WESTCOUNTRY RIVERS TRUST CITIZEN SCIENCE

MONITORING OF THE PAR RIVER AND ITS TRIBUTARIES

MARCH 2022

Par River at Cam Bridges Photo: Joan Farmer

CONTENTS & PAGES

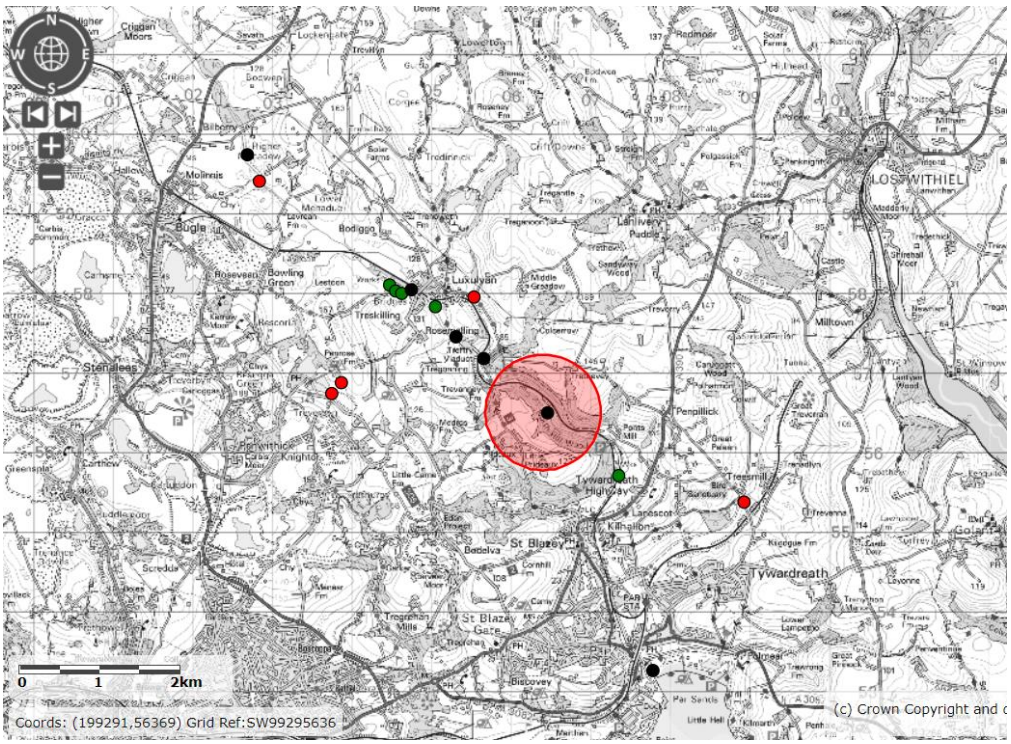
A. KEY POINTS FROM WRT CSI MONITORING IN MARCH 2022

1. We have reduced the number of sampling points in consultation with the Westcountry Rivers Trust. This will allow for the additional work on bacteria and the Riverfly surveys.
2. Positive signs: reduced phosphate levels; evidence for otters and, indirectly, fish; and the riverfly trigger level was exceeded.
3. Concerning signs: very high levels of E.coli and Total Coliforms in the Lower Par; continued pollution of the Carbis Stream with china clay; high phosphate levels.

A. OUR GROUP

Monitoring is part of the Citizen Science programme run by the West Country Rivers Trust (WCRT) and is carried out monthly by volunteers from the Friends of Luxulyan Valley. The team comprises: Dave Burrell; Mandy Case; Joan Farmer; Veronica Jones; Sue Perry; Linda and Roger Smith; Dave Stillings. They have received training from Lydia Deacon, Junior Evidence and Engagement Officer of the West Country Rivers Trust (https://wrt.org.uk/project/become-a-citizen-scientist/). Results are logged on the Cartographer website. The support and advice given by Ross Tonkin, Claire and Gary Phillips, David Edwards, Nick Taylor, Jeremy Roberts, Matt Healey, Simon Browning and Lydia Deacon is greatly appreciated. The interest and encouragement offered by Environment Agency officers, especially Lisa Best and Lisa Goodall, has been invaluable.

B. MARCH 2022 MONITORING POINTS



This month we monitored at 11 locations. Monitoring points along the main Par River are shown in **black**. Those in **red** are on tributaries. Those in green where show where there were visual

checks. The red circle highlights Lady Rashleigh Mine, where riverfly and bacteria monitoring also took place.

Source: https://magic.defra.gov.uk/MagicMap.aspx

LOCATION	TYPE OF CHECK	MONITORED BY
Criggan Moors, Par River, SX 01882 61133	None	
South of Minorca Lane, Par River, SX 02657 59788	CSI sampling	Roger Smith
Carbis Stream SX 02834 59401	CSI sampling	Roger Smith
Treverbyn Stream, East of Innis Fishery (Point B) SX 03770 56781*	CSI sampling	Roger Smith
Treverbyn Stream, East of Innis Fishery (Point C) SX 03857 56884*	CSI sampling	Roger Smith
Luxulyan sewage treatment works, Par River, (SX 0455 58114 before Nov 2021)	Visual check	Joan Farmer, Roger Smith
Treverbyn Stream, SX 04532 58033	Visual check	Joan Farmer, Roger Smith
Rosemullion, Tregarrick Stream, SX 04623 57990	Visual check	Joan Farmer, Roger Smith
Luxulyan allotments, Par River, SX 04732 58045	CSI sampling	Joan Farmer, Roger Smith
Luxulyan SWW pumping station, Par River, SX 05033 57849	Visual check	Joan Farmer, Roger Smith
Cam Bridges, Par River, SX 05292 57454	CSI sampling	Joan Farmer, Roger Smith
Gatty's Bridge, Bokiddick Stream SX 05531 57953	CSI sampling	Joan Farmer
Treffry Viaduct, Par River, SX 05650 57179	CSI sampling	Joan Farmer, Roger Smith
Lady Rashleigh Mine, Par River, SX 06451 56509	CSI sampling, Riverfly, E.coli, Total Coliform	Roger Smith, Joan Farmer
Ponts Mill, Par River, SX 07354 55875	Visual check	Joan Farmer, Roger Smith
Treesmill, Tywardreath Stream, SX 08873 55385	CSI sampling	Veronica Jones
Par Beach slipway, SX 0776 53261	CSI sampling	Veronica Jones

*By special request. No untoward results at either location so no further comment is made in this report but the results are on Cartographer.

Surveys conducted on these dates, each of which is colour-coded:

10th March 2022

13th March 2022

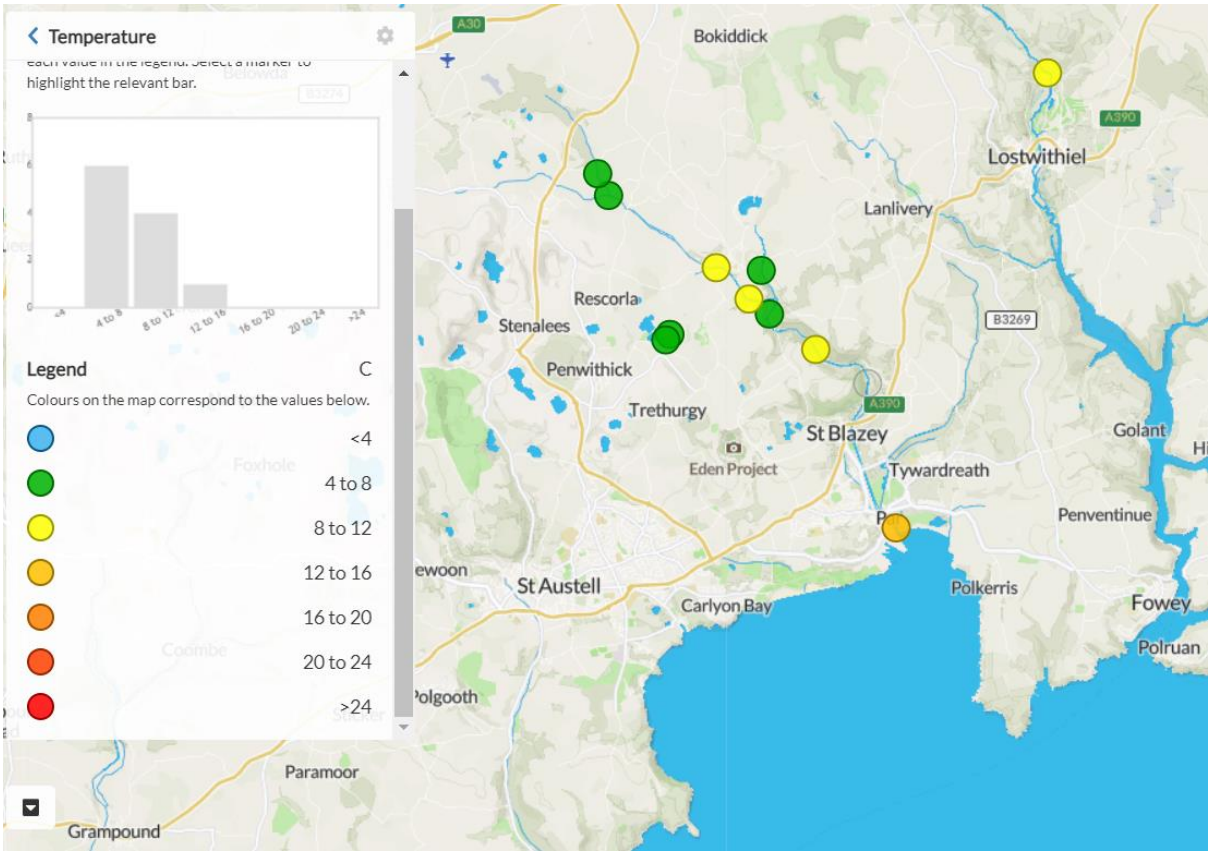
14th March 2022

C. TEMPERATURE

1. This is the WRT's explanation of why this is monitored:

Temperature is a vital parameter within the river ecosystem. It controls many of the aquatic species life cycles. Temperature fluctuates with the seasons; however, you do get variation within that, particularly in small rivers and streams. Another important reason to measure temperature is to track the impact of our warming climate on our waterbodies.

2. **Geographical comparison.** Source: Cartographer.



N.B. The temperature for Treesmill has not been shown on the map.

PAR RIVER/TRIBUTARY	LOCATION	Temperature ˚Celsius
Par	South of Minorca Lane, Par River, SX 02657 59788	7
Tributary	Carbis Stream SX 02834 59401	7
Par	Luxulyan allotments, Par River, SX 04732 58045	8
Par	Cam Bridges, Par River, SX 05292 57454	8.4
Tributary	Gatty's Bridge, Bokiddick Stream SX 05531 57953	6.4
Par	Treffry Viaduct, Par River, SX 05650 57179	6.4
Par	Lady Rashleigh Mine, Par River, SX 06451 56509	8
Tributary	Treesmill, Tywardreath Stream, SX 08873 55385	18.8
Par	Par Beach slipway, SX 0776 53261	15.3

CSI Surveys conducted on these dates, each of which is colour-coded:

10th March 2022

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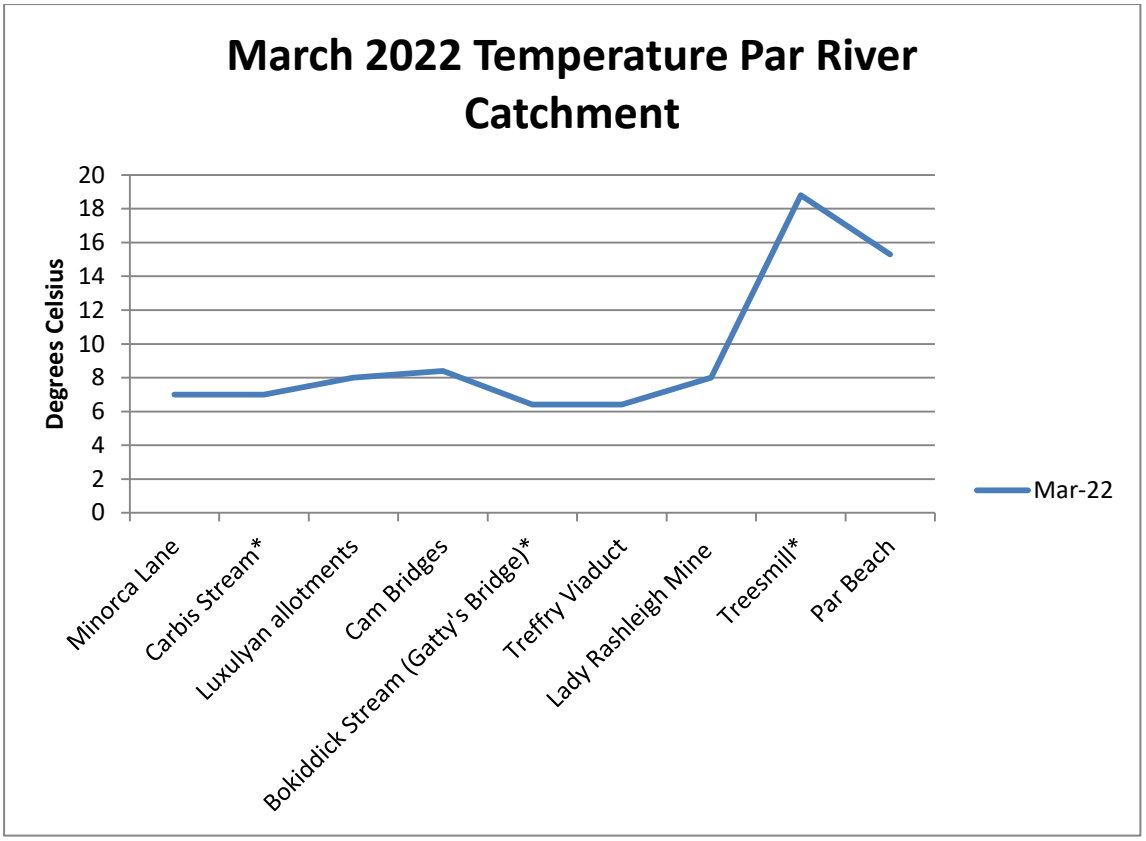
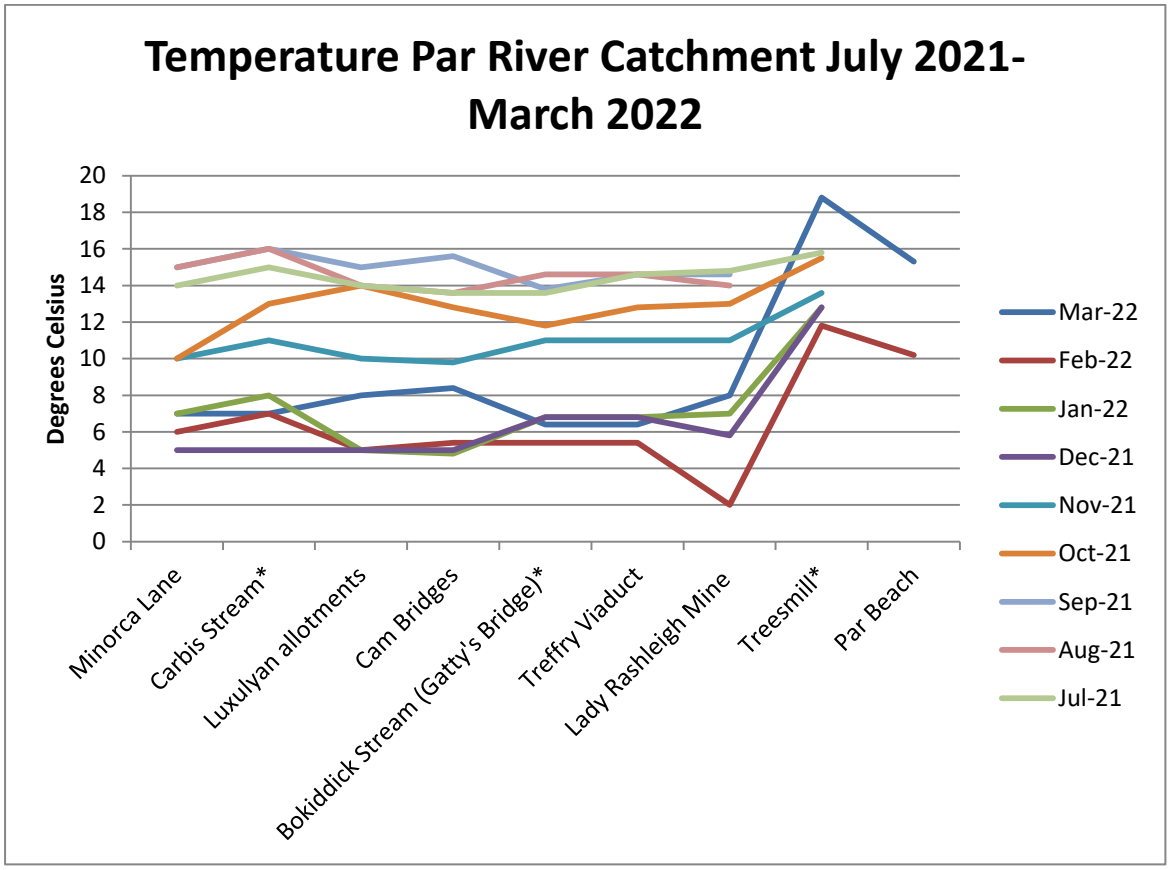
14th March 2022



*indicates a tributary of the Par River.

3. **Historical data** on temperature:

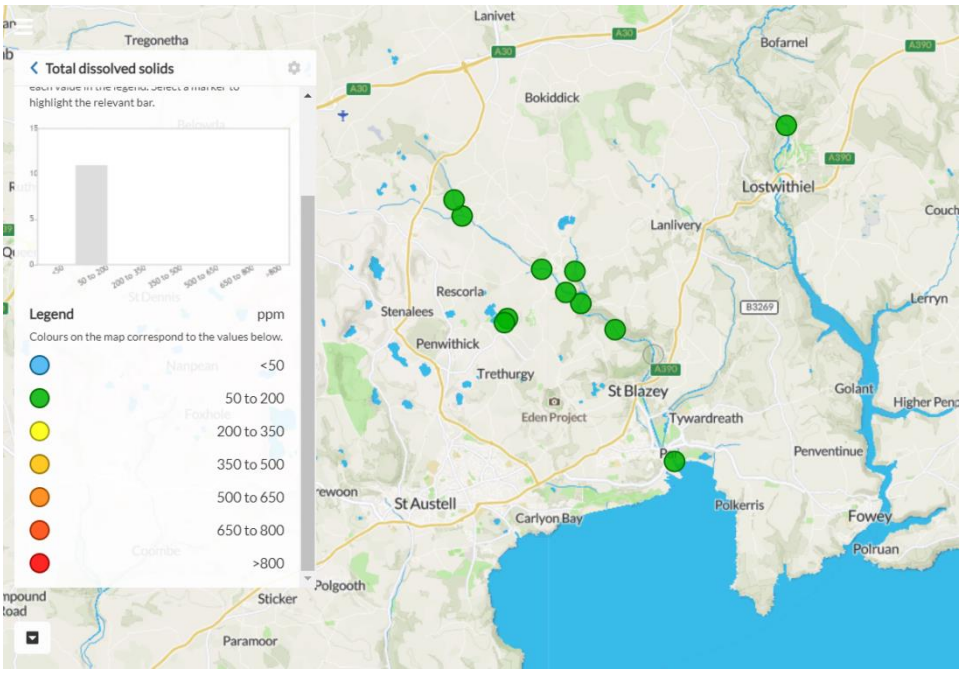


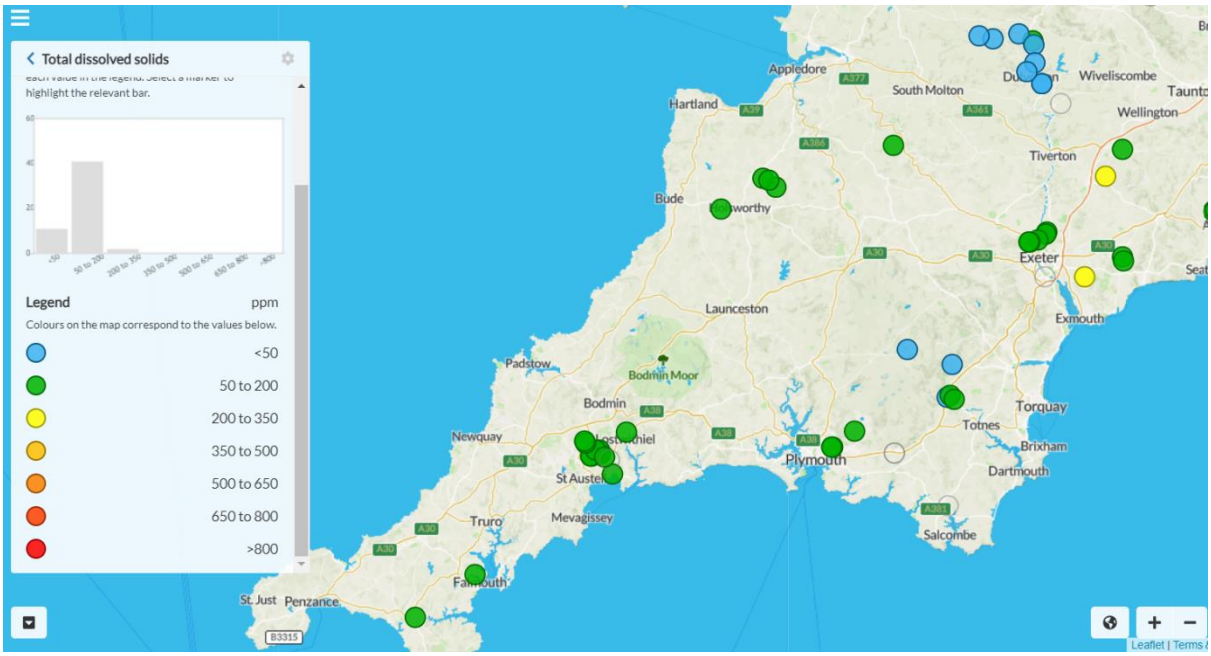
D. TOTAL DISSOLVED SOLIDS

1. We measure these in ppm (parts per million). This is the WRT's explanation:

Total Dissolved Solids (TDS) is directly related to the conductivity of the water. The more minerals, salts and metals that are dissolved in the water the more conductive it gets. Low levels of dissolved solids in waters such as those on Dartmoor near to the source of the river are a result of very low levels of input from the surrounding landscape. As the river runs down to the sea it collects material from many different inputs, some natural and some man-made such as farms, sewage plants, factories and residential areas. This typically increases the amount of solids dissolved in the water leading to a higher reading. Harmful pollution from things like sewage, slurry and factory discharge will usually elevate your TDS reading. However, some pollutants such as oil can lower conductivity; therefore it should be used as a general indicator of water quality not a specific measure of toxicity. Geology will influence the normal level of conductivity in a watercourse (e.g. Areas dominated by granite generally give a lower conductivity than those with limestone). Regular monitoring will allow the detection of changes in conductivity which can indicate pollution.

2. **Geographical comparison.** Source: Cartographer.





PAR RIVER/TRIBUTARY	LOCATION	Total Dissolved Solids ppm
Par	South of Minorca Lane, Par River, SX 02657 59788	70
Tributary	Carbis Stream SX 02834 59401	147
Par	Luxulyan allotments, Par River, SX 04732 58045	112
Par	Cam Bridges, Par River, SX 05292 57454	112
Tributary	Gatty's Bridge, Bokiddick Stream SX 05531 57953	74
Par	Treffry Viaduct, Par River, SX 05650 57179	97
Par	Lady Rashleigh Mine, Par River, SX 06451 56509	94
Tributary	Treesmill, Tywardreath Stream, SX 08873 55385	114
Par	Par Beach slipway, SX 0776 53261	186

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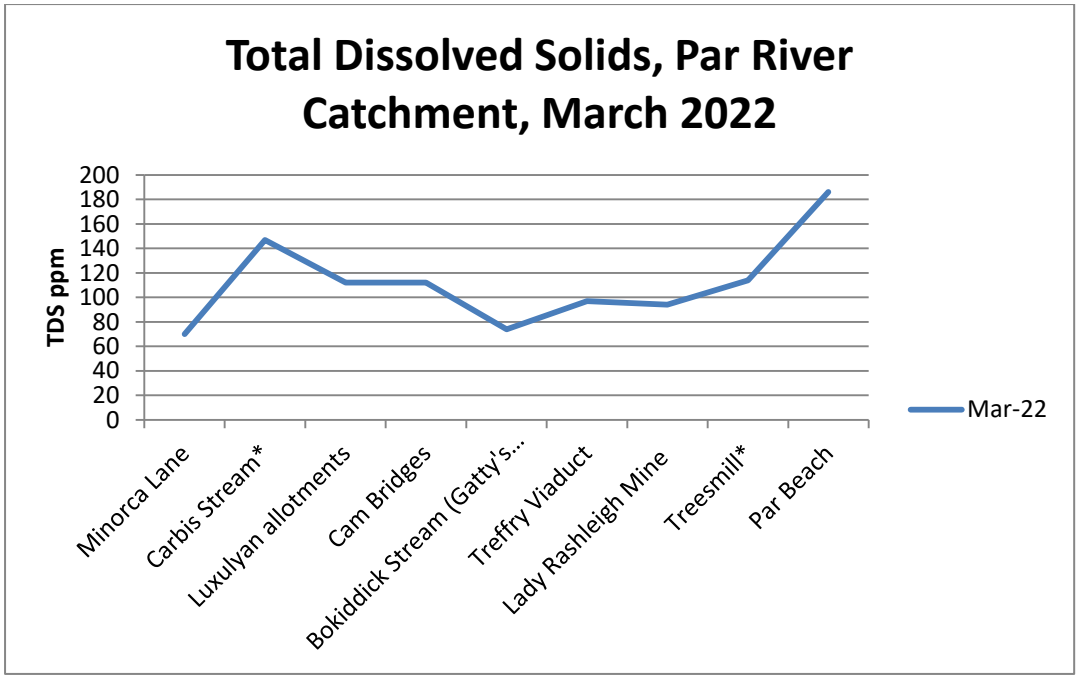
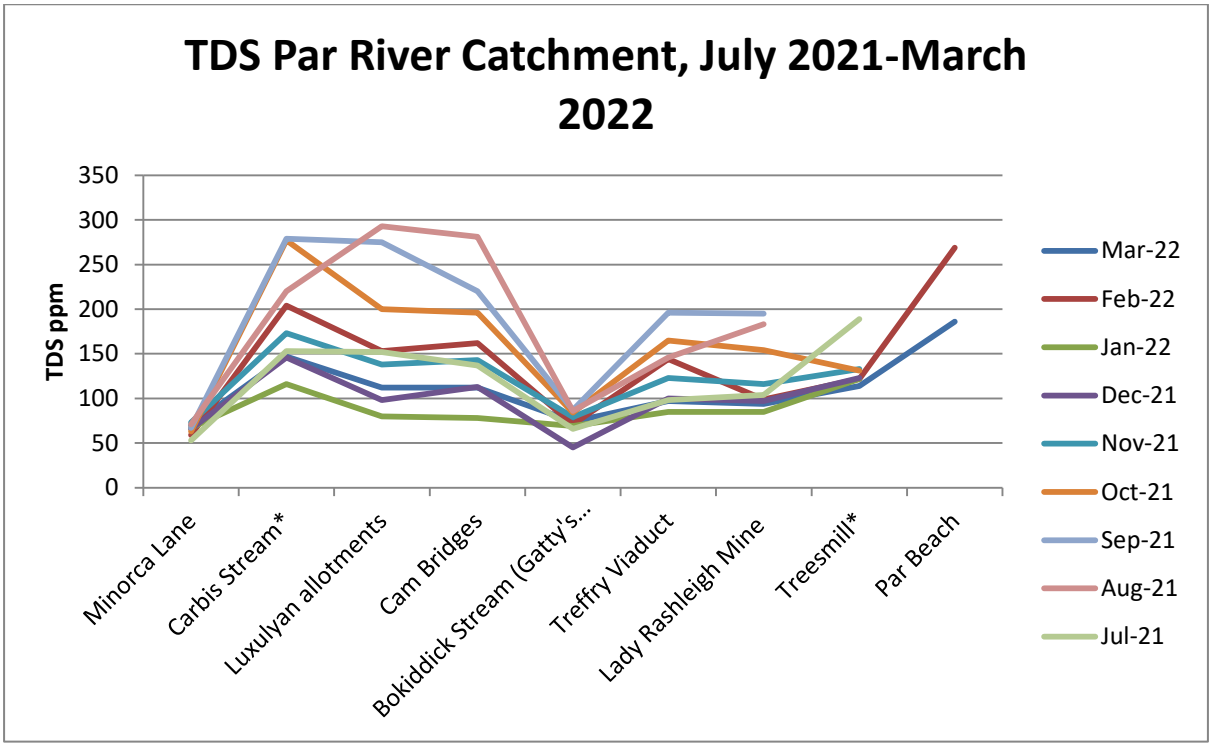


3. **Historical data** on total dissolved solids:

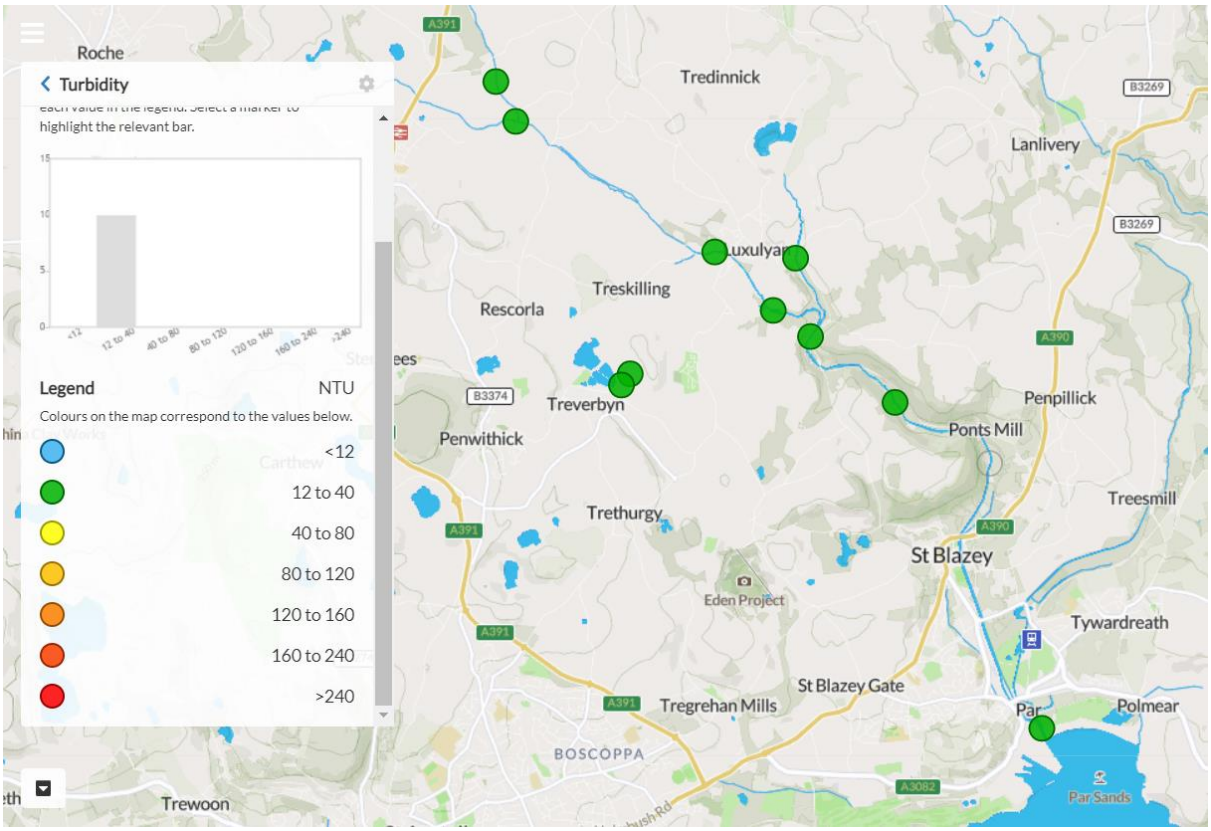


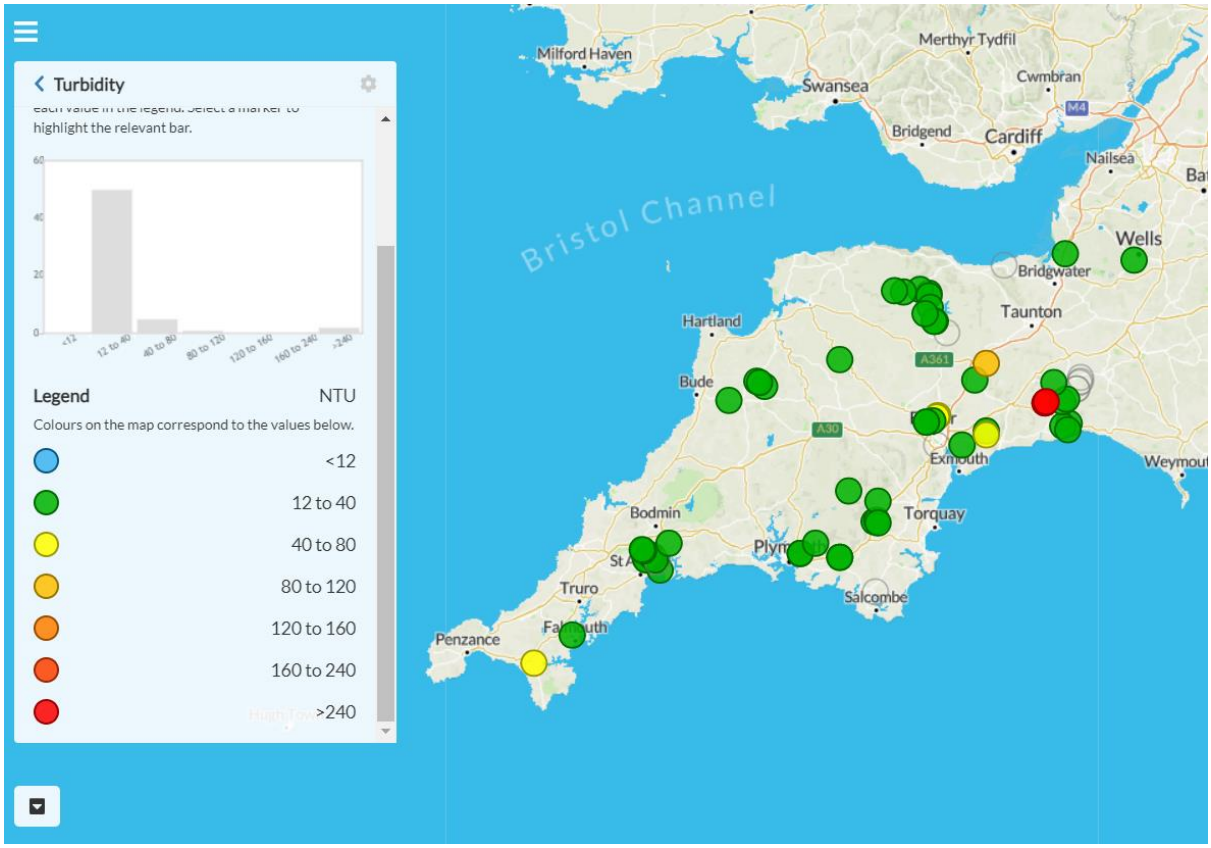
E. TURBIDITY

1. This is the WRT explanation of this measure:

Turbidity tube is a measure of the optical clarity of the water. The more suspended particles in the water the lower the clarity and the higher the turbidity. You will often find your waterbody gets more turbid after heavy rainfall due to soil running off the fields and sediment being mixed into the water column. This loss of topsoil is both a problem for farmer and river. It can often contain chemicals from the fertiliser and pesticides used on the land. An increase in sediment level on the substrate of the river can cause smothering of habitat by removing light and oxygen. Aquatic wildlife such as the less mobile invertebrates and fish eggs struggle to survive in low oxygen conditions and without light, plants are unable to grow. It is a good idea to sample your river after different weather conditions to understand how it responds to rainfall or drought.

2. **Geographical comparison.** Where scores are shown as 0, it means that the reading using the Secchi tube was <12. Source: Cartographer.





PAR RIVER/TRIBUTARY	LOCATION	Turbidity
Par	South of Minorca Lane, Par River, SX 02657 59788	0
Tributary	Carbis Stream SX 02834 59401	28
Par	Luxulyan allotments, Par River, SX 04732 58045	0
Par	Cam Bridges, Par River, SX 05292 57454	0
Tributary	Gatty's Bridge, Bokiddick Stream SX 05531 57953	0
Par	Treffry Viaduct, Par River, SX 05650 57179	19
Par	Lady Rashleigh Mine, Par River, SX 06451 56509	0
Tributary	Treesmill, Tywardreath Stream, SX 08873 55385	0
Par	Par Beach slipway, SX 0776 53261	0

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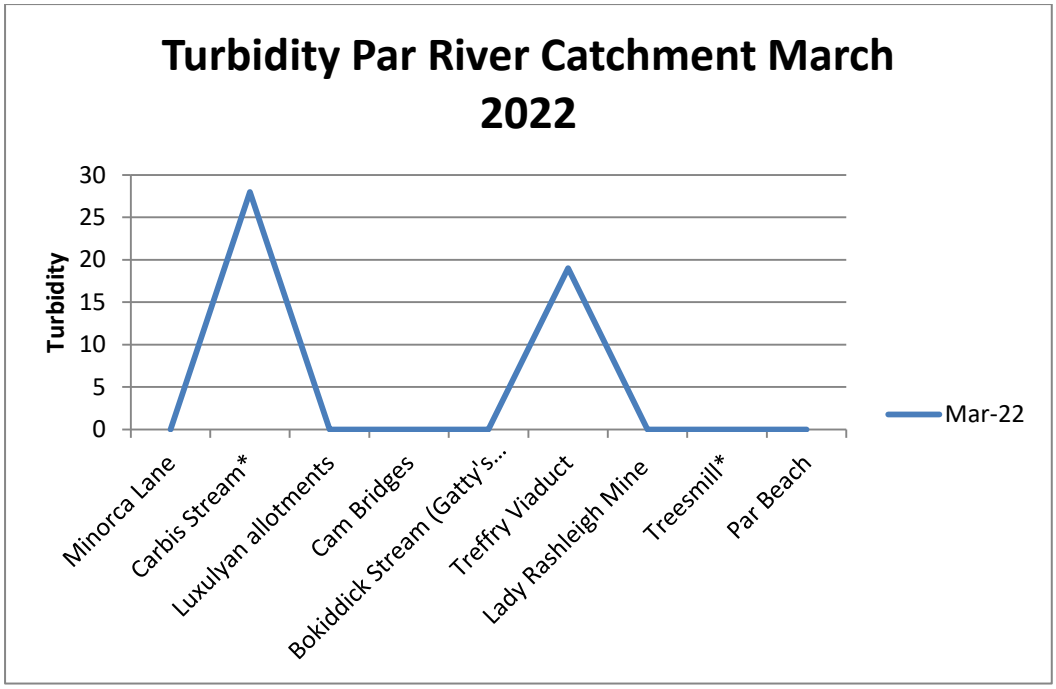
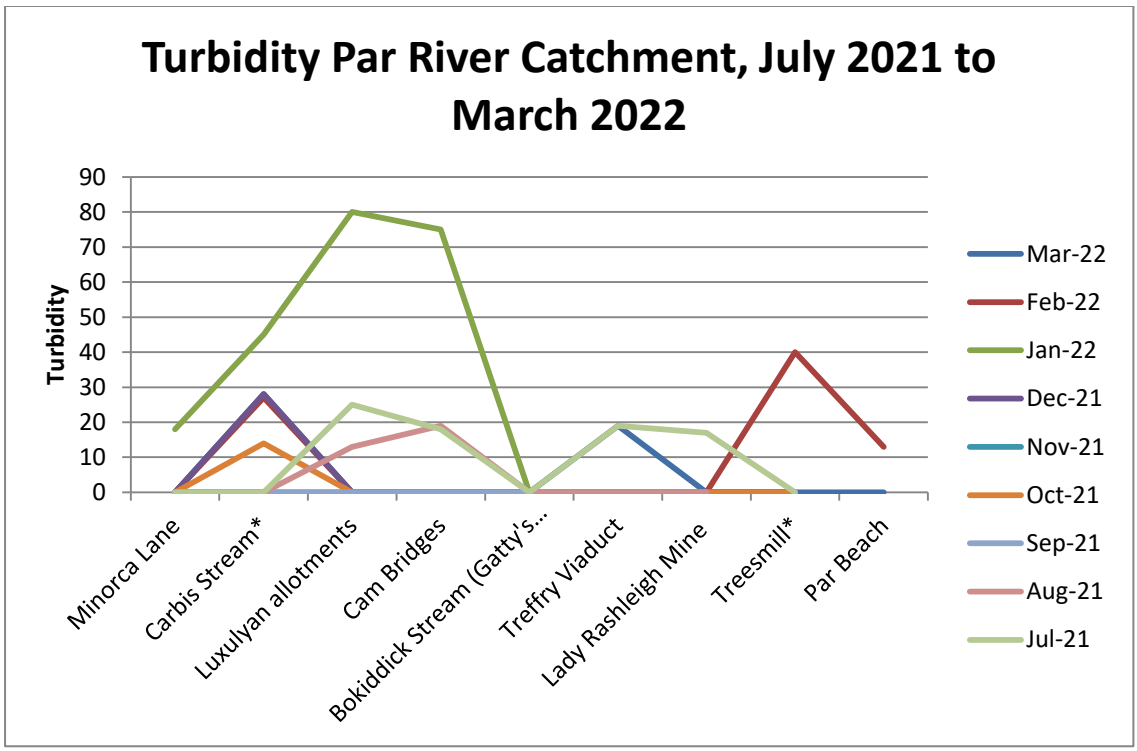
14th March 2022



4. Historical data on turbidity:



F. PHOSPHATES

1. This is the WRT's explanation of this measure.

Phosphate occurs naturally within the river ecosystem, but in very low levels under 0.05 mg/l. Therefore, higher levels may indicate anthropogenic input. Phosphate is found in animal and human waste, cleaning chemicals, industrial runoff and fertiliser so this can be a good indicator of pollution. Having raised levels of phosphate can lead to increases in plant growth within the watercourse. This leads to a depletion of oxygen due to the plant's aerobic respiration during the night. Without oxygen aquatic species cannot survive and the river ecosystem collapses. (It is important to note that phosphate is taken up by plants. You may get a low reading but high plant growth, indicating eutrophication.)

Ranges on phosphate diagnostic colour chart:

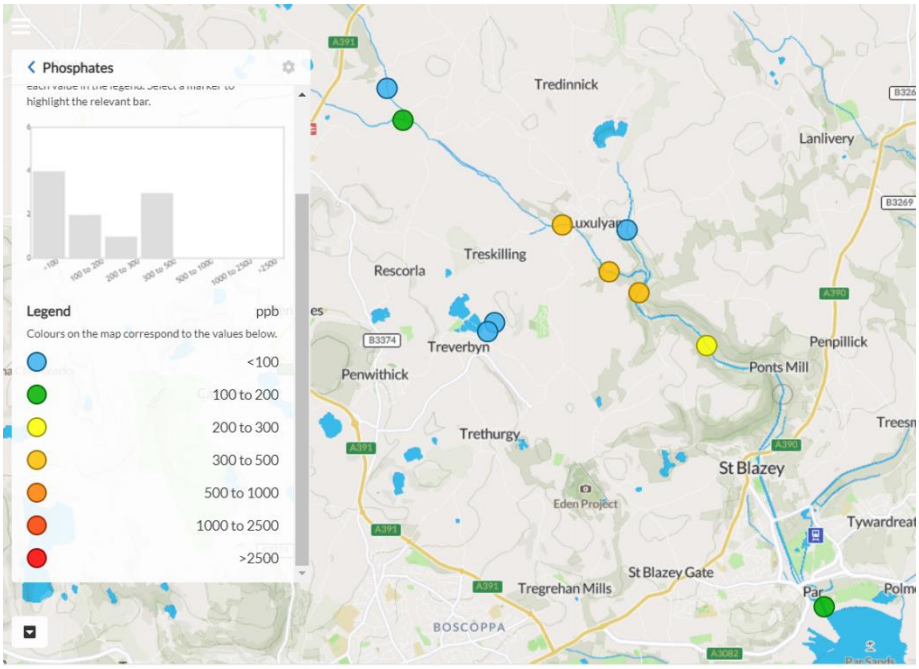
0 – 100 OK

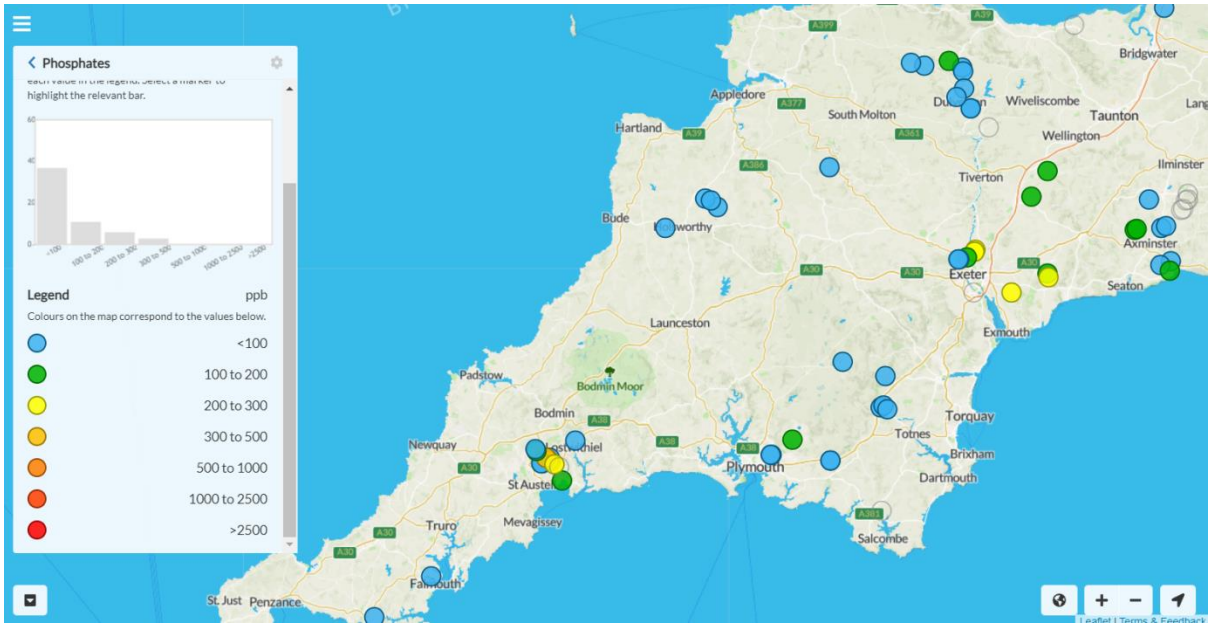
200 – 300 HIGH

500 – 2500 – TOO HIGH

Phosphate levels were relatively low for the second month running. Levels at all sites monitored were OK according to the WRT guidance. Maximum scores of 2500 PPB have been recorded at some sites but these precede the date range in the historical graphs. They have been recorded on Cartographer.

2. **Geographical comparison.** Source: Cartographer





PAR RIVER/TRIBUTARY	LOCATION	Phosphates ppb
Par	South of Minorca Lane, Par River, SX 02657 59788	0
Tributary	Carbis Stream SX 02834 59401	100
Par	Luxulyan allotments, Par River, SX 04732 58045	300
Par	Cam Bridges, Par River, SX 05292 57454	300
Tributary	Gatty's Bridge, Bokiddick Stream SX 05531 57953	0
Par	Treffry Viaduct, Par River, SX 05650 57179	300
Par	Lady Rashleigh Mine, Par River, SX 06451 56509	200
Tributary	Treesmill, Tywardreath Stream, SX 08873 55385	0
Par	Par Beach slipway, SX 0776 53261	100

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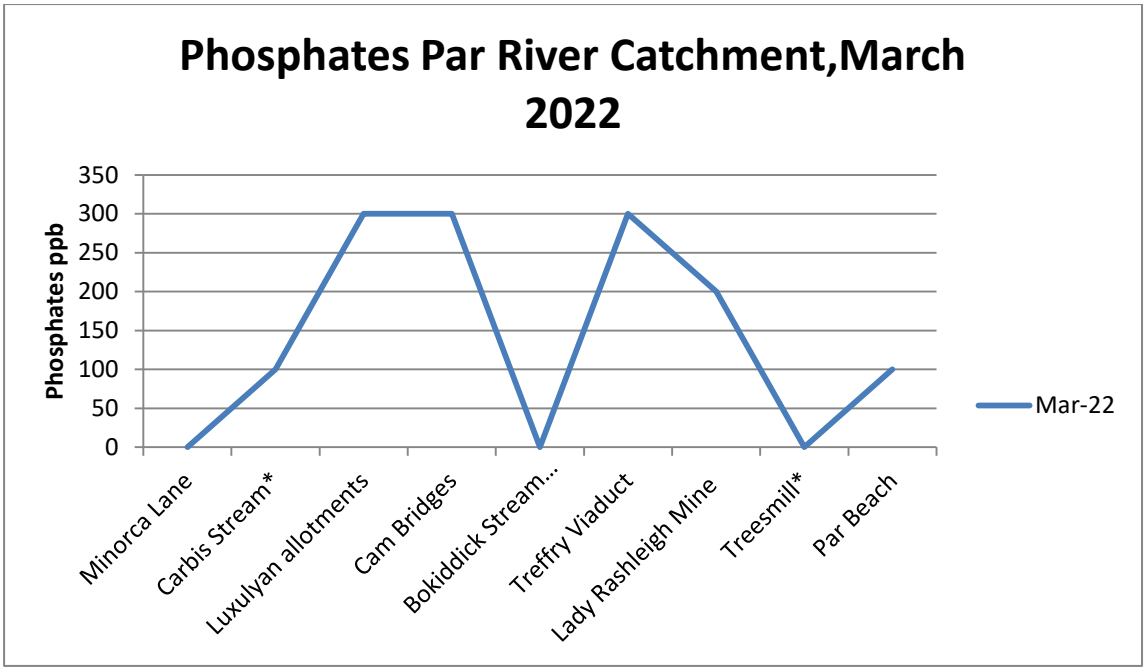
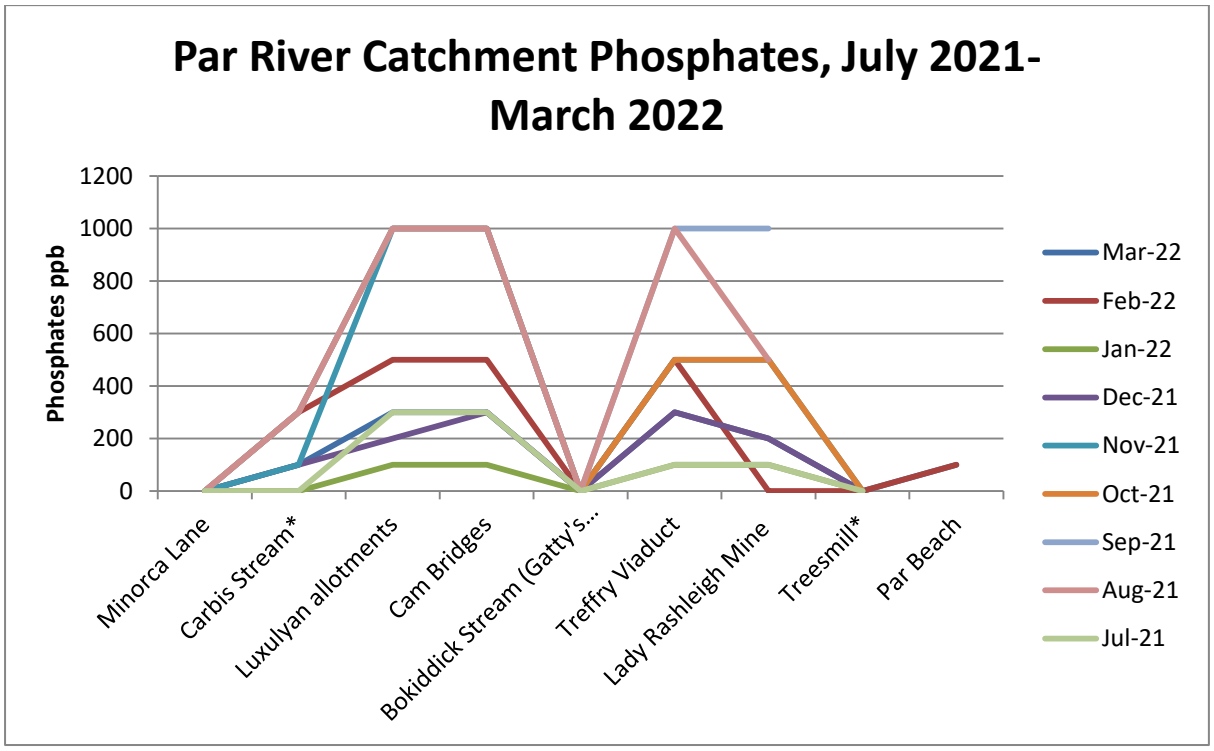
14th March 2022



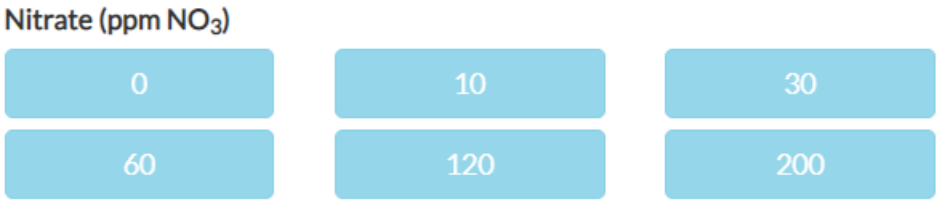
*indicates a tributary of the Par River.

5. **Historical data on phosphates:**



G. NITRATES

1. The WRT kit has these ranges for nitrates:



2.

PAR RIVER/TRIBUTARY	LOCATION	Nitrates ppm
Par	South of Minorca Lane, Par River, SX 02657 59788	10
Tributary	Carbis Stream SX 02834 59401	10
Tributary	Treverbyn Stream, East of Innis Fishery (Point B) SX 03770 56781*	10
Tributary	Treverbyn Stream, East of Innis Fishery (Point C) SX 03857 56884*	10
Par	Luxulyan allotments, Par River, SX 04732 58045	10
Par	Cam Bridges, Par River, SX 05292 57454	10
Tributary	Gatty's Bridge, Bokiddick Stream SX 05531 57953	10
Par	Treffry Viaduct, Par River, SX 05650 57179	10
Par	Lady Rashleigh Mine, Par River, SX 06451 56509	10
Tributary	Treesmill, Tywardreath Stream, SX 08873 55385	-
Par	Par Beach slipway, SX 0776 53261	-

CSI Surveys conducted on these dates, each of which is colour-coded:

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13th March 2022

14th March 2022

H. OTHER OBSERVATIONS

1. E.coli (EC) and Total Coliform(TC)

(a) On 21st March 2022 testing took place on the Par River at Lady Rashleigh Mine (SX 06451 56509) using the Aquagenx CBT EC+TC MPN Kit which 'simultaneously detects and quantifies E. coli (EC) and Total Coliform (TC) bacteria in a 100 mL sample'.

(b) Key information:

What is the difference between total coliform and E. coli?

Total coliform is a large collection of different kinds of bacteria. Faecal coliform are types of total coliform that exist in faeces. E. coli is a subgroup of faecal coliform. https://doh.wa.gov/sites/default/files/legacy/Documents/Pubs//331-181.pdf

Why is E. coli in river water a concern?

The presence of E. coli **indicates faecal contamination of the drinking water** and as a result, there is an increased risk that enteric pathogens may be present. https://www.canada.ca/en/health-canada/programs/consultation-e-coli-drinking-water/document.html

Particular thanks are due to Joan Farmer for allowing the use of her home for the unpleasant process of incubating the samples and also for contacting the manufacturers of the kit in North Carolina, USA, for guidance on the results. Thanks too to Ross Tonkin for sharing his professional expertise.

(c) Results submitted by Joan Farmer for February and March 2022:

Aquagenx CBT EC=TC (Compartment Bag Test)

Surface and Recreational Waters

Lady Rashleigh Mine SX 0645 5650

Results are shown in MPN/100ml (Most Probable Number)

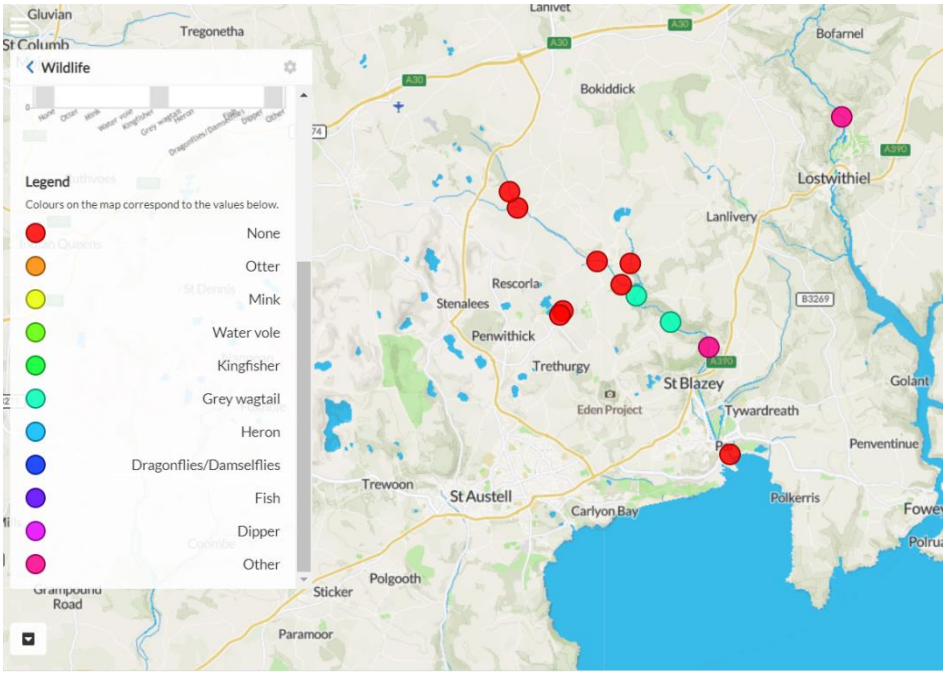
>1000 is the highest reading on the 32 row chart. 483 is the second highest number.

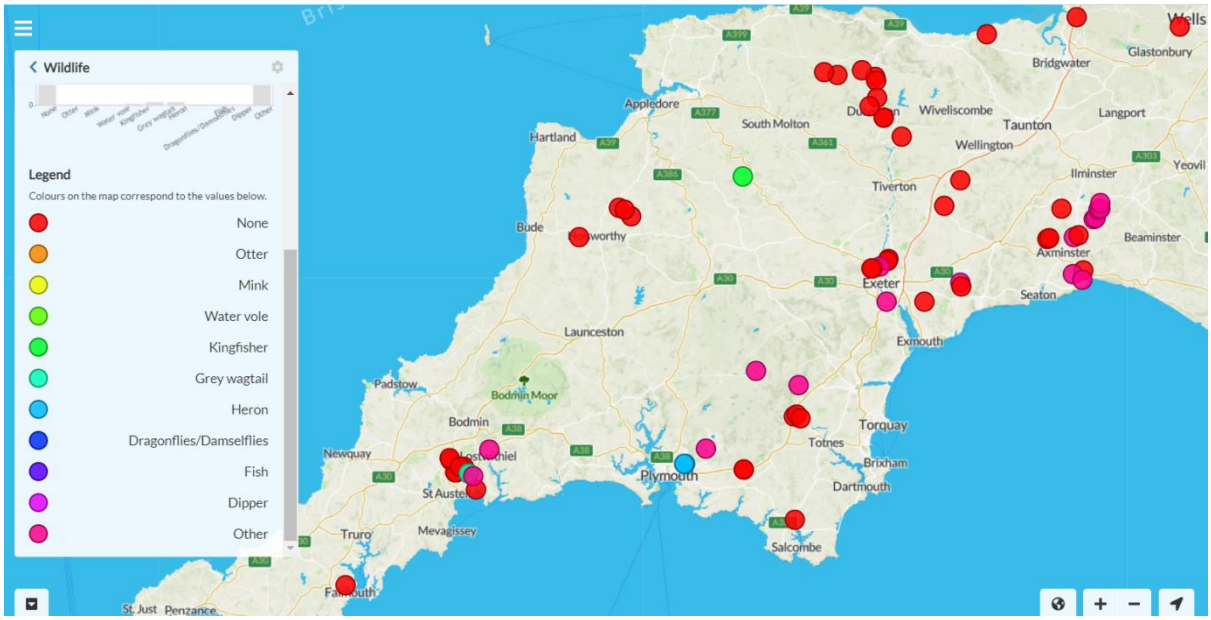
Sample Date	Rain? Notes	Result Date	Results E coli	Health Risk	Results Coliforms	Health Risk
21/02/22	Rain prev. 24hrs.	23/02/22 24/02/22	483 [1] >1000	Very High Unsafe Very Unsafe	>1000 >1000	V Unsafe V Unsafe
21/3/22	dry	24/03/22	136	High risk Prob. Unsafe	>1000 [2]	V.Unsafe

[1] Readings taken twice on the 1st sample as it took 12 hours to reach the minimum temperature of 25 degrees
[2] Compartments 4 and 5 had only very pale blue fluorescence in UV light, but definitely glowed with no trace of yellow.

2. Wildlife

Source: Cartographer.





3. **Otter survey:**

A. SURVEY CONDITIONS

Date & time	10/3/2022, 13/3/2022, 14/3/2022
Surveyors	Roger Smith, Joan Farmer
Areas surveyed	Par River from STW to Cam Bridges; Par River from Treffry Viaduct to Ponts Mill; Upper Par (Criggan Moors and Minorca Lane)
Weather	Dry.
River level	Average- high
River flow	Steady
Water quality	High phosphate levels from Luxulyan allotments downstream (300 ppb); at Lady Rashleigh Mine 200 ppb. Phosphate levels have been much higher. There are also concerns about levels of E.coli and Total Coliforms.
Other wildlife	Dippers and grey wagtails seen on 13/3/2022.

B. EVIDENCE FOR OTTERS ✓

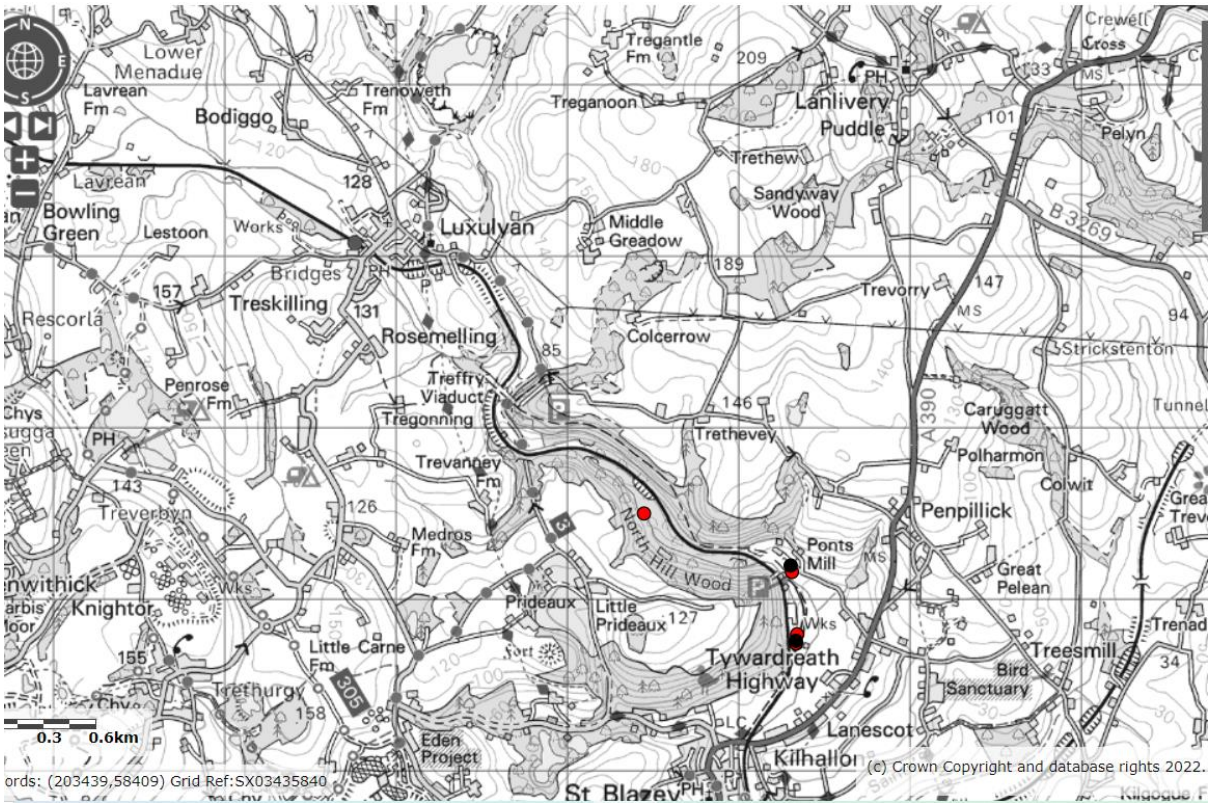
EVIDENCE	SEEN/ ORKS*	LOCATION	NOTES
Spraint - fresh			
Spraint – recent	✓*	SX 06456 56498 Lady Rashleigh Mine – boulder in river	Fish bones and scales in spraint.
	✓*	SX 07312 56164 under canal bridge at Ponts Mill	Sticky. Could not see bones or scales.
Spraint - old	✓*	SX 07342 55795 sluice gate Ponts Mill.	Feathers visible in spraint.
Anal jelly			
Sign heap			
Staining			
Tracks	✓*	SX 07312 56164 under canal bridge at Ponts Mill	Plenty of prints near spraint. Can't be positive they were otter prints.
Path			
Slide	✓	SX 0733 5577 Downstream from Ponts Mill sluice	On river bank next to log on which there was spraint. Likely but not certain.
Holt			
Hover			
Couch			
Live sighting			
Corpse			

***Report sent to ORKS: https://erccis.org.uk/**

C. MAP

Source: https://magic.defra.gov.uk/MagicMap.aspx

Red dots – definite evidence. Recorded on ORKS.
Black dots – possible evidence. Not recorded on ORKS.



D. **PHOTOGRAPHS**

1. Spraint with fish bones, Par River at Lady Rashleigh Mine (SX 06456 56498).

2. Spraint and footprints under the canal bridge at Ponts Mill (SX 07312 56164).

3. Footprints in the sand under the canal bridge at Ponts Mill (SX 07312 56164).

4. Location of spraint near sluice gate on Par River south of Ponts Mill (SX 07342 55795).

5. Spraint near sluice gate on Par River south of Ponts Mill (SX 07342 55795). This appeared to have feathers in it, although a fish tail is another possibility.

6. Possible slide on Par River bank downstream from Ponts Mill sluice gate (SX 0733 5577). This was next to a log on which there was spraint, and close to a previous live sighting, so a slide is a reasonable assumption. However, this has not been recorded on the ORKS website.

7. Spraint on log downstream from Ponts Mill sluice gate (SX 0733 5577). Fish bones and scales can be seen.

4. ARMI Riverfly Survey

Three of the group (Joan Farmer, Veronica Jones and Roger Smith) have undertaken the training to carry out Riverfly Surveys under the Anglers' Riverfly Monitoring Initiative (https://www.riverflies.org/rp-riverfly-monitoring-initiative). In short, sampling for 8 riverfly groups is carried out using standardised methods with scores calculated for their abundance. Information is passed to ARMI and the ORKS database. If the score does not reach a trigger level (in our case we have a temporary trigger level of 5), the Environment Agency must be informed immediately since it is highly likely to indicate that the water is polluted. Our group received approval to sample at two sites: Luxulyan allotments (SX 04743 58054) and Lady Rashleigh Mine (SX 06453 56500). We have decided, for the time being, to concentrate on the latter.

It is impossible to count every invertebrate so this counting method is used:

Abundance	Score	Estimated Number
1-9	1	Quick count
10-99	2	Nearest 10
100-999	3	Nearest 100
>1000	4	Nearest 1000

Results, 21st March 2022

	SPECIES	NUMBER	CATEGORY
Trichoptera			
1	Cased Caddisfly	3	1
2	Caseless Caddisfly	7	1
Ephemeroptera 3 tails			
3	Mayfly (Ephemeridae)	1	1
4	Blue-winged olive (Ephemerellidae)	0	0
5	Flat-bodied up-wings (Heptageniidae)	13	2
6	Olives (Baetidae)	26	2
Plecoptera 2 tails			
7	Stoneflies	10	2
Gammaridae			
8	Freshwater Shrimp	12	2
			11

CATEGORY TOTAL	**11**
TRIGGER LEVEL	**5**

I. DISCUSSION

1. As citizen scientists our work is very basic and there is always a higher possibility for error than with work undertaken by professionals; therefore, it is important to scrutinise and challenge all our results and inferences. The nitrate testing is a case where we do not feel confident about the results. With one exception (last month on the Bokiddick Stream), the result at all monitoring points has been 10 ppm. While this may be correct, the colour of the strip when first taken from the canister looks like 10 ppm anyway, which makes us wonder if it is indicating anything at all. Possibly we are doing the testing incorrectly but since it is such a simple procedure that seems unlikely.

   The testing for E.coli and Total Coliform is at an early stage. We believe that procedures have been followed properly. The results are alarming and on the face of it would justify contacting the Environment Agency immediately. But since the group has only carried this out twice we have been reluctant to raise the alarm in case there has been any error in our approach. Joan Farmer made contact with the firm making the sampling kit, Aquagenx LLC, to seek clarification (see below).

   An additional caveat is that it is impossible, even with a reduced number of sites, to test simultaneously, so that sampling occurs on different days and different times of day. This, perhaps, might be one factor in explaining some of the high temperature readings at some locations.

2. Results for E.coli and Total Coliform relate to one site: the Par River at Lady Rashleigh Mine (SX 06453 56500). We also conduct CSI sampling and Riverfly monitoring here and it is a site where otter spraint has been found for over a decade. Huge credit must be given to Joan Farmer for incubating the water sample at her home and also for her rigorous interrogation of the results. As shown above, the E.coli reading for March was in the category 'High Risk, Probably Unsafe' (last month 'Very Unsafe'). For Total Coliforms it was 'Very Unsafe', as was the case last month.

   After last month's survey Joan contacted Aquagenx for corroboration of our conclusions about the sample:

   'I have no idea how these readings relate to those used by the Environment Agency, or indeed how alarmed we should be, but your chart labels the Health Risk as Very Unsafe.'

   To which, Lisa Hirsh (Sales, Marketing, Product Development, Aquagenx LLC) replied:

   '…you can be confident the test results you obtained using a 1:10 dilution with our Compartment Bag Test reveal your sample is very unsafe, as the right-hand column in our MPN Table demonstrates. It would be good for you to find a UK colleague or contact who can relate your test results to UK recreational water quality standards.'

Personal correspondence with someone who carries out professional E.coli testing for a large local business on 8 local watercourses suggests our results stand out. This business has its samples analysed by an independent pathology laboratory and no traces of E.coli have been found in the last 5 years.

Possibly we have made errors in sampling and incubation. Or we are detecting high levels of E.coli and Total Coliform that pose a health threat to anyone entering the river. It is not known where the business conducts its samples and we do not know what the levels of bacteria are in other parts of the Par River. Given the likely link between phosphates and the local sewage treatment works at Luxulyan suggested by the Environment Agency, it is possible that this is the source but that is just speculation.

3. Phosphate levels on the main Par River from Luxulyan allotments (SX 04732 58045) downstream are High, according to the WRT classification, but once again are not reaching the very high levels recorded consistently last year. This is good news but the reason is unknown. We do not know if this is a trend.

4. The ARMI Riverfly monitoring on the Par River at Lady Rashleigh Mine (SX 06453 56500) was conducted on 21st March, at the same time the sample for bacteria was taken, but the CSI samples were taken on 13th March. Ideally all would be done at the same time but the amount of time needed to do all these tests, even at a reduced number of locations, makes this impracticable. Nonetheless, the number of invertebrates was easily sufficient to exceed the temporary trigger level that we had been set and can be taken as a positive indication of the river's health. One species was not found, the Blue-winged olive, but it is believed that its absence is not unusual at this time of year.

5. China clay continues to pollute the Carbis Stream (SX 02834 59401) upstream from its confluence with the Par near Higher Menadue. The source has not yet been established but this is something that needs to be established.

6. If the monitoring results are taken at face value, it can be said that the Par River has some positive signs of health: generally low turbidity; mostly temperatures that are appropriate for the season; and the presence of otters and fish, plus other indicator species such as dippers and grey wagtails, in the Lower Par. On the other hand, E.coli and Total Coliform levels at one site in the Lower Par are unsafe and phosphates are high (though reduced from previous levels). On the tributaries, water quality seems to be good, with the exception of the Carbis Stream.

Roger Smith on behalf of the Par River Monitoring Group, 2nd April 2022