected the survivorship or distribution of young of year Macquarie perch. The gorge (G18) continues to be a stronghold for adult Macquarie perch (>220 mm) (Table 2).
- Five Macquarie perch (>300mm) were recaptured from past surveys (Table 3). All were recaptured at the site they were initially tagged. Three were from the gorge (G18) and were initially tagged in 2013, and one each from G23 and G19 which were initially tagged in 2015. These individuals have not grown in length since being tagged.
- The size range of the juvenile Macquarie perch captured is indicative of strong recruitment in the 2013 and 2014 Spring spawning periods. This recruitment pattern follows the results of other populations throughout Victoria, including the Yea River, Sevens Creek and King Parrot Creek (Goulburn Broken catchment); Lake Dartmouth and Yarra River. The small number of YOY fish captured this year however, is indicative of poor recruitment from the spring 2015 spawning season. The aforementioned localised flash flood in January 2016 is a likely driver of this pattern; particularly given recent surveys of nearby systems not subject to this event (e.g. King Parrot Creek and Sevens Creek) reported reasonable numbers of YOY fish.
- The abundance of carp has increased in Hughes Creek. Carp were present at 25 sites. The size range of carp collected indicates recent recruitment. Hundreds of juvenile carp were observed at Bungle Boori and the Rock chute. Targeted carp control is recommended.
- Instream woody habitat densities were highest at three regions; the gorge (G1*), G23 and between sites G15 to G29 (Figures 9 - 16). Macquarie perch and river blackfish occur in greatest abundances in G18. G23 contains a good refuge pool for Macquarie perch just downstream of the works zone (Figure 7) and river blackfish were collected off a few of the newly installed structures. River blackfish were also more abundant at site G15. Further research is currently underway to investigate the relationship between fish occupancy and instream woody habitat as part of the Statewide fish habitat project.
- Given the substantial investment in enhancing the instream habitat values of Hughes Creek, we recommend repeating the surveys in 2017. In particular, monitoring changes in occupancy and distribution of native fish species at these sites following the interventions (above and below the gorge) will be of considerable interest to help inform future restoration programs. Continued monitoring of fish in Hughes Creek will also provide insight into the effect of other events (such as the localised flash flooding) on population dynamics of fish species (both native and introduced) in the system, as well as Macquarie perch year class strength and reproductive output.

- Improvements to fish habitat, such as installing instream woody habitat, riparian revegetation and sand management, will benefit the resident Macquarie perch population in Hughes Creek. We suggest focusing future works close to the downstream distributional range of Macquarie perch in Hughes Creek. Improving habitat values, particularly structural habitat and refuge pools, will hopefully expand the downstream distribution of the population to achieve the ultimate long-term objective of facilitating fish access the Goulburn River. Interventions at selected locations within the reach between G23 and G29 would help improve habitat condition and connectivity within the downstream range of Macquarie perch in Hughes Creek. Actions could be targeted initially in the upstream locations and progressively occur downstream to encourage connectivity with the main Macquarie perch stronghold in the gorge.

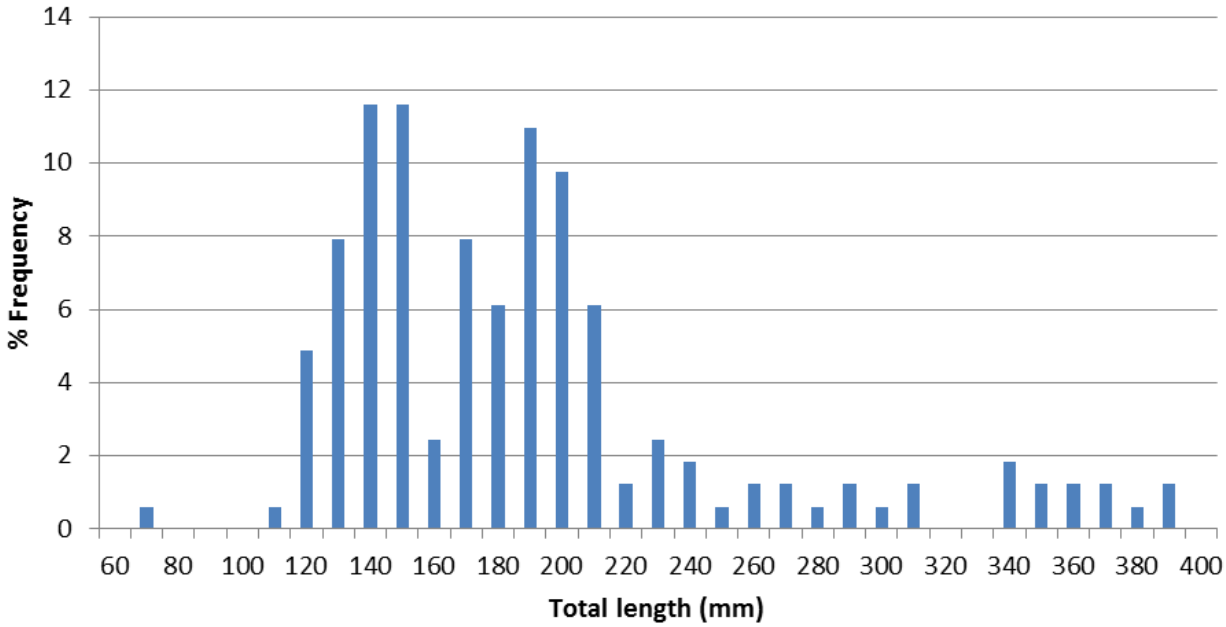

Figure 3. Size frequency histogram (% of occurrence) of Macquarie perch captured in Hughes Creek, March 2016

Table 3. Macquarie perch recaptured in Hughes Creek in March 2016, including site and total length (mm) since initial year tagged.

FISH (PIT number)	INITIAL TAGGING Year, Site, Total length (mm)	RECAPTURE Year, Site, Total length (mm)	RECAPTURE Year, Site, Total length (mm)
178750071	2013, G18, 372 mm	2015, not collected	2016, G18, 365 mm
178750083	2013, G18, 400 mm	2015, G18, 397 mm	2016, G18, 392 mm
178750075	2013, G18, 388 mm	2015, G18, 392 mm	2016, G18, 385 mm
982000199068516	2015, G23, 313 mm		2016, G23, 315 mm
951000501144683	2015, G19, 309 mm		2016, G19, 307 mm

Figure 4. A young of year Macquarie perch and a hatchling Murray River turtle collected at sites HC5 and G29

Figure 5. Adult Macquarie perch collected at HC4 (205 mm) and in the G18 (353 mm), respectively.

Figure 6. A juvenile Murray cod collected at HC9

Figure 7. This large complex instream woody habitat is a refuge area for Macquarie perch at site G23

Figure 8. Recent catchment erosion has deposited large volumes of cobbles and boulders into Hughes Creek within the upper region of the gorge (Latitude: -37.004828, Longitude: 145.291614)

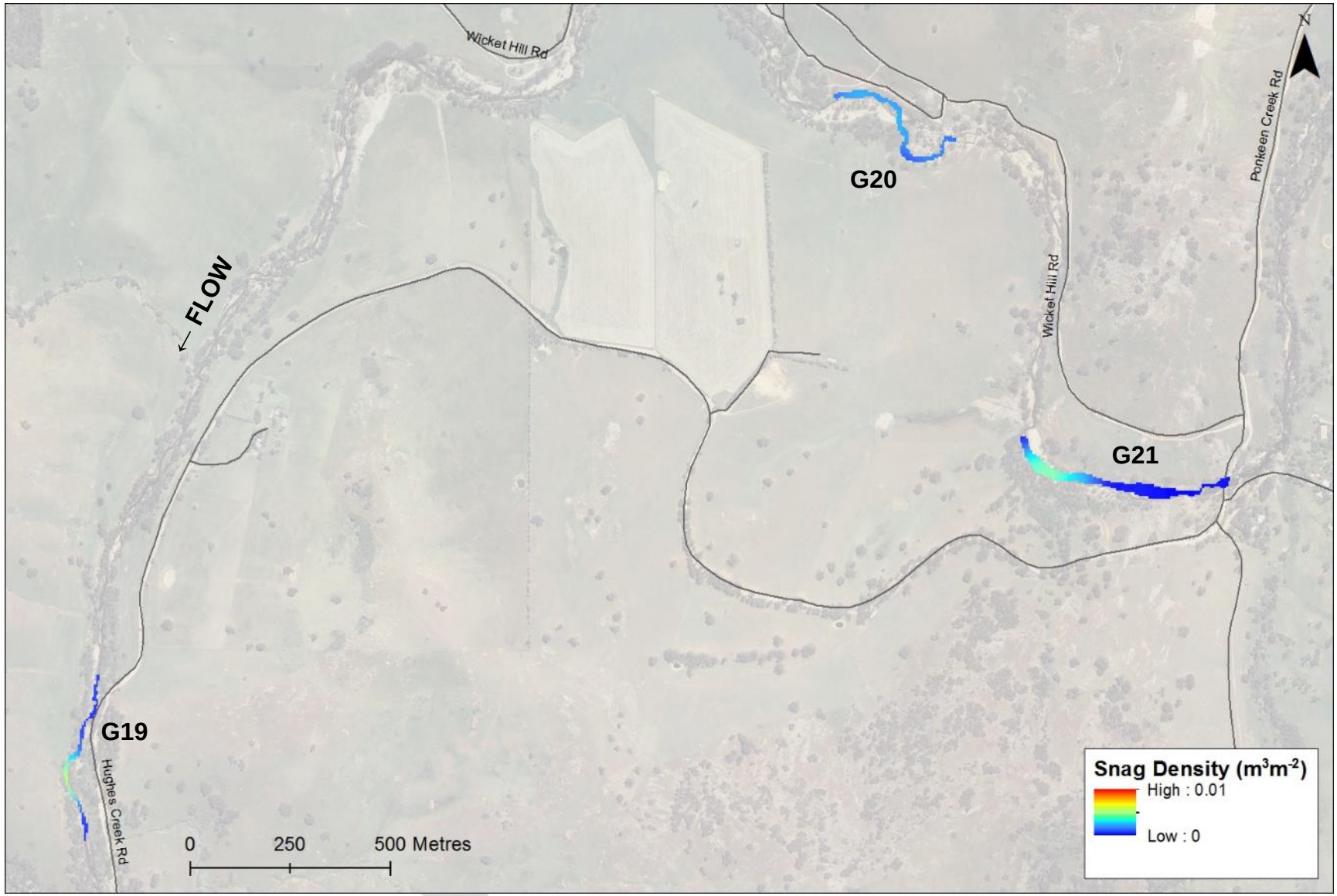

Figure 9. Instream woody habitat (snag) density (m^3 m^{-2}) for sites from G19 to G21 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.

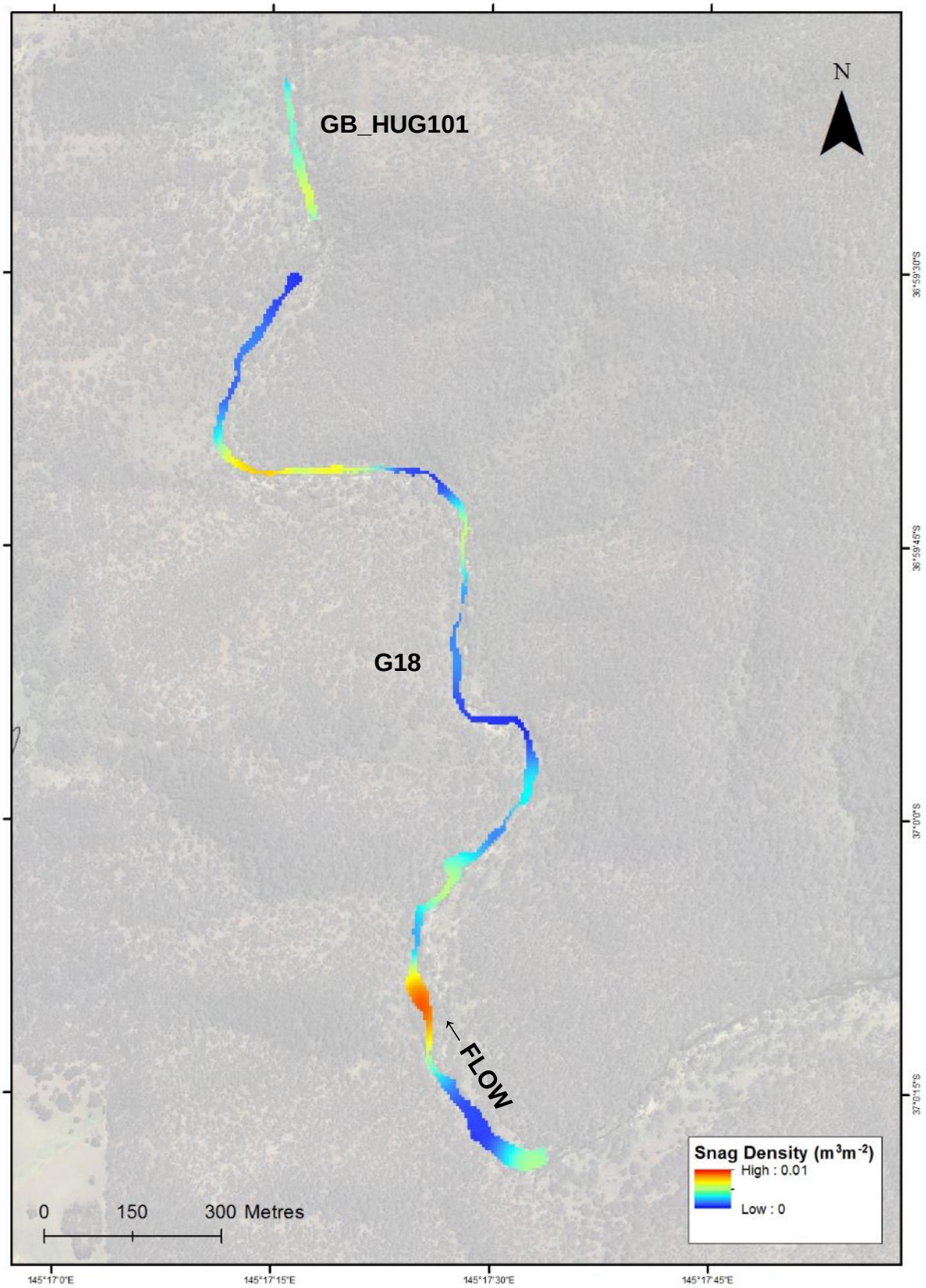

Figure 10. Instream woody habitat (snag) density (m^3 m^{-2}) for sites GB_HUG101 to G18 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.

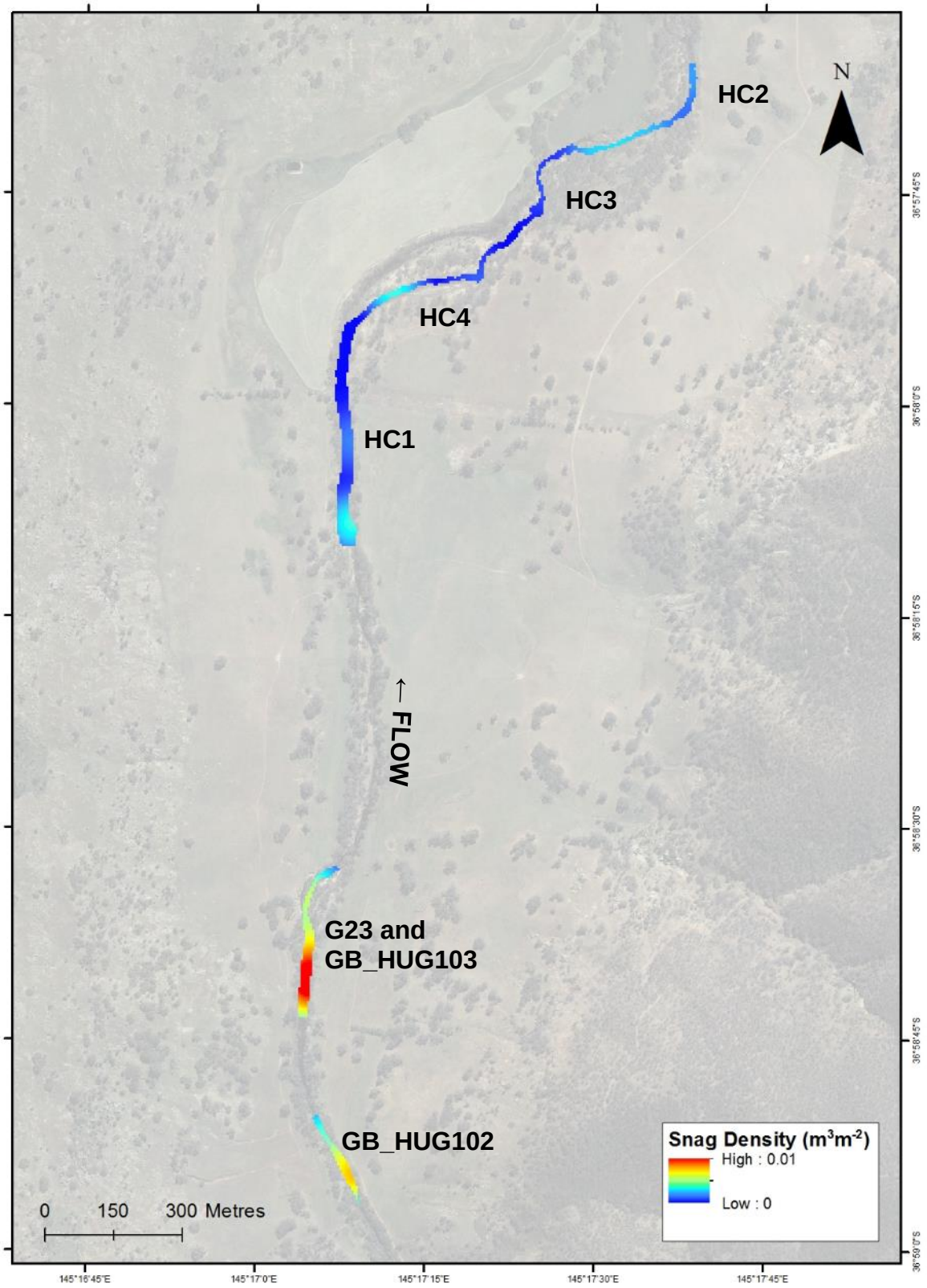

Figure 11. Instream woody habitat (snag) density (m^3 m^{-2}) for sites from HC2 to GB_HUG102 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.

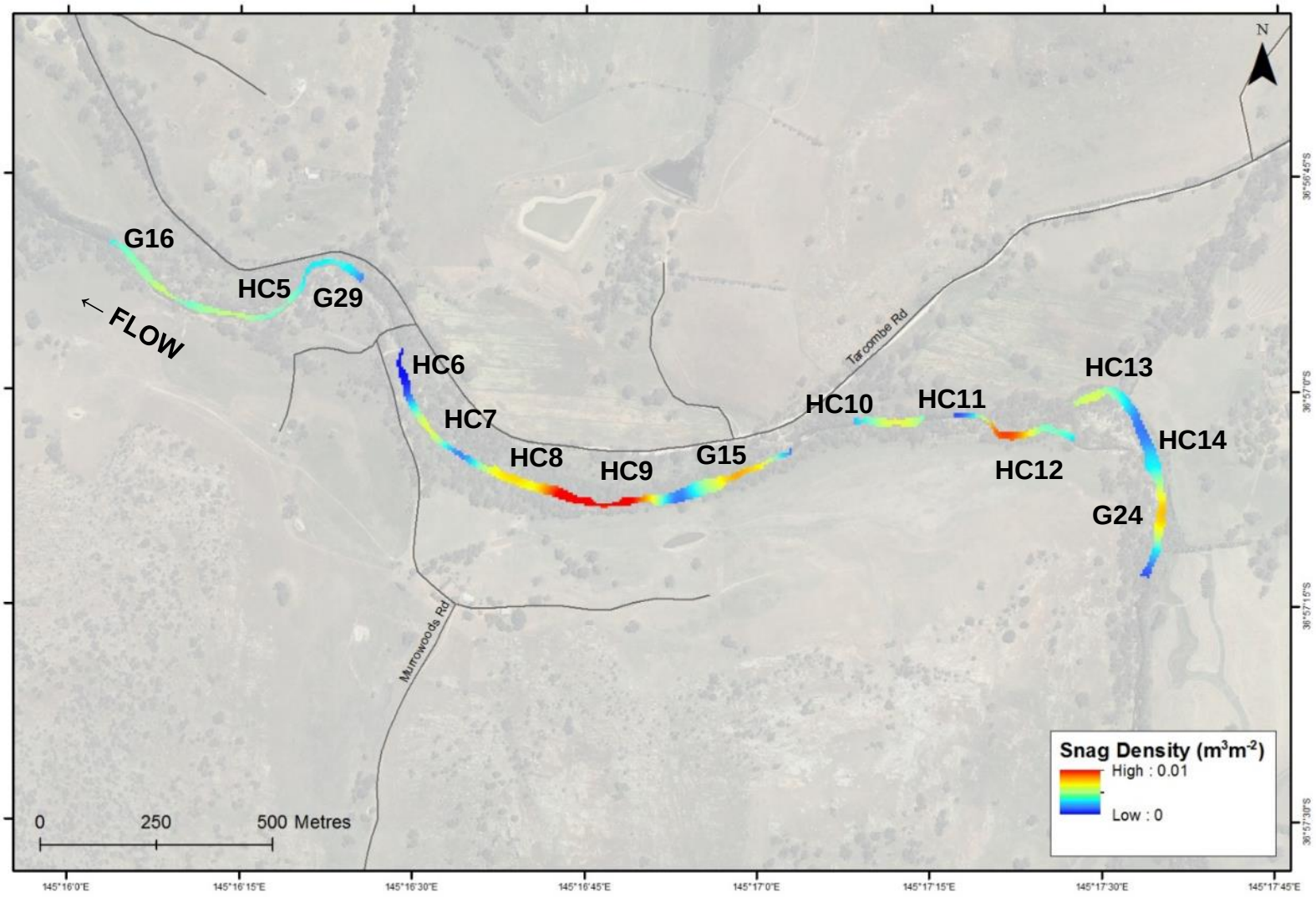

Figure 12. Instream woody habitat (snag) density (m^3 m^{-2}) for sites from G16 to G24 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.

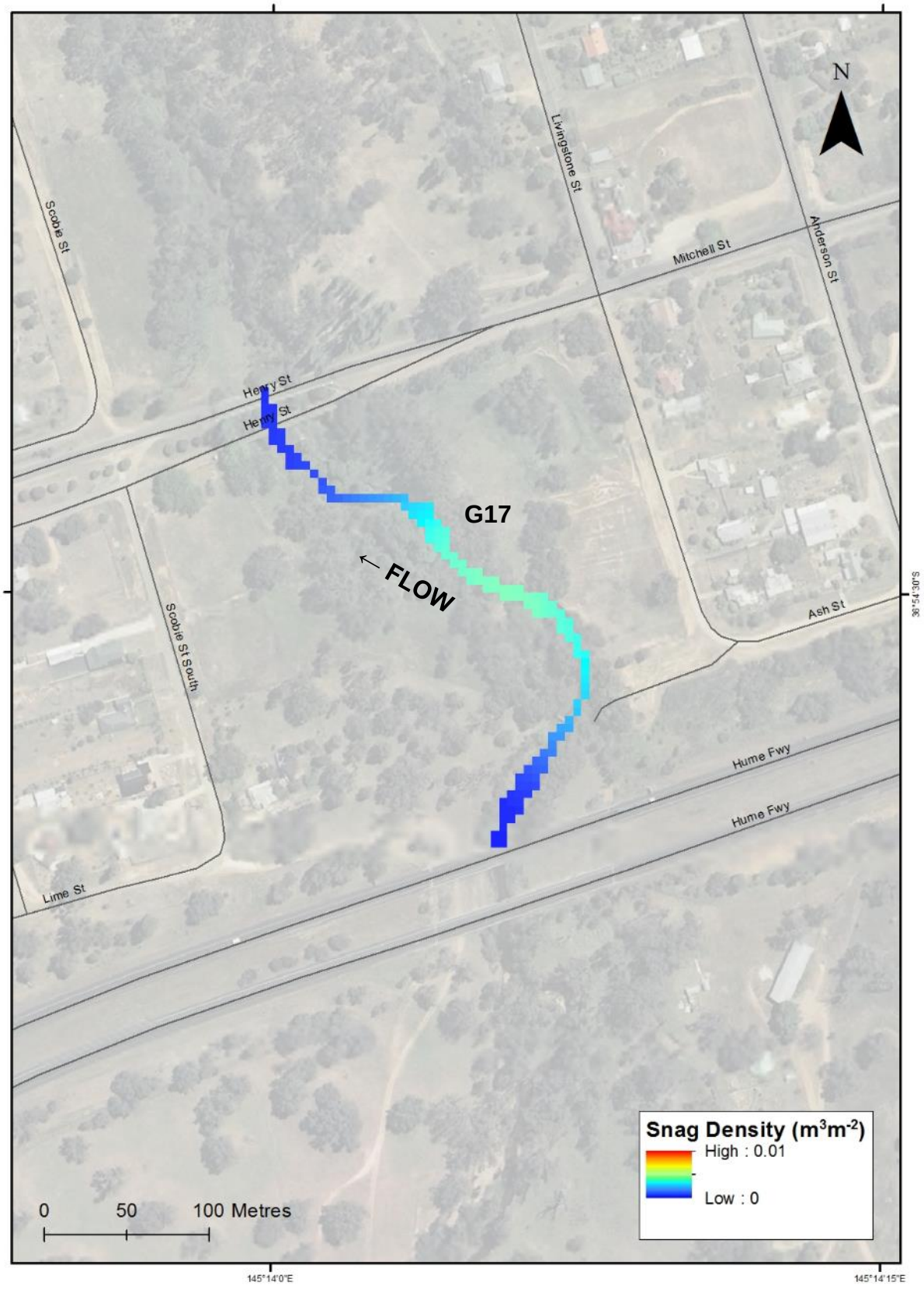

Figure 13. Instream woody habitat (snag) density (m^3 m^{-2}) for site G17 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.

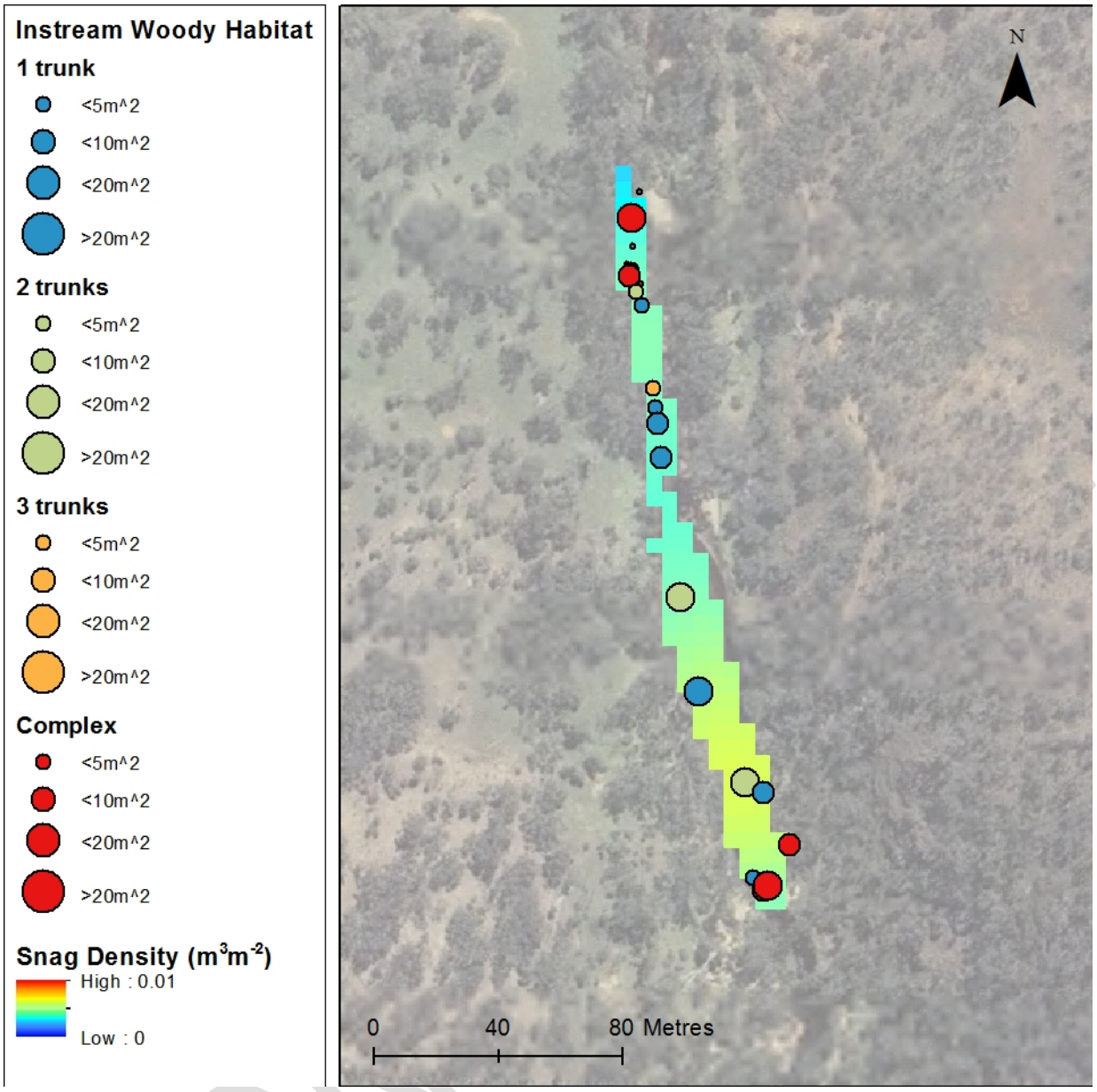

Figure 14. Instream woody habitat (snag) location, complexity, volume (coloured circles) and snag density (m^3m^{-2}) for works site GB_HUG101 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.

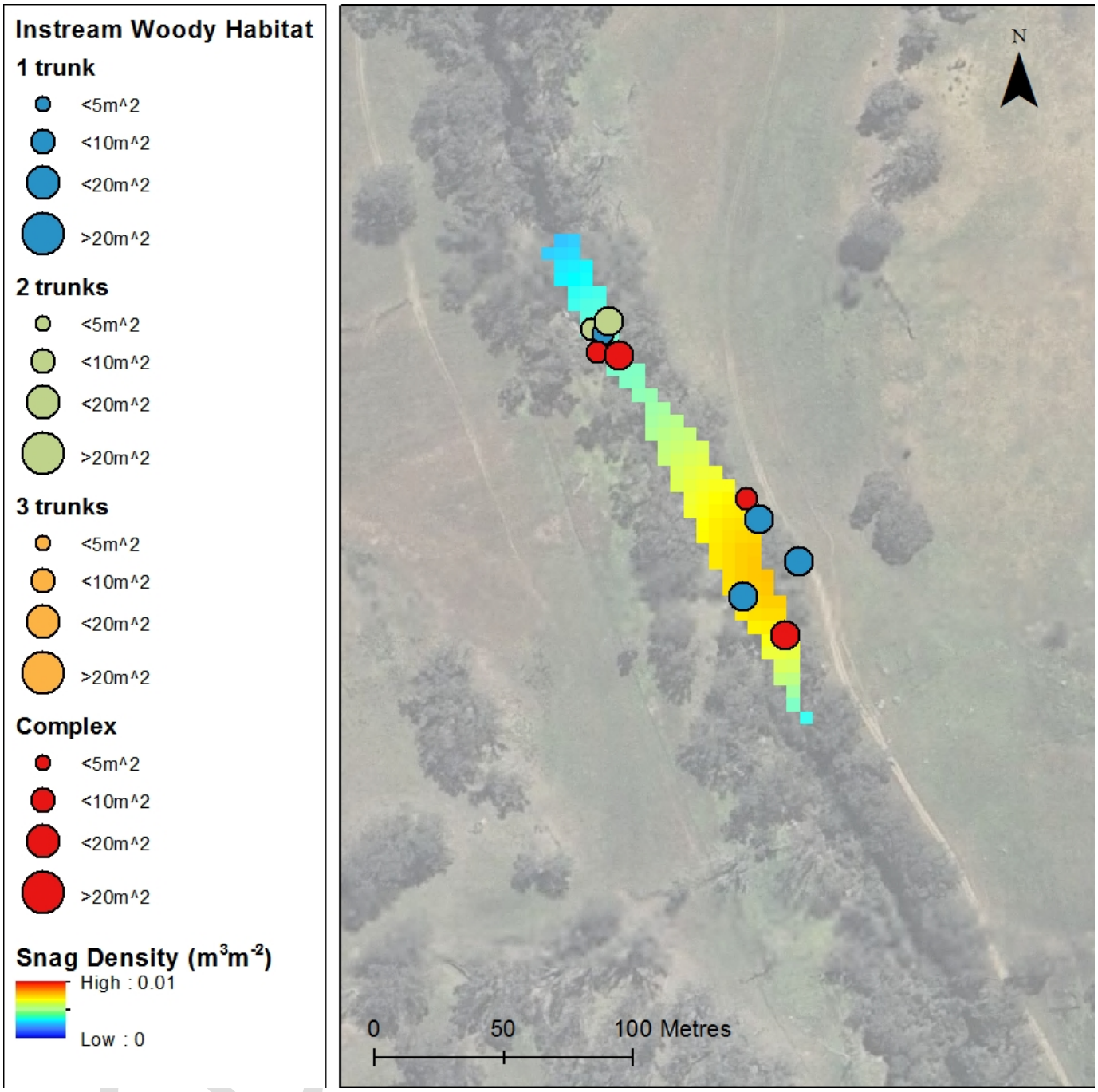

Figure 15. Instream woody habitat (snag) location, complexity, volume (coloured circles) and snag density (m^3m^{-2}) for works site GB_HUG102 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.

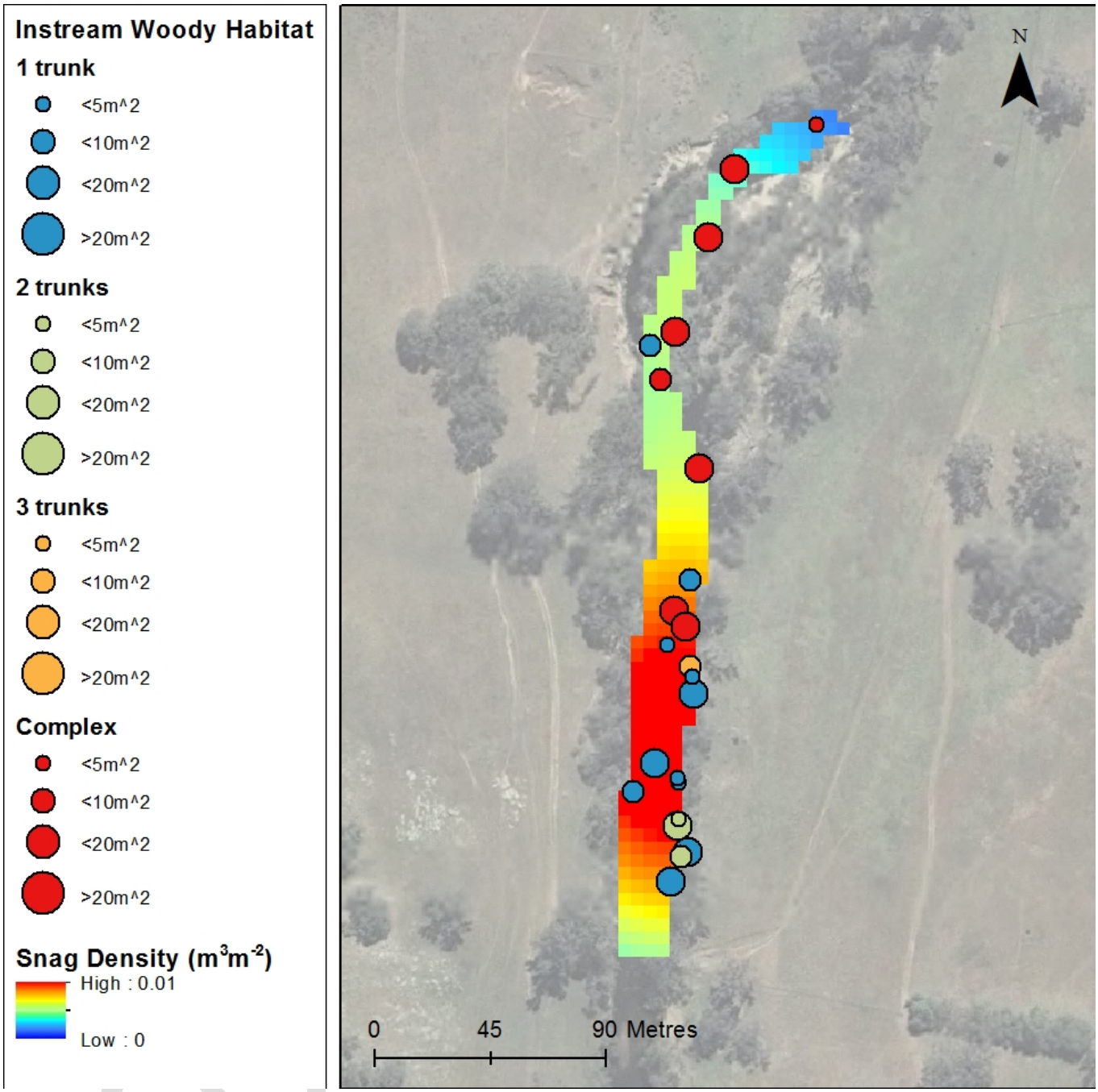

Figure 16. Instream woody habitat (snag) location, complexity, volume (coloured circles) and snag density (m^3m^{-2}) for works site G23 in Hughes Creek. Kernel density estimate with 100m radius weighted by snag volume.