Pool and Bench Vegetation of Stream E, Ginninderry: spring 2021

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Summary

This survey (the third repeat survey) followed the same protocols and methods described in *Pool and Bench Vegetation of Stream E, Ginninderry: Baseline in Spring* 2018 (Roberts and Sharp 2019). To make this report more concise, two indicators (Annuals and Grasses) and two parts (Evaluation and Bench floristics) were excluded from this report. However, the average height of tall emergent macrophytes was measured and added to this report for the first time. All indicators were chosen because they are expected to respond to urbanisation effects on stream hydrology and water quality.

The water flow in stream E (2021) was slower and clearer than 2020 in upstream areas, and the surrounding vegetation in downstream areas was less dense. Overall, the impacts of grazing and pugging damage in 2021 showed clear signs of improvement compared with 2020.

For pools, the total depth in 2021 was lower than 2020, but the changes in sediment depth were less obvious. This was probably because no water had been released from two sediment ponds in the upstream area before the field survey. Besides, it is important to note that the sediment depth in 2020 and 2021 was a lot lower than 2019, which may suggest the sediment in 2019 had been flushed out by higher flows in the following years. The area of tall emergent macrophytes in 2021 was significantly higher than the previous surveys in 2019 and 2020, whereas the area of submerged macrophytes only showed increases in site E32.

All benches were mainly covered by grasses. More dominant species were identified but fewer forb species had been found in bench quadrats compared with the previous years. Among these forb species, nearly all of them were introduced species and only two forb species had been identified as native in site E13.

1. Pool and bench vegetation survey of Stream E (2021)

1.1: Background

This is the third repeat survey of vegetation of Stream E. Design and rationale for this survey, and results of the Baseline Survey in October- November 2018, are given in *Pool and Bench Vegetation of Stream E, Ginninderry: Baseline in Spring* 2018 (Roberts and Sharp 2019).

This report uses the same lay-out as previous monitoring reports (Roberts and Sharp 2020). Results are in two sections (Section 2: Pools; Section 3: Benches). In this report, Sections 2 and 3 now have a short description of the Method, immediately before each set of Results. Evaluation against targets (Section 4 in the previous monitoring report) is not included, as this report focuses on comparing data between three different years (2019, 2020, and 2021) and aims to make this version more concise.

Vegetation is monitored on two geomorphic features of Stream E: pools and benches. As these are where vegetation changes are likely to occur in response to upstream development. For practical reasons, runs (which are a third geomorphic feature of Stream E) were not included.

This survey uses two qualitative indicators (reference photos and impact gradient) and eight quantitative indicators. For qualitative indicators, the previous studies revealed that large animals cause impacts on pools and bench edges, so grazing effects and physical damage will be added in this report as one of qualitative indicators (present as impact gradient). On the other hand, the eight quantitative indicators, including vegetation height, dominant species, quadrat cover (%), nativeness (%), pool depth (cm), tall emergent macrophytes area (m^2), submerged macrophytes area (m^2), and average height of tall emergent macrophytes (cm), were chosen because they are expected to respond to urbanisation effects on stream hydrology (increased discharge, faster flows, fewer dry spells) and water quality (sediment load).

The raw data was recorded on the data sheets in the field survey and then transferred to an Excel file where average and standard deviation (referred to as **SD** in this report) were calculated. All the charts in this report were plotted by the programming language Python by importing pyplot (Matplotlib) and numpy modules.

1.2: Study sites and Conditions

Study sites: The field study was launched in Stream E, one of several short steep streams in the Ginninderry Conservation Corridor, flowing down into the Murrumbidgee River. In this survey, nine sites were sampled along Stream E: with the most upstream site being E01 (-35.22745, 148.98026) to the most downstream site being E32 (-35.22761, 148.96894) (Figure 1). Two of the sites in the previous studies, rc1 and rc2 were excluded from this report because rc1 is in one of the steeper parts of Stream E and therefore it is very hard to access and the nine sites we chose to include in this survey already represented the stream and its vegetation well. As a result, the number of sites here is 9, rather than 11 for the last year.

Figure 1. The nine study sites along Stream E (marked in blue).

Survey Team and Timing: The survey team in 2021 comprised Bridie Noble, Chen-Yang Tsai, Moonawara Rashid, Rachel Eland, Rebecca McGuire, Sharae Hurley, and Tyson Powell. Field work was done on two days (15 November to 16 November 2021) and each from morning to mid-afternoon, which is one week later than the last survey (on 7 and 9 November 2020). These dates conform to the mid-spring timeframe recommended in the Baseline report.

Conditions: Rainfall is often considered as an important indicator for water depth and vegetation growth. The weather conditions in 2021 were considerably wetter than the previous two years (Figure 2). The total rainfall from June to November in 2021 was 535.2mm, which is higher than total rainfall in 2020 (454.4mm) and 2019 (121mm) (Figure 2). Individually, rainfall (2021) in June, July, September, and November was also a lot higher than their counterparts in 2019 and 2020 (Figure 2).

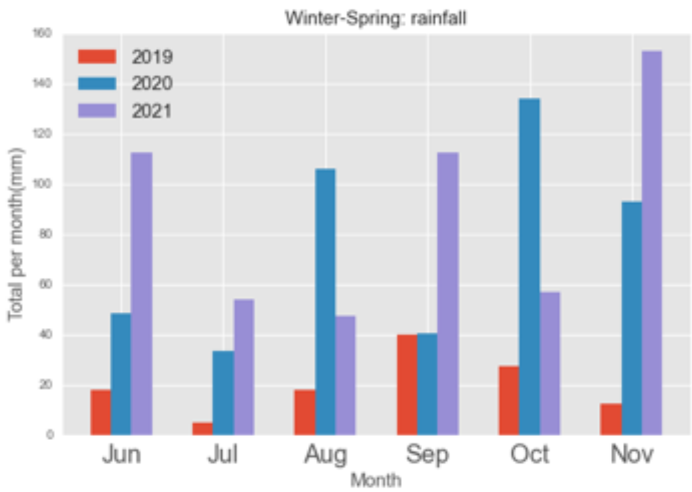

Figure 2. Winter to spring rainfall in 2019, 2020, and 2021 (Station 070351, Bureau of Meteorology)

Three important factors affecting the turbidity and water depth of Stream E are worthy to consider: November 2021 was the wettest November on record in Australian Capital Territory with more than two times its average monthly rainfall (Bureau of Meteorology, 2021); two sediment ponds on the edge of Strathnairn suburb that flow into Stream E, were taken offline before field survey due to the reshaping and landscaping activities; with the activities being undertaken, the water in the ponds could no longer be treated before being released into Stream E during times of high rainfall.

Sediment depth is likely to be influenced by many factors, such as erosion (Duodu, Goonetilleke, & Ayoko, 2017), terrain (Wang, Yan, Wen, & Chen, 2016), and water flow (Gupta and Chakrapani, 2005). Further studies are required to decide the main factors affecting the sediment depth of Stream E.

2. Pools in 2021

2.1: General Description

Reference Photographs

METHOD

Two reference photos were taken at each site: one looking downstream, and one looking upstream. The observer was positioned so that the angle and scope of the photograph matched the baseline photograph taken in 2018 (a set of photographs was taken into the field for this purpose)

RESULTS

All reference photos for each site, including looking upstream and downstream, are in Appendix. It can be discussed in two aspects: pools and vegetation.

Pools: the water flow in stream E (2021) was **slower** and **clearer** than 2020. However, the differences between these two years were less significant when the pools were close to the Murrumbidgee River.

Vegetation: vegetation on mudflats, benches, and the hillside beside Stream E was **less** dense than 2020 in downstream areas of Stream E (reference photos site E19, E26, E28, and E32); no significant differences between 2020 and 2021 in upstream areas.

2.2: Indicators

Pool Depth

METHOD

The monitoring program used two metrics for pool depths, all measured with a metre rule in the deepest part of the pool: (1) total depth, which is the depth from firm substrate to water surface (or water depth plus sediment depth); and (2) sediment depth, which is the depth of sediment and was obtained by subtracting water depth from total depth. All measurements were made three times, in the deepest part of the pool that can be located by probing with a 1 metre metal rule, and the mean of the three measurements was used. The type of substrate (rock, gravel, sand, silt, unconsolidated clay) was noted for each measurement, based on probing with the metal rule.

RESULTS

Total Depth (pools): total depth in 2021 averaged 53.1 cm (SD = 30.0). This was significantly lower than the previous two years, which was 63.2 cm (SD = 26.3) in 2019 and 67.1 cm (SD =22.7) in 2020. Individually, the total depth was ranging from 19.3 cm (E04) to 98.5 cm (E07), which showed a high variability in total depth between different sites (Figure 3). Like the previous two years, E07, E09, and E13 had the deepest pools among those sites, but only the pools in E07 and E09 were slightly deeper than their counterparts in the last two years; all the other pools were decreased in 2021 (Figure 3).

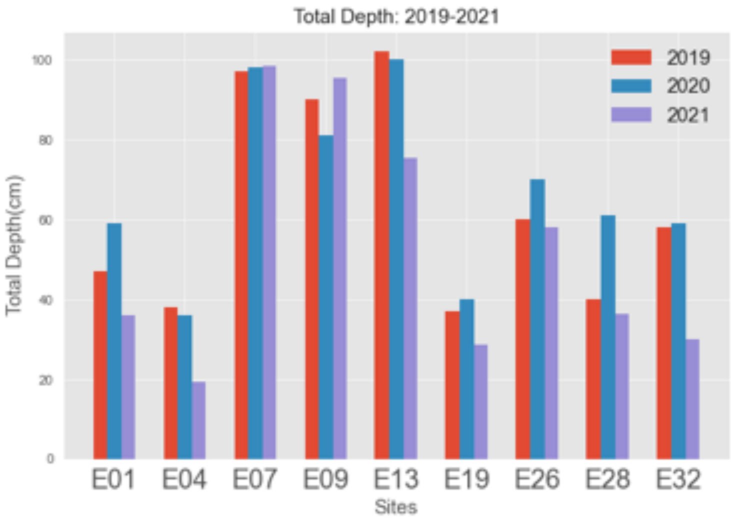

Figure 3. Total depth (Pools) along Stream E in 2019, 2020, and 2021

Although total rainfall in 2021 was the highest on record (Bureau of Meteorology, 2021), the total depth (pools) was significantly lower than the previous two years. This may indicate that the released water from sediment ponds (in upstream areas of Stream E) played a more important role than rainfall in shaping total water depth.

Sediment Depth (pools): the depth of unconsolidated sediment in 2021 averaged 10.5 cm (SD = 12.2). This was shallower than the previous survey in 2019 that averaged 31.3 cm (SD = 9.8), but deeper than survey in 2020 that averaged 3.8 cm (SD = 4.8). It showed that the sediments can be hardly seen in some sites (less than 5 cm), including E04, E07, E09, E13, and E19 (Figure 4). However, there were also signs of increasing sediment depth in the other sites compared with 2020, such as E01, E26, E28, and E32 (Figure 4). Among them, the highest sediment depth was recorded in E01, which was 30.1 cm (Figure 4).

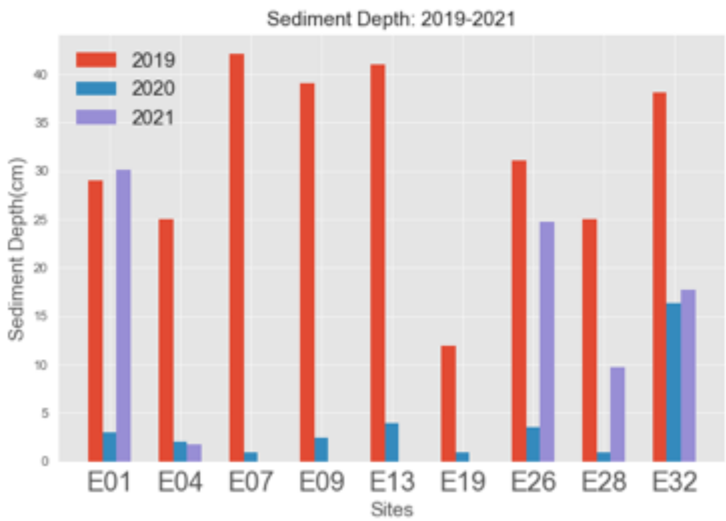

Figure 4. Sediment depth (Pools) along Stream E in 2019, 2020, and 2021

It is important to note that sediment depth in 2020 and 2021 was a lot lower than 2019 in each pool (except for E01) (Figure 4), which may indicate that the sediment had been flushed out during this period. This could be caused by higher flows or higher rainfall in 2020 and 2021 (Figure 2). However, further studies and more data collection along Stream E are highly required in order to have a stronger analysis, as the provided data were only collected once per year.

Tall Emergent and Submerged Macrophytes

METHOD

Three tall emergent macrophytes and three submerged macrophytes species are used as ecological indicators: *Phragmites australis*, *Schoenoplectus tabernaemontani*, *Typha domingensis, Chara australis*, *Nitella pseudoflabellata*, and *Potamogeton crispus*. In this report, they will be referred to as *Phragmites, Schoenoplectus, Typha*, *Chara, Nitella,* and *Potamogeton* respectively.

Two metrics were used: abundance and occurrence. **Abundance**, as area of each species in the marked-out pool, was measured in the field, by treating each species as one or more simple geometric shapes (rectangle, circle, ellipse, equilateral triangle) and measuring its critical dimensions (width, length, or diameter) as relevant (assume each shape had full coverage). The total area (m^2) of emergent and submerged macrophytes species were calculated separately. **Occurrence**, meaning the number of pools where a species is recorded, is derived from area data. Additionally, the height of tall emergent macrophytes in each site and its average were measured and calculated for the first time, as the macrophytes are recognised as an important indication of stream health and therefore monitoring their growth has become necessary.

RESULTS

Figure 5. *Schoenoplectus tabernaemontani* (top left); *Phragmites australis* (top right); and *Typha domingensis* (bottom) in Stream E.

1. Tall Emergent Macrophytes

All three species of tall emergent macrophytes were present in Stream E in the 2021 survey (Figure 5), and no additional species were recorded.

Combined area: the area of tall emergent macrophytes in 2021 averaged 38.40 m^2 (SD = 36.2). This was significantly higher than the previous surveys in 2019 and 2020, which was 2.96 m^2 (SD = 6.18) and 3.95 m^2 (SD = 3.88) respectively (Figure 6). As same as previous years, the area of tall emergent macrophytes in each site was highly variable, ranging from 11m^2 (E32) to 128.4 m^2 (E09) (Figure 6). Individually, the change for each site was also significant: all pools show increases compared with the previous two years. Among them, E09 had the biggest increase, with its area of tall emergent macrophytes rising from 3.4 m^2 in 2020 to 128.4 m^2 in 2021 (Figure 6).

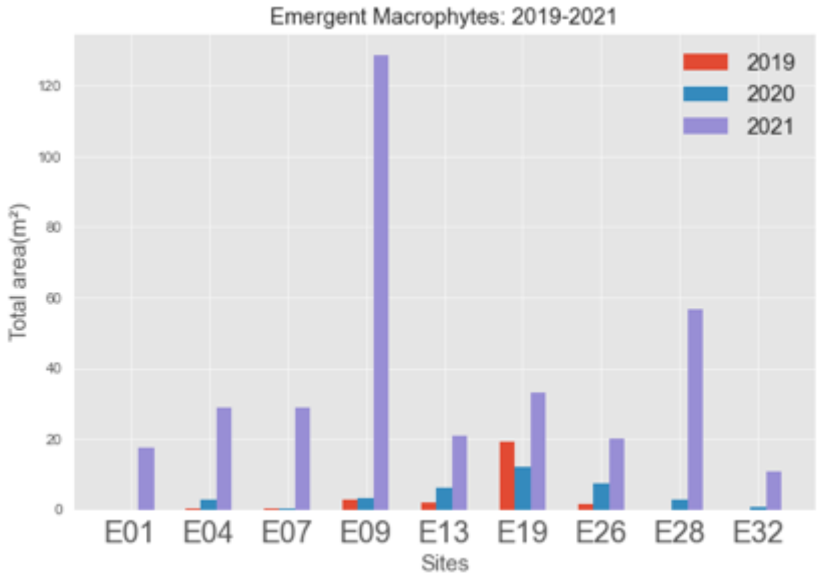

Figure 6. Area (m^2) of emergent macrophyte per pool in 2019, 2020, and 2021

Average height: Tall emergent macrophytes in two sites (E13 and E19) had the highest average height, which was 280.0 cm and 195.5 cm respectively (Figure 7). E26, E28, and E32 showed the lowest values, which was 104.5 cm, 81.7 cm, and 77.0 cm respectively (Figure 7). It is important to note that E26, E28, and E32 were also the only three sites where submerged macrophytes were detected in 2021 survey (Figure 7) (Figure 9).

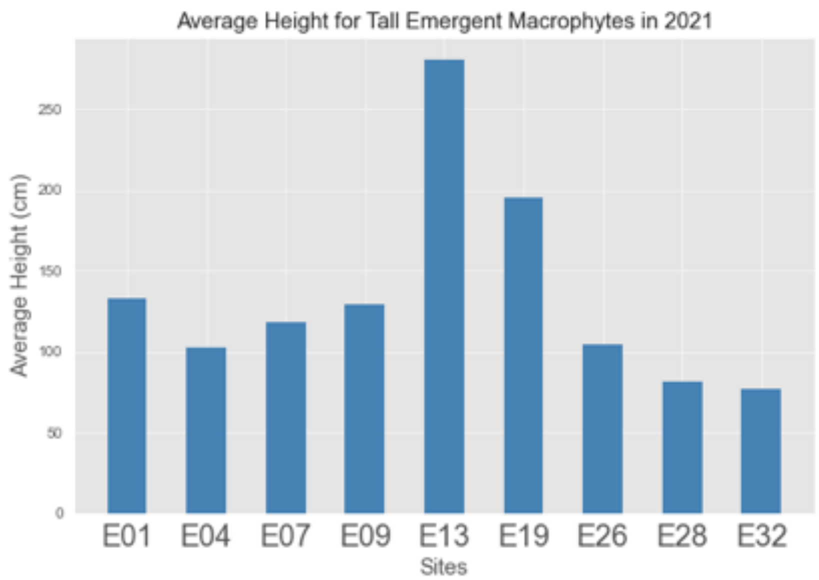

Figure 7. Average height (cm) of tall emergent macrophytes in each pool

Individual species: For each species, mean area of tall emergent macrophytes in 2021 was significantly higher than the previous two years. *Phragmites* showed the biggest growth, which was from 2.48 m^2 in 2020 to 22.6 m^2 in 2021 (Table 1). The number of sites where each species was present increased as well. *Phragmites* was present at 8 sites, *Schoenoplectus* at 7 and *Typha* at 5 compared with 5, 6, and 4 respectively in 2020 (Table 1).

Table 1. Mean area and occurrence for tall emergent macrophytes in 2019, 2020, 2021

	Year	*Phragmites*	*Schoenoplectus*	*Typha*
Species Area Mean (m^2) (SD) per site	2021	22.6 (34.46)	12.65 (15.69)	3.15 (6.82)
	2020	2.48 (3.93)	0.41 (0.76)	0.8 (2.01)
	2019	2.06 (5.67)	0.50 (0.98)	0.23 (0.66)
Number of sites present	2021	8	7	5
	2020	5	6	4
	2019	3	4	3

2. Submerged Macrophytes

Only one indicator species of submerged macrophytes (*Potamogeton*) was present in Stream E in 2021 survey (Figure 8) and it only appeared on the downstream areas of Stream E.

Figure 8. *Potamogeton crispus* in Stream E

Combined area: the area of submerged macrophytes in 2021 averaged 5.09 m^2 per site (SD = 12.33) (Figure 9). This was higher than the previous two years (1.20 m^2 in 2019 and 3.31 m^2 in 2020). Like the 2020 survey, the submerged macrophytes in 2021 can be only found in three sites (E26, E28, and E32) (Figure 9). Among these downstream sites, the total area of submerged macrophytes in E26 and E28 had decreased from 11.8 m^2 to 6.25 m^2 and 4.1m^2 to 2.0 m^2 respectively, but it showed a big growth in E32, which was from 0 m^2 (2019) to 19.8 m^2 (2020) and 37.5 m^2 (2021) (Figure 9).

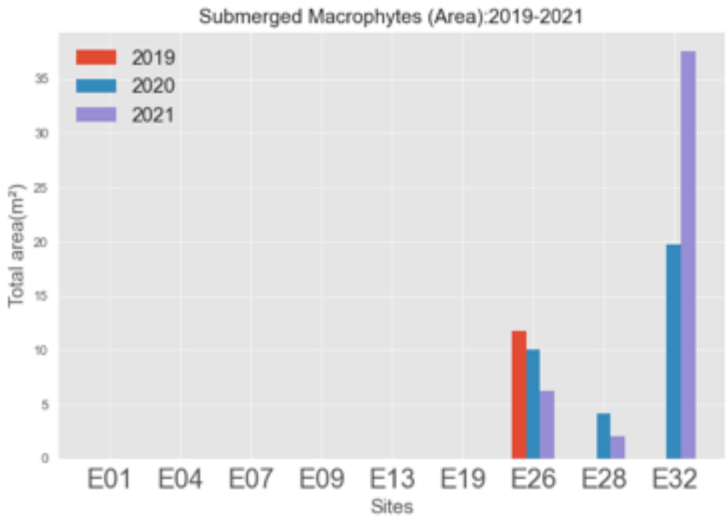

Figure 9. Area (m^2) of submerged macrophyte per pool in 2019, 2020, and 2021

Individual species: only one species, *Potamogeton*, had been found in the 2020 and 2021 survey and their mean area had increased from 3.31 m^2 to 5.09 m^2 (Table 2). *Chara* and *Nitella*, however, was quite rare and only present in the 2019 survey with a very small number of individuals (0.002 m^2 and 0.001 m^2 respectively) (Table 2). As for occurrence, the number of sites present in 2021 for each species was identical to the 2020 survey, being 0, 0, and 3 sites for *Chara*, *Nitella,* and *Potamogeton* respectively (2020 and 2021) compared with 2, 1, and 1 respectively in 2019 (Table 2).

Table 2. Mean area and occurrence for all submerged macrophytes in 2019, 2020, 2021

	Year	*Chara*	*Nitella*	*Potamogeton*
Species Area Mean (m^2) (SD) per site	2021	0	0	5.09 (12.33)
	2020	0	0	3.31(6.45)
	2019	0.002 (0.003)	0.001 (0.003)	1.2 (3.60)
Number of sites present	2021	0	0	3
	2020	0	0	3
	2019	2	1	1

3. Benches in 2021

3.1: General Description

Bench condition

METHOD

Extent and severity of grazing and of physical damage (such as pugging, slumping and erosion) to soil surface or bank are noted at each site, and subsequently categorised as **none, little, some,** or **lots**. Each site was then positioned on the impact gradient, colour-coded from light (= none) to dark (= lots). The impact gradient used here was an updated version of the impact gradient used and presented in the last year's report (Roberts and Sharp, 2020).

RESULTS

The intensity of grazing and pugging damage varied along Stream E (Table 3). It showed that every site was slightly or moderately affected by grazing or pugging, but generally the conditions were better than 2020 and 2019 because most sites were positioned towards the lower(left) end of the impact gradient (Table 3).

For some sites, such as E04, E09, and E19, where pugging, grazing or both were causing serious impacts on them in 2020 and 2019, showing signs of improvement in the 2021 survey; however, two sites (E26 and E28) that had been marked as no impact in the 2020 survey were facing a worse condition in 2021 (Table 3). Like the survey in 2020, E04 is a preferred place for livestock, and therefore it will continue to have more serious grazing and pugging damage.

Table 3. Bench condition arranged as an impact gradient

Grazing	none	none	little	little	some	some	some	little	lots
Pugging	none	little	little	some	none	little	some	lots	lots
2021		E09	E01,E07,E19, E26	E13,E28,E32		E04			
2020	E26, E28	E19, E32	E01, E07, E13					E04, E09	
2019			E07		E13, E26, E32		E09, E19		E01, E04, E28

3.2: Indicators

Bench vegetation height

METHOD

Vegetation on the bench was checked to record if it is a grassland (dominated by grasses), sedgeland, rushland or forbland. Vegetation height was estimated as an average of erect culms.

RESULTS

All benches were mainly covered by grasses with the average height (estimation) ranging from 25 cm (E19) to 100 cm (E01). This was taller than previously recorded data in 2019 (roughly 10 cm tall) and 2020 (15-30 cm tall for all sites except E28). For E28, it showed a big decrease in height (2021) of ground cover compared with the survey in 2020, which drops from 110 cm to 35 cm.

Woody species were rare and noted only once in bench quadrats (E32) in 2021, and these were some individuals of *Rubus fructicosus* (Blackberry). In previous years, *Acacia* species and some juveniles of introduced shrubs, such as hawthorn *Crataegus monogyna*, Sweet Briar *Rosa rubiginosa* had been recorded in benches, but not in 2021 survey.

Dominant species

METHOD

The species that dominate (that are visually most abundant) in the bench quadrat were recorded. Dominant means up to five species per quadrat, as suits.

RESULTS

16 species were noted as dominant species in the 2021 survey (higher than 14 species in 2020 and 10 species in 2019) and nearly all were non-native species (Table 4). The most frequently recorded species were *Holcus lanatus* (9 sites; Non-native) *and Avena* (7 sites; Non-native), (Table 4). Eight of these 16 species were marked as new recorded species, including *Cardamine hirsute, Couch spp, Juncus articulates, phragmites, Plantago, Schoenoplectus, Trifolium dubium,* and *Typha domingensis* (Table 4).

Table 4. Dominant species on benches in 2021 (new species are marked with green)

Dominant Species	Occurrence in 2021	Occurrence in 2020	Occurrence in 2019	Origin
Avena spp	7		2	Non-native
Bothriochloa macra			1	Native
Bromus diandrus			1	Non-native
Bromus hordeaceus	2	2	1	Non-native
Carthamus lanatus		1		Non-native
Cardamine hirsuta	1			Non-native
Cenchrus clandestinus	3	7	9	Non-native
Couch spp	1			Non-native
Eragrostis curvula	2		1	Non-native
Holcus lanatus	9	3	2	Non-native
Juncus articulatus	4			Non-native
Lolium spp	4	4	8	Non-native
Paspalum distichum		1		Non-native
Phragmites spp	1			Native
Plantago spp	1			Non-native
Nasturtium officinale		1		Non-native
Schoenoplectus spp	4			Native
Themeda triandra		1		Native
Trifolium arvense		1		Non-native
Trifolium campestre		1		Non-native
Trifolium dubium	1			Non-native
Trifolium repens		2		Non-native
Trifolium subterraneum		1	1	Non-native
Typha domingensis	1			Native
Veronica anagallis-aquatica	1	1		Non-native
Vulpia spp	1	1	1	Non-native
Number of Dominants	16	14	10	

Quadrat Cover

METHOD

Percentage cover of bare ground (unvegetated soil with no plants growing), rocks, litter (dead material not attached to a plant), shrubs, perennials, and annuals was recorded in each 5(m) x 1(m) bench quadrat. Quadrats were set out to correspond to their position in previous years by using photographs as a guide.

RESULTS

Bare ground: all benches had less than 10% except for E04 (35%) (Table 5). Site E04 has been recognised as severely affected by grazing, pugging, and erosion since 2018. As a result, it always showed a very high percentage of bare ground cover compared with the other sites.

Rocks and litter: all benches had a low percentage of rocks cover (no more than 5%) and litter cover (no more than 15%) (Table 5).

Shrubs: all benches had 0% shrub cover with an exception in site E32 (15%) (Table 5).

Perennials and annuals: most benches had a higher percentage of perennials than annuals (except for E13 and E32) (Table 5).

Table 5. Cover (%) in the 5 x 1 m quadrat for each bench in 2021

	Bare Ground	Rocks	Litter	Shrubs	Perennials	Annuals
E01	1	1	0	0	80	18
E04	35	0	0.5	0	45	19.5
E07	0	0	0	0	80	20
E09	0	0	1	0	70	29
E13	8	5	15	0	32	40
E19	0.5	0	0	0	85	14.5
E26	0	0	2	0	85	13
E28	0.5	0	15	0	70	14.5
E32	0	0	15	15	15	55

Nativeness of Forbs

METHOD

'Nativeness' refers to native forb species and native forb cover (%) in each bench quadrat. For this, the bench quadrat was scrutinized: all species of forbs present and their %cover were recorded. Species that cover less than 1% of the 5x1 m quadrat were recorded as 0.5%.

RESULTS

18 forb species were recorded in the bench quadrats, which was less than the previous survey (50 forb species in 2020). Among these 18 forb species, only 2 were native species (*Wahlenbergia communis*; *Vittadinia muelleri*) and both were found in site E13 (Table 6). The most frequently occurring species (occured in more than 3 sites or more than 20% cover in the quadrats) were: *Trifolium repens* (in 7 quadrats), *Trifolium dubium* (in 4 quadrats), *Vicia sativa* (in 4 quadrats), and *cardamine hirsute* (30% in site E01 and 0.5% in site E19) (Table 6).

Site E09 showed the most forb species (8 species), whereas only 1 forb species had been recorded in site E28. It is important to note that the most frequently occurring species in 2021 were quite different than the 2020 survey, suggesting the species may vary from year to year. For example, *Trifolium campestre* and *Trifolium subterraneum* had been identified as the most frequently occurring species (showed up in 6 quadrats) in 2020. However, none of them were found in any of the bench quadrats in 2021.

Table 6. The cover (%) of **the most frequently occurring** forb species in each bench quadrat (blue) and the cover (%) of **native** forb species in each bench quadrat (yellow)

	Trifolium repens	*Trifolium dubium*	*Vicia sativa*	*cardamine hirsuta*	*Wahlenbergia communis*	*Vittadinia muelleri*
E01	1	0	0	30	0	0
E04	25	7.65	1	0	0	0
E07	15	0	2	0	0	0
E09	5	30	0	0	0	0
E13	0	10	0	0	1	10
E19	3	1	1	0.5	0	0
E26	7	0	0	0	0	0
E28	0	0	0.5	0	0	0
E32	0.5	0	0	0	0	0

4. Conclusion

For pools, the total depth in each pool was lower than the previous two years (except for E07 and E09) even though the weather conditions in 2021 were considerably wetter. This was probably caused by no released water from upstream sediment ponds before the field survey. As for the depth of unconsolidated sediment in 2021, it was still shallower than the survey in 2019 (except E01), but deeper than 2020 in general. The area of tall emergent macrophytes in 2021 was significantly higher than the previous surveys in 2019 and 2020, while the area of submerged macrophytes only showed a significant increase in E32 compared with their counterparts. Tall emergent macrophytes in two sites (E13 and E19) had the highest average height, which is an important baseline for the following surveys(Gupta & Chakrapani, 2005).

For benches, all benches in 2021 were mainly covered by grasses with a larger average height than the previous two years. Although the impacts of grazing and pugging damage on benches were still visible (E04 was the worst with 35% bare ground percentage in its bench quadrat), the overall conditions for all sites were better than before. For species in bench quadrats, 16 species were noted as dominant species (higher than 2020 and 2019) and most of them were non-native species; 18 forb species were recorded in quadrats, but only 2 species were native and all of them were found in site E13.

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Appendix:

Reference photos of pools: 7-9 November 2020 vs 15-16 November 2021


Pool **E01** looking downstream: 2020 (left) vs 2021(right).


Pool **E01** looking upstream: 2020 (left) vs 2021(right).

Pool **E04** looking downstream: 2020 (left) vs 2021(right).

Pool **E04** looking upstream: 2020 (left) vs 2021(right).

	
Pool **E07** looking downstream: 2020 (left) vs 2021(right).	

	
Pool **E07** looking upstream: 2020 (left) vs 2021(right).	

Pool **E09** looking downstream: 2020 (left) vs 2021(right).

Pool **E09** looking upstream: 2020 (left) vs 2021(right).


Pool **E13** looking downstream: 2020 (left) vs 2021(right).


Pool **E13** looking upstream: 2020 (left) vs 2021(right).


Pool **E19** looking downstream: 2020 (left) vs 2021(right).


Pool **E19** looking upstream: 2020 (left) vs 2021(right).

Pool **E26** looking downstream: 2020 (left) vs 2021(right).

Pool **E26** looking upstream: 2020 (left) vs 2021(right).


Pool **E28** looking downstream: 2020 (left) vs 2021(right).


Pool **E28** looking upstream: 2020 (left) vs 2021(right).


Pool **E32** looking downstream: 2020 (left) vs 2021(right).


Pool **E32** looking upstream: 2020 (left) vs 2021(right).