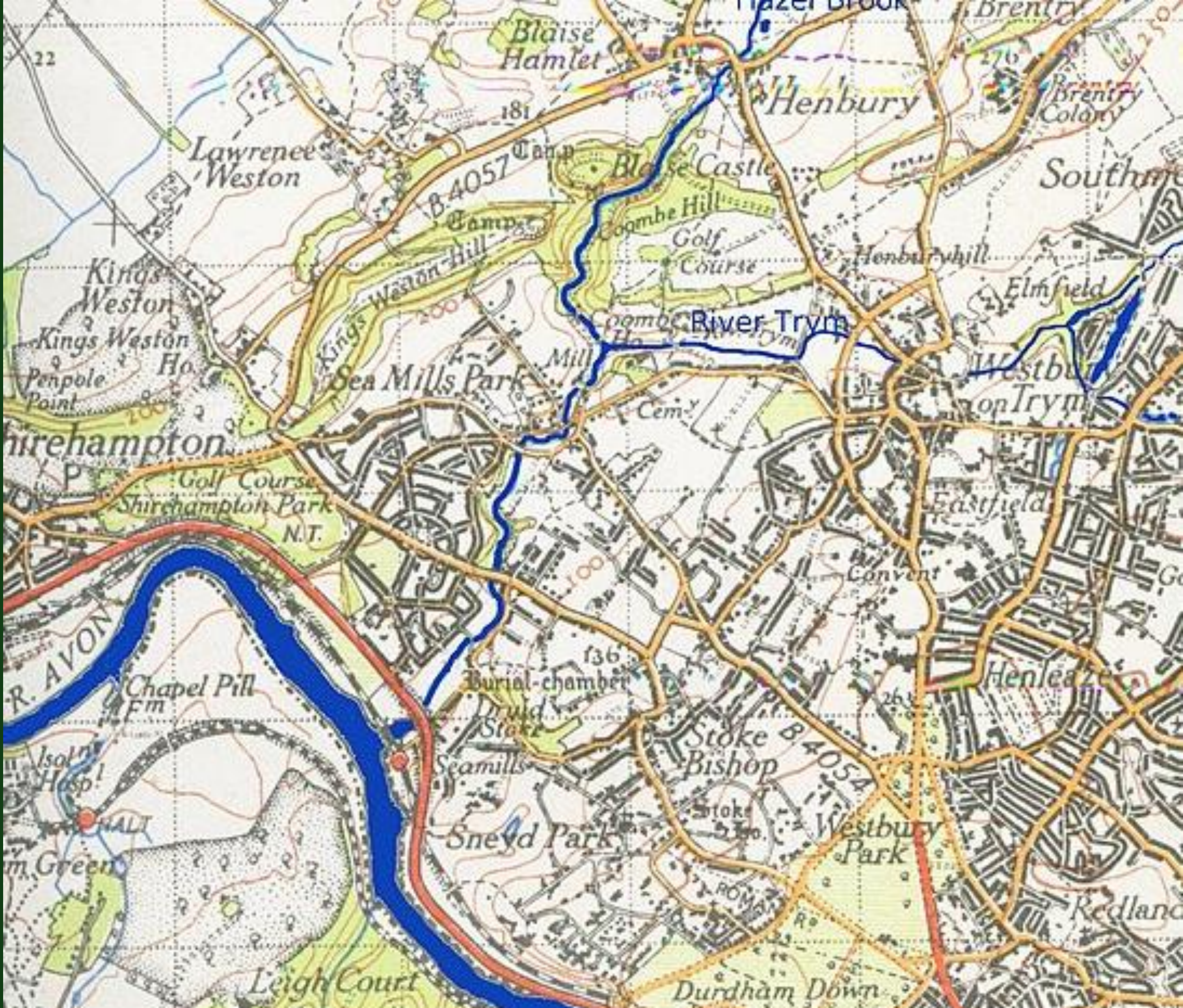
Trout in the Trym

Group 6



Trout in the Trym (NGO)

- A grassroots, volunteer led community group.
- Aim to 'restore trout to the Trym' by cleaning up the area from pollution.

Background information

- The river Trym flows south into the River Avon, with a tributary known as the River Hazel Brook
- Wessex Water manages multiple Combined Storm Overflows (CSOs) along the course of the Trym

Why is it important?

Visible litter

- Investigating the microplastic pollution in the area between the Trym River and the Hazel Brook
- Hazel Brook water originates in Cribbs Causeway from a pond with waste
- Environmental consequences on wildlife and human exposure
- Investigating multiple locations to find the source
- Consistent monitoring to monitor interventions and progress

Hypotheses and research questions

Aim of research: To explore the microplastics concentration and the possible causes of this along the River Trym.

Do CSOs have an impact on the microplastics in the river?

Hypothesis 1: There will be more microplastics found downstream than upstream of a CSO.

Does the car park (and roads) impact microplastics in the river?

Hypothesis 2: There will be more microplastics found downstream of the car park than upstream.

How does discharge impact microplastic concentration along the river?

Hypothesis 3: Sites with a higher discharge will have a higher concentration of microplastics.

How does the water chemistry vary between the sites?

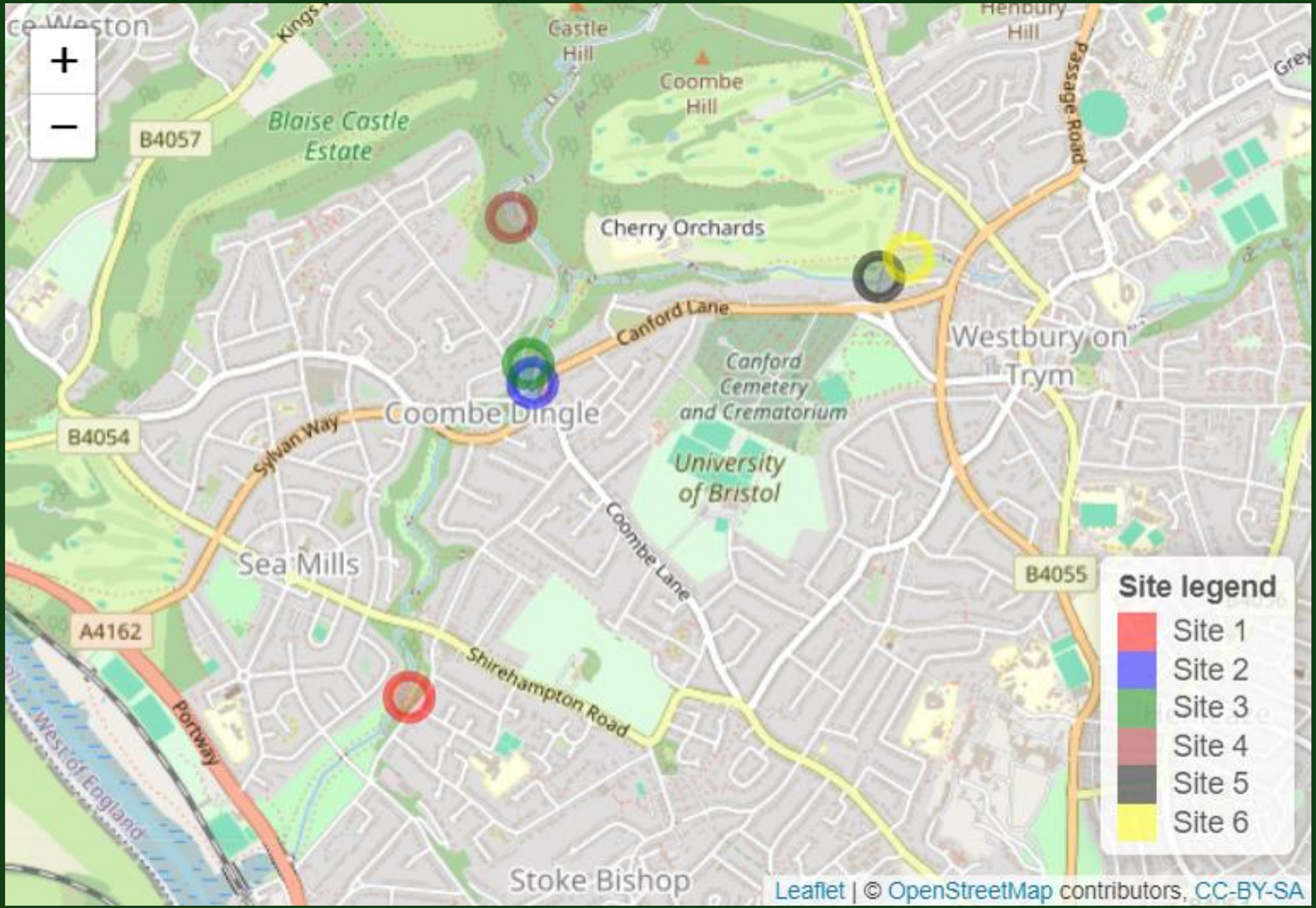
Hypothesis 4: Sites downstream from CSO will have higher EC, and lower DO, and sites with more microplastics will have a lower pH.

Field sites

downstream

- Site 1: downstream, approaching mouth to the Avon
- Site 2: downstream of car park
- Site 3: upstream of car park
  - *Site 4: Hazelbrook tributary*
- Site 5: downstream of CSO on the other tributary
- Site 6: upstream of CSO on the other tributary

upstream



Sampling strategy

- Purposive sampling technique
- Worked our way upstream
- Water samples not sediment samples
- Samples and probe readings collected from the center, upstream of discharge
- Flowmeter for velocity

Sampling procedure

1. Microplastic contamination samples
    - Standardised depths
    - 8 repetitions

2. Probe measurements
    - 3 repetitions

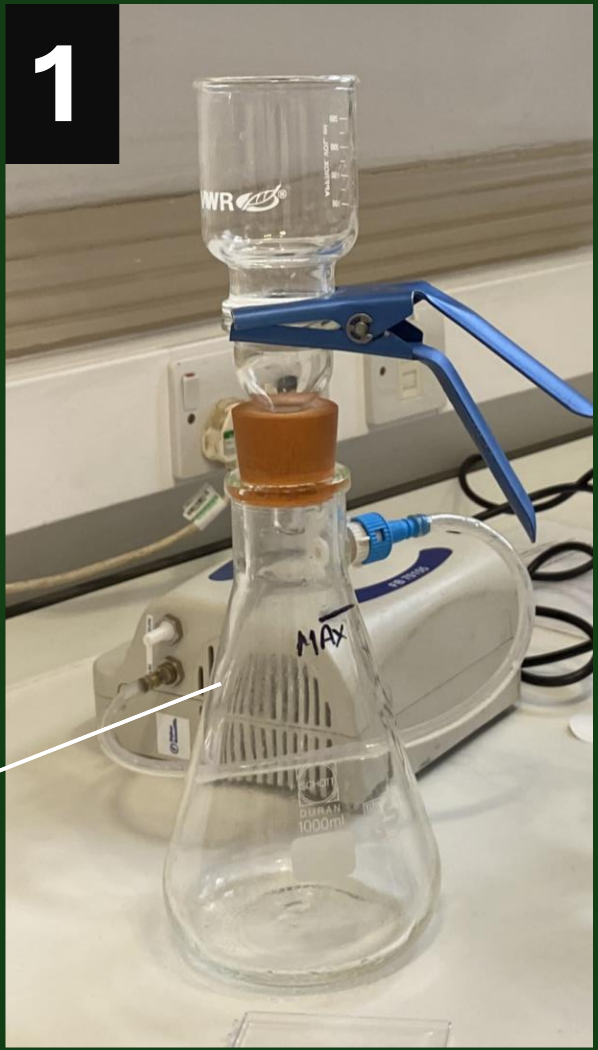
3. Flow velocity -> discharge
    - Segmented channel width
    - Flow metre
    - Q = AV

Lab work

Selective fluorescence staining method using Nile Red

Procedure:

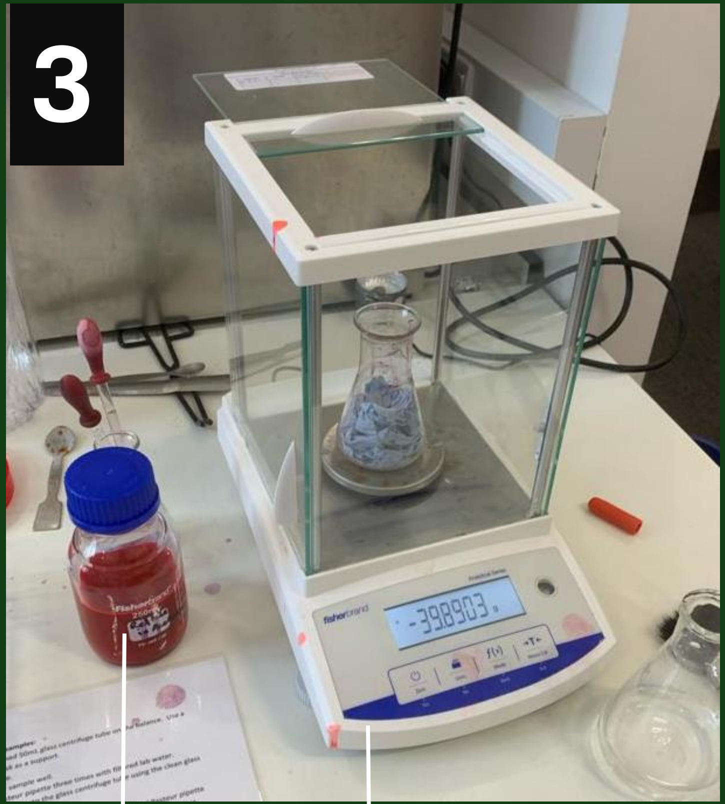
1. Plastic-free laboratory water
2. Ultrasonic Sonicator bath



Glass & ceramic pressure filter unit

Ultrasonic sonicator bath

3. Adding the NR
4. Mixing and filtering
5. Photographing using Crime-lite

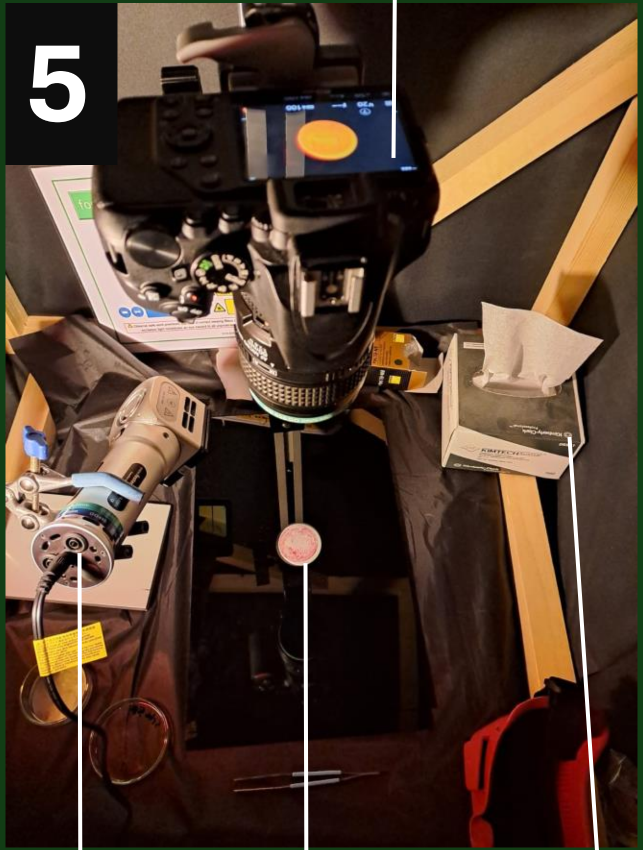


Nile Red dye

Analytical balance

Rotating mixer

Camera on stand



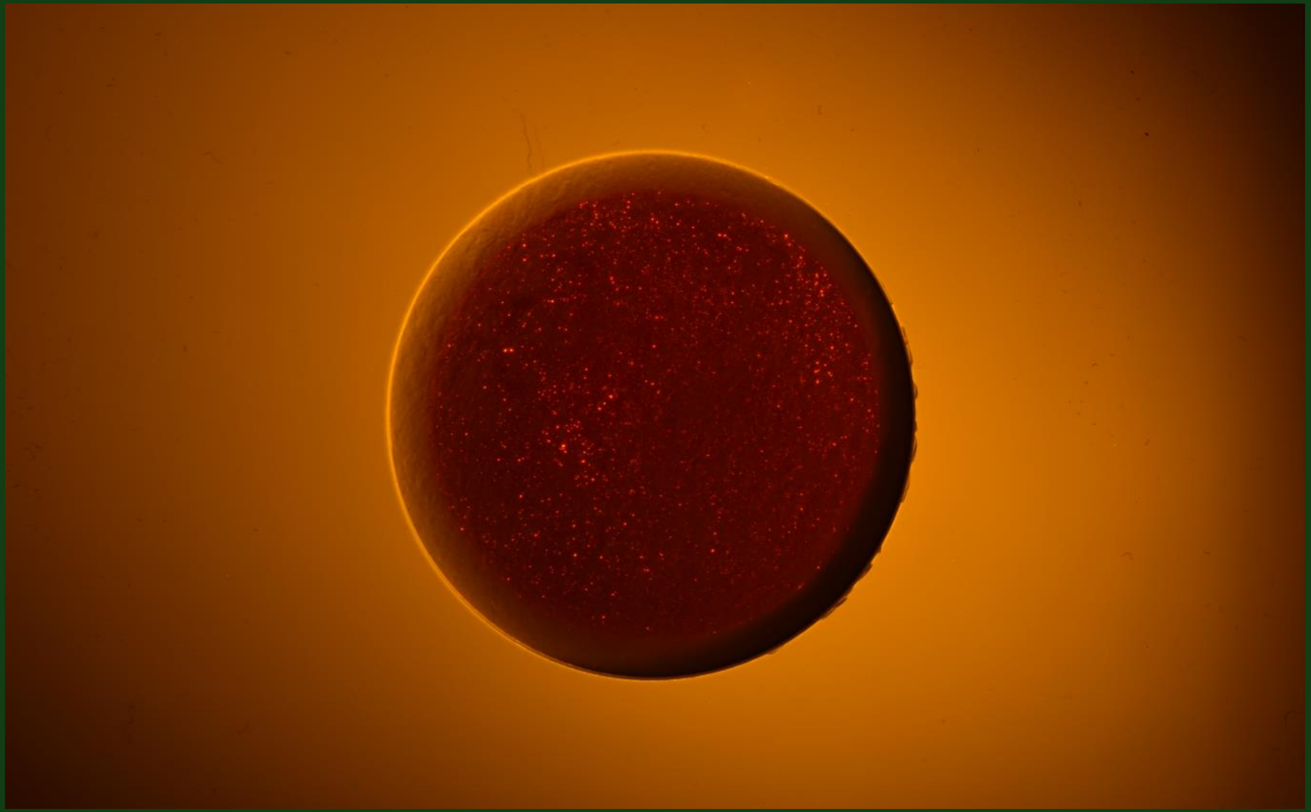
Crime-lite

Filter paper with sample

Lens wipes

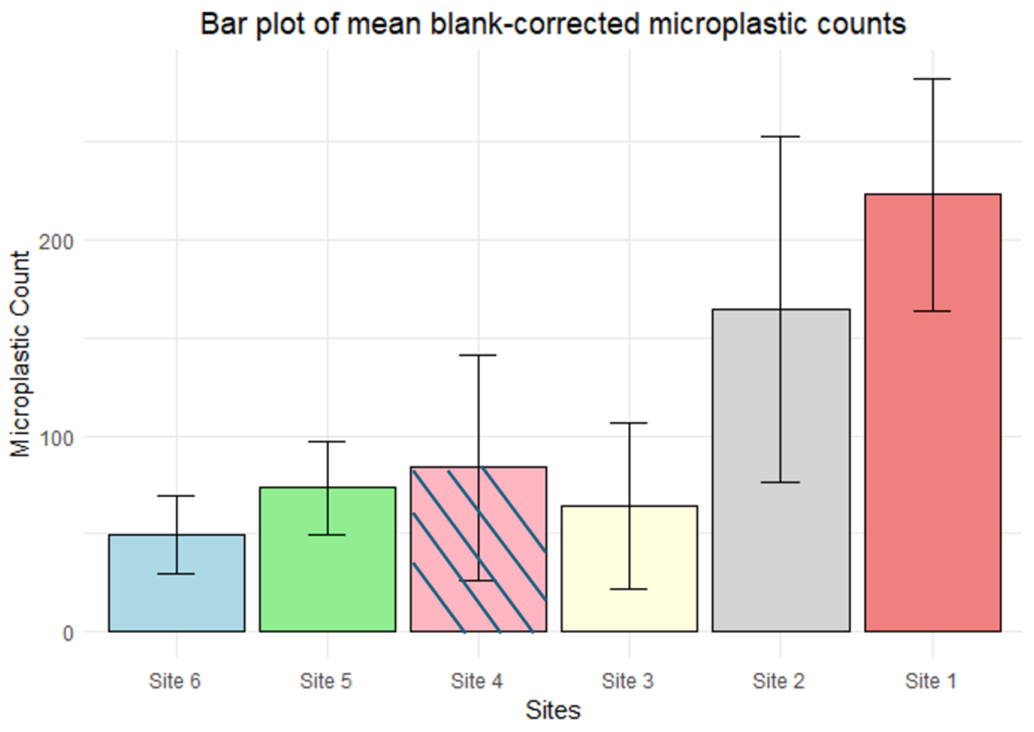
Analysis

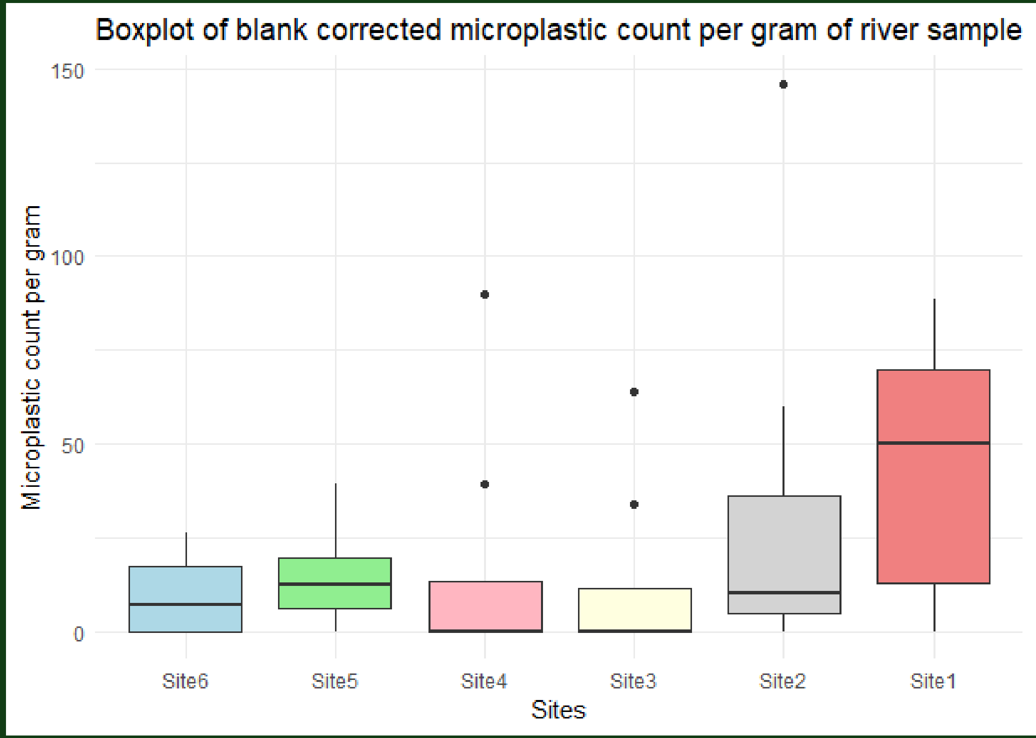
- Microplastic count
- Water chemistry analysis
- Microplastic per gram comparisons
- Discharge vs microplastics
- Analysis implications



Microplastic count

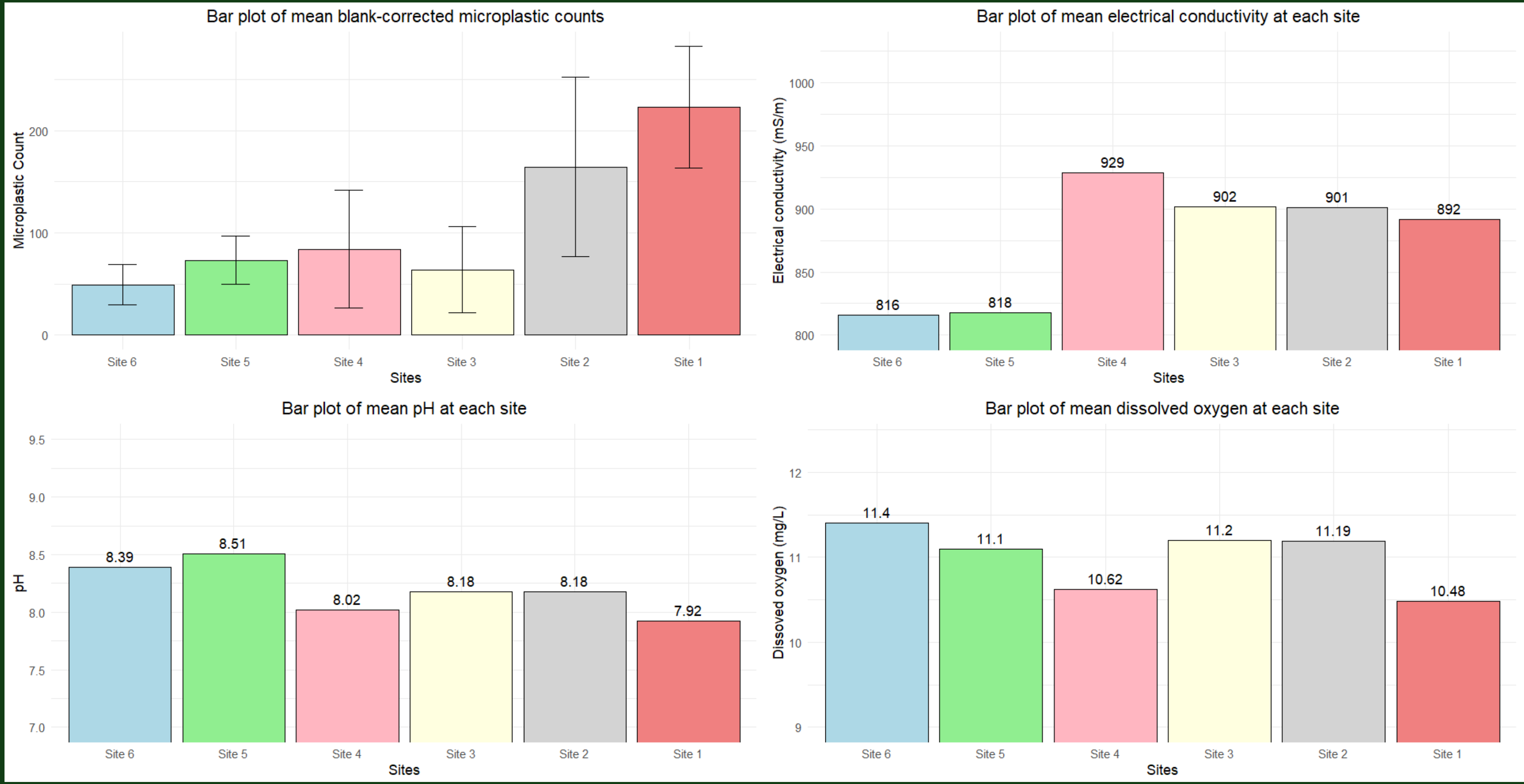
- Strong downstream trend
- Inflated values of sites downstream of pollution source
- Error bars show higher variance at sites with higher microplastic count
- Most sights have some microplastic free recordings





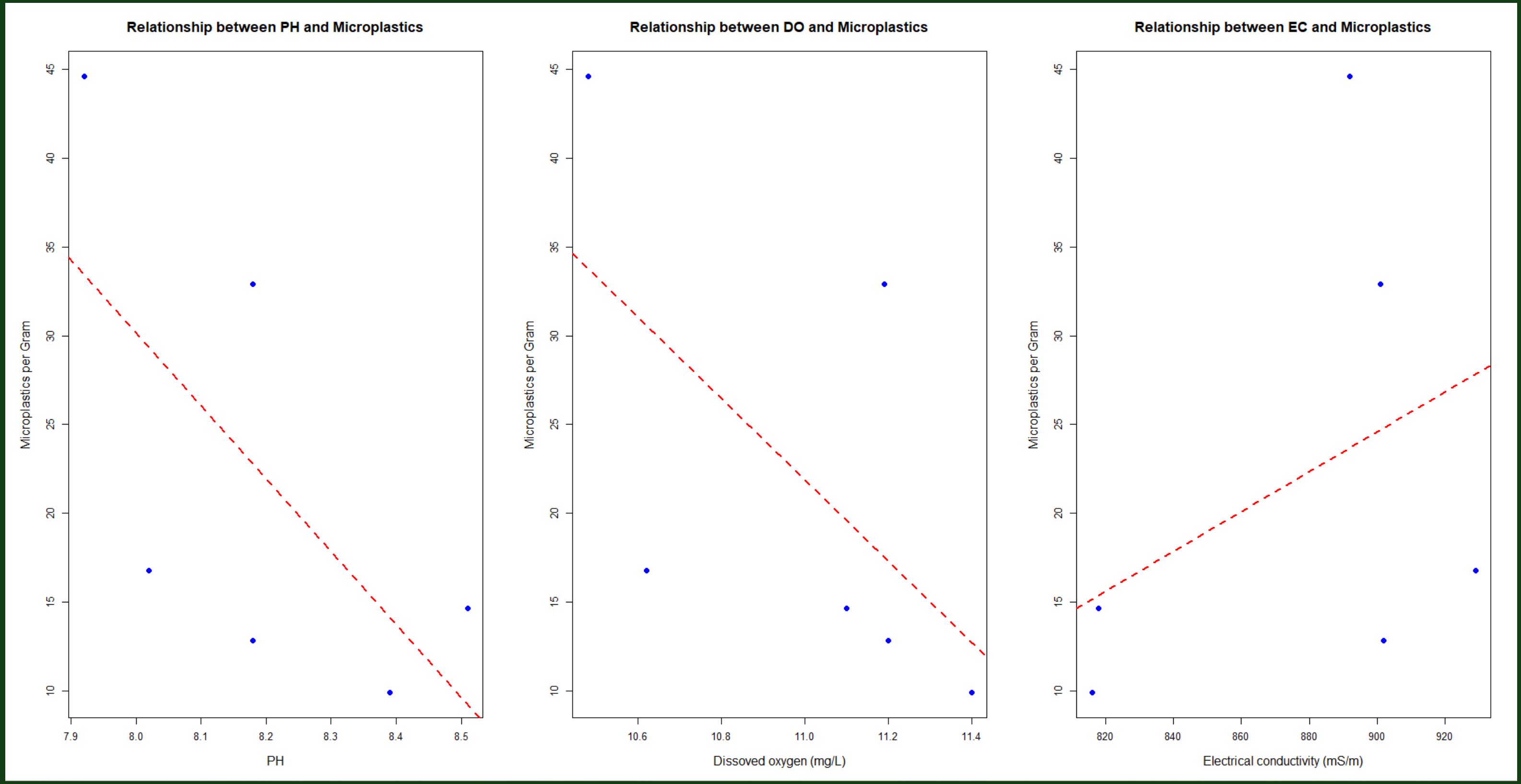
Water chemistry analysis

- Visual representations and statistical tests show no correlation in EC and microplastics
- Very weak negative correlation between DO and microplastic with 20% of variance being explained by DO
- Slight correlation with high microplastics at low pH which will be explored further



Water chemistry analysis

- Few PH anomalies
- No statistical similarity between pH mean and microplastic mean.
- Weak negative correlation between pH and microplastic at 29.5%



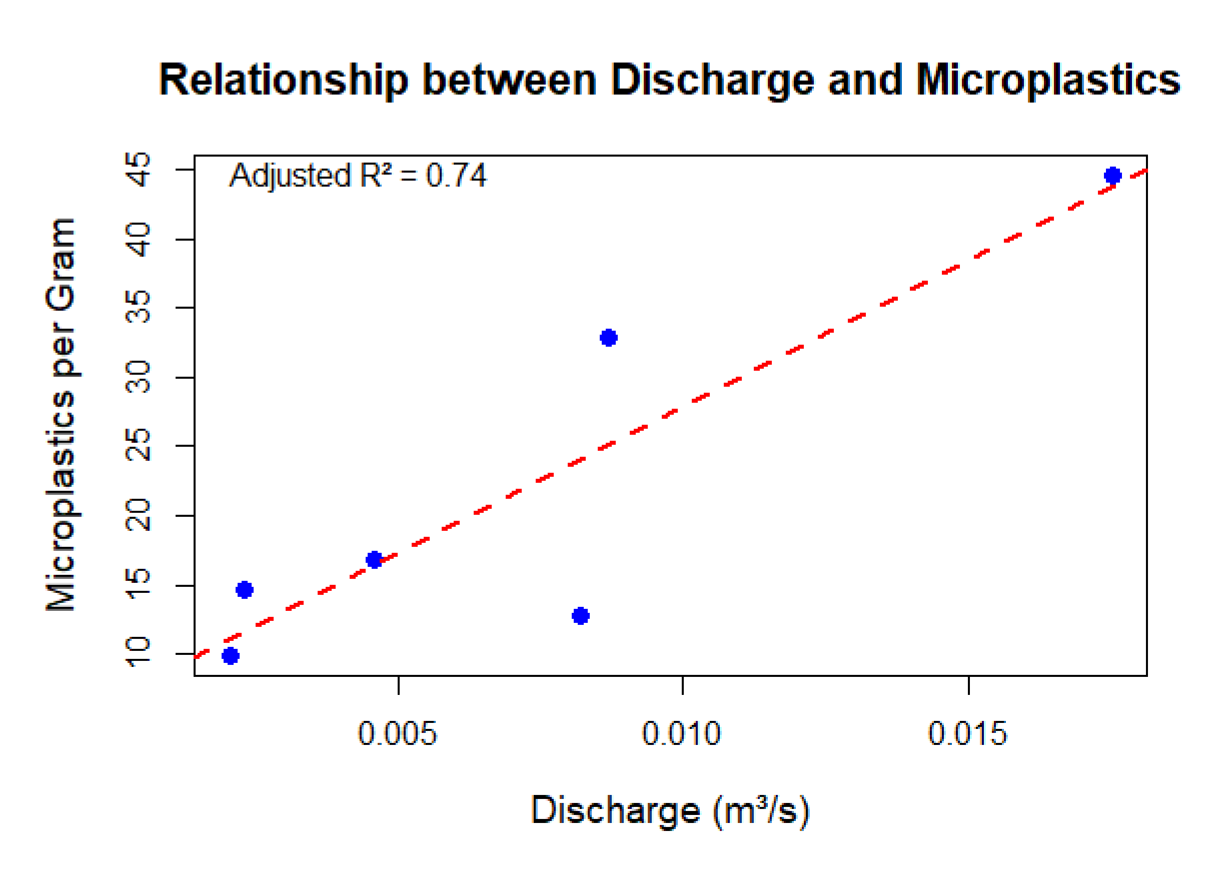

```
        Welch Two Sample t-test

data:  main_dataset$microplastics_per_gram and main_dataset$PH
t = 2.4491, df = 5.0026, p-value = 0.05798
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.679214 28.154214
sample estimates:
mean of x mean of y
  21.9375    8.2000
```

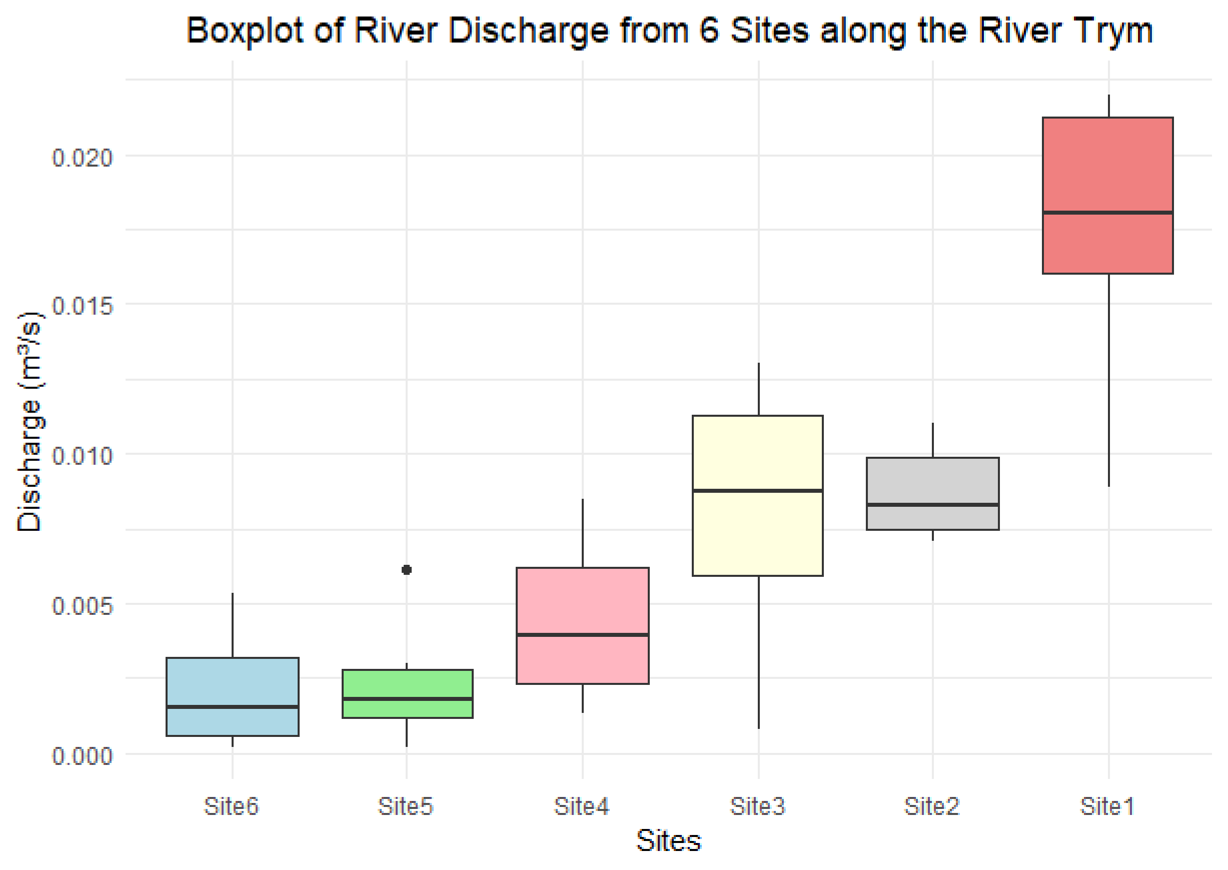
```
lm(formula = microplastics_per_gram ~ PH, data = main_dataset)

Residuals:
      1       2       3       4       5       6
 11.190  10.141  -9.959 -12.554   5.442  -4.261

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   358.64     191.69   1.871    0.135
PH            -41.06      23.37  -1.757    0.154

Residual standard error: 11.54 on 4 degrees of freedom
Multiple R-squared:  0.4356,    Adjusted R-squared:  0.2945
F-statistic: 3.087 on 1 and 4 DF,  p-value: 0.1537
```

Discharge vs microplastics

- Linear regression models shows 73.5% of microplastics per gram variance is influenced by discharge.
- T test shows there is no significant difference between the means of the two variables (p value = 0.0112).

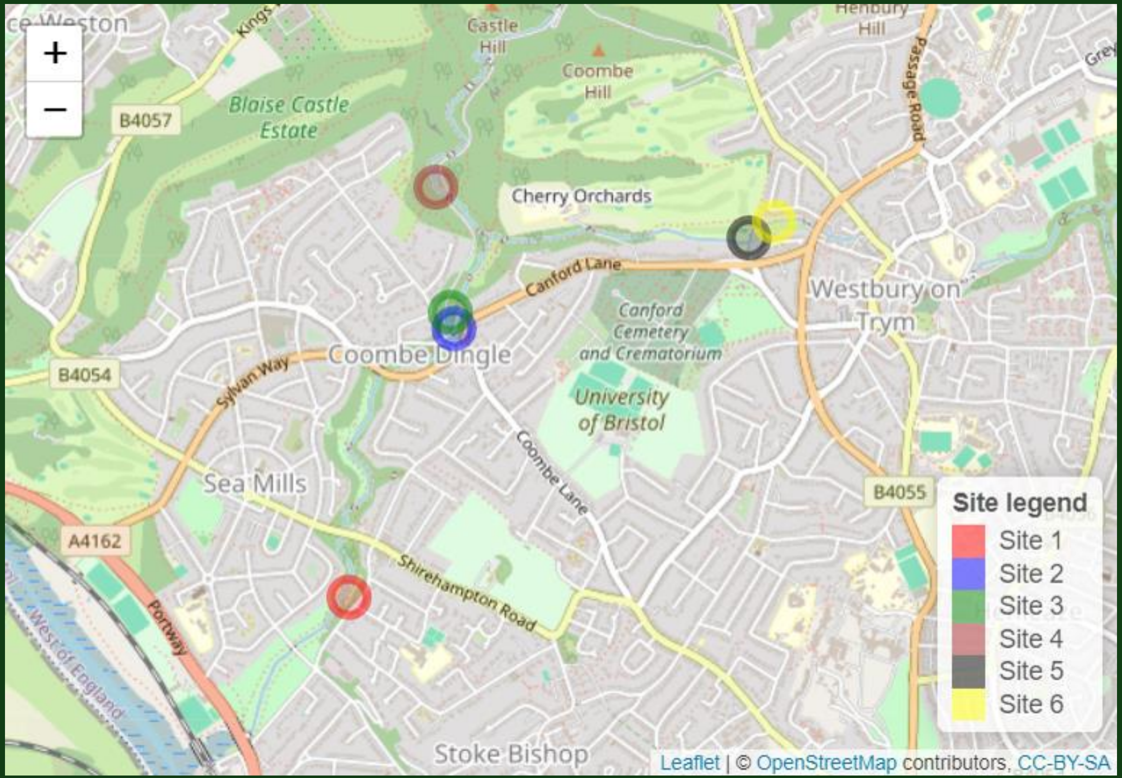
```
lm(formula = microplastics_per_gram ~ discharge, data = main_dataset)

Residuals:
      1        2        3        4        5        6 
 0.9584   7.8916 -11.2142   0.4399   3.0746  -1.1503 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)  
(Intercept)    6.646      4.903   1.355   0.2468  
discharge   2115.441    548.396   3.858   0.0182 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 7.07 on 4 degrees of freedom
Multiple R-squared:  0.7881,	Adjusted R-squared:  0.7352 
F-statistic: 14.88 on 1 and 4 DF,  p-value: 0.01819
```





Microplastic per gram site comparisons

- Tukey test shows very little correlation
- Site 1 and site 6 correspond the least which has the biggest distance between them
- This confirms downstream trend
- T test between site 2 and 3 shows means are significantly different showing car park effect (p value = 0.327)




```
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = Values ~ Site, data = your_data_long)

$Site
               diff       lwr     upr     p adj
Site2-Site1 -11.725 -57.1196 33.6696 0.9709118
Site3-Site1 -31.825 -77.2196 13.5696 0.3105702
Site4-Site1 -27.850 -73.2446 17.5446 0.4574140
Site5-Site1 -29.975 -75.3696 15.4196 0.3754570
Site6-Site1 -34.750 -80.1446 10.6446 0.2228194
Site3-Site2 -20.100 -65.4946 25.2946 0.7714243
Site4-Site2 -16.125 -61.5196 29.2696 0.8940644
Site5-Site2 -18.250 -63.6446 27.1446 0.8342756
Site6-Site2 -23.025 -68.4196 22.3696 0.6572992
Site4-Site3   3.975 -41.4196 49.3696 0.9998214
Site5-Site3   1.850 -43.5446 47.2446 0.9999960
Site6-Site3  -2.925 -48.3196 42.4696 0.9999607
Site5-Site4  -2.125 -47.5196 43.2696 0.9999920
Site6-Site4  -6.900 -52.2946 38.4946 0.9974121
Site6-Site5  -4.775 -50.1696 40.6196 0.9995614
```

Secondary Data Collection - Microplastics

We gathered a variety of secondary data, all of which included studies identifying microplastics as plastic particles measuring under 5000μm (GESAMP, 2015).

We also tried to find studies which used water samples instead of sediment as the microplastic sampling method.

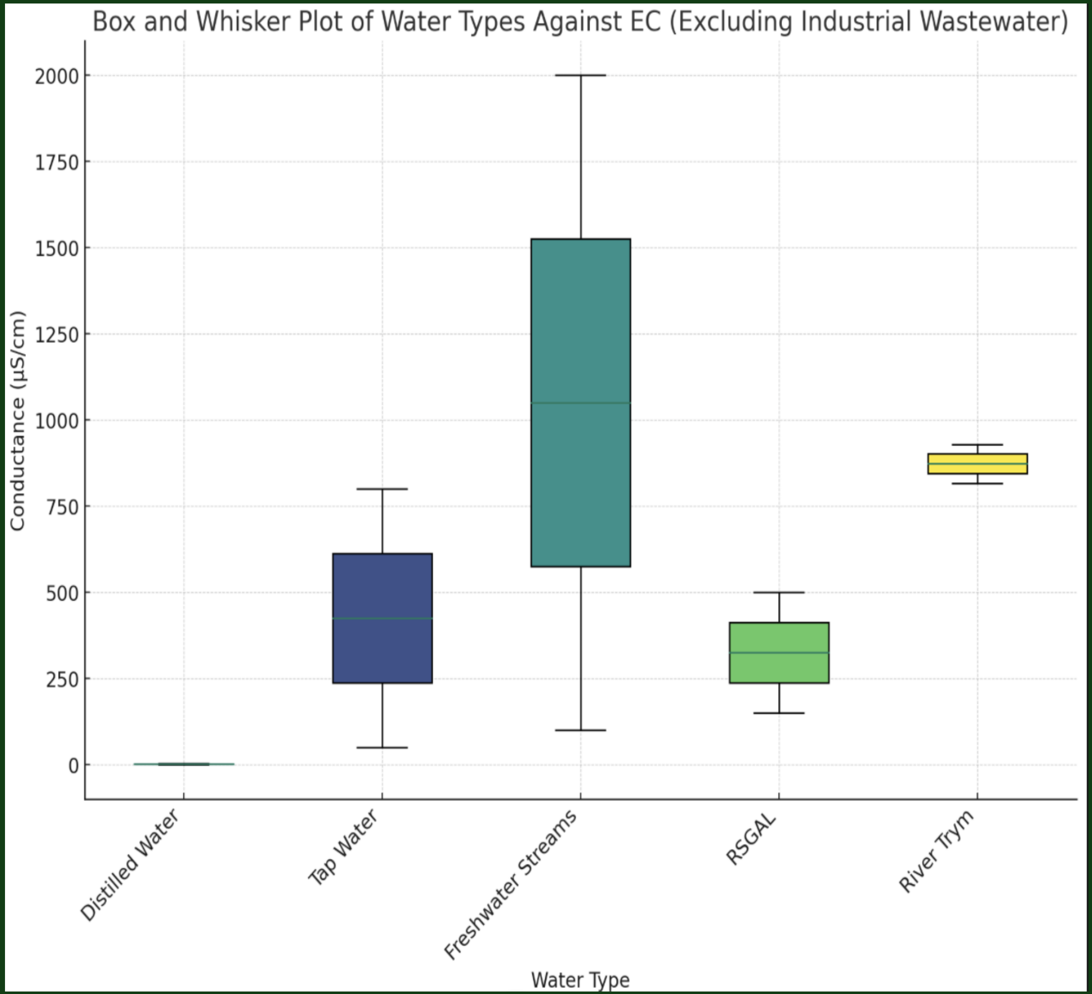
Figure Label	Reference	Size of mesh filter used	Concentration in MP/g	Landscape	Comments on Study
A	Blair et al., 2019	11 μm	0.141-0.432 MP/g	Freshwater urban river	Research of an urban river, River Klein, Glasgow
B	Tibbetts, et.al 2018	63-250 μm	0.092 MP/G	Urbanised catchment area	High concentration reflects urbanized, populated catchment area
C	Dikareva & Simon, 2019	63-500 μm	0.303MP/g	Small streams, New Zealand	Urbanization gradient study across a catchment
D	Group 6 Avon Project, 2023	0.22 μm	10.44MP	Ashton Brooke small stream, Bristol	Average of 2 points in a small stream, flowing in and out a reservoir
E	Horton *et al.*, 2016	1.2 μm	1.41 MP/g	Urban freshwater lake	Urban Freshwater lake in the UK
F	Harley-Nyang et al., 2022	1.2 μm	37.7-286.5 MP/g	Inflow at wastewater treatment works	Field and laboratory study using density separation and infrared spectroscopy
G	Trout on the Trym	1.2 μm	21.9 MP/G	River Trym	Urban River

Secondary Data Collection - EC

Here we compared the values of EC in different types of water.

RSGAL – Rivers supporting good aquatic life (SWT, n.d)

All other values are taken from (Atlas Scientific, 2022)



Water Type	Conductance Range (µS/cm)
Distilled Water	0.5-3
Tap Water	50-800
Freshwater Streams	100-2,000
Rivers supporting good Aquatic life	150-500
Industrial Wastewater	10,000
River Trym	816-929

Discussions

Analysis implications

- Small negative correlation between pH and microplastics.
- No correlation between DO and EC with microplastics.
- Strong downstream trend shows added pollution from CSO’s and car park.
- Large increase in microplastics upstream and downstream from car park.
- Strong positive statistically significant correlation between discharge and microplastic per gram.

Discussions

Limitations in the lab

- Contamination (lab coats, plastic equipment, airborne/dust)

  Nile red (NR):
  - Potential for biogenic staining (algae, lignin)
  - Favours the detection of hydrophobic samples

Limitations in the field

- Sudden, unexpected change in river discharge
- Hand-held flow metre

Limitations in the analysis

- Counting microplastics manually lead to a large uncertainty in results, had to change method

Discussions

Suggestions for future work

- Using specialised equipment e.g. FTIR – identify polymer types – find sources
- Impacts of the microplastics for wildlife and environment
- Investigate the impact of CSOs on microplastic concentration before and after storm overflow events
- Further investigate the link between DO and Microplastics

Conclusions

Hypothesis 1: There will be more microplastics downstream than upstream of a CSO.

✓ *Accept – significant increase in microplastics directly downstream from CSO (site 5) compared to upstream (site 6)*

Hypothesis 2: There will be more microplastics found downstream of the car park than upstream.

✓ *Accept – significant increase in microplastics downstream from the car park (site 2) compared to upstream (site 3)*

Hypothesis 3: Sites with a higher discharge will have a higher concentration of microplastics.

✓ *Accept – statistically significant increase in microplastics in sites with higher discharge*

Hypothesis 4: Sites downstream from CSO will have higher EC, and lower DO, and sites with more microplastics will have a lower pH.

No correlation found between EC and microplastics, and inconclusive results regarding DO being in lower concentration downstream of CSOs, and a slight negative correlation between microplastics and pH

Questions?

Fieldwork lead: Perry Oakes

Analytical lead: Jennifer Duffield

Quality assurance: Xavier Faden da Silva Altern

Editor: Natalie Mycka

Project manager: Aikaterini Kanari

Contextual editor: Rohan Luthra