TRACER EXPERIMENT TECHNICAL REPORT

Group A

26-05-2023

Short introduction

The goal of the experiment was to measure EC-values of the Mechelback and its tributaries as well as the discharge of the streams as certain locations. These measurements can be used to determine the quantities of water flow each tributary contributes to the Mechelback. Furthermore, it was analysed what caused the streams to have a certain EC-value by analysing the surrounding area and landscape during a walk along the Mechelback.

Equipment

- EC-meter
- Notebook + pen
- Laptop with AquaCal software
- Rhodamine probe
- Pre-made rhodamine solution
- Hiking gear

Method

After collecting all the necessary equipment, our group proceeded to the designated downstream point of the Mechelback. At this location, an EC-meter and a laptop connected to a rhodamine probe were utilized to measure the EC (electrical conductivity) and rhodamine dilution. This downstream point served as our reference point for calculating the discharges of both the tributaries and the main stream.

Once the initial measurement was completed, the group embarked on a journey upstream along the river, measuring the EC at each intersection where a tributary met the main stream. The specific locations where these measurements were taken can be observed in Figure 1. Point 1 in the figure represents the furthest downstream location where measurements were conducted. Additionally, measurements with the rhodamine probe were performed at points 1, 6, and 10.

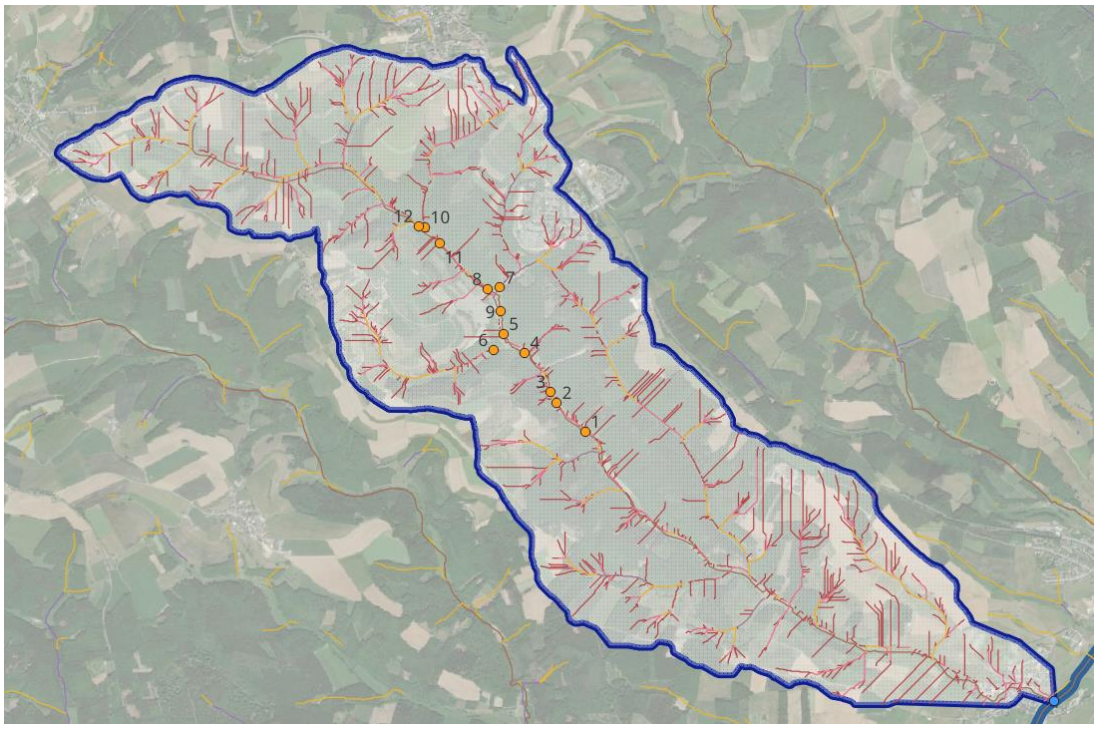

Figure 1: Measurements points along Mechelback

Results

All the results for the EC measurements can be seen in Table 1, which in turn are shown more clearly in Figure 2.

Location	EC (µS /cm)	Discharge Rhodamine (ml)	Temperature (Celcius)
1	223	238	9.8
2	73.4		
3	233		
4	240		9.5
5	237		9.5
6	271	34	9.1
7	413		10.3
8	208		9.9
9	237		9.8
10	304	First: 32 Second: 30	9
11	221		9.6
12	184		9.9

Table 1: EC, temperature measurements + used rhodamine

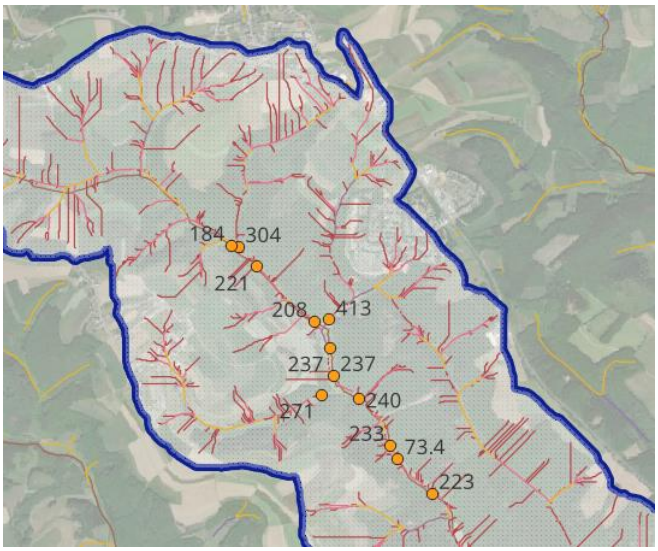

Figure 2: EC-values for main stream and tributaries

Apart from the EC, rhodamine measurements were performed at three locations. Using these measurements and the known amount of rhodamine the discharge could be calculated at these locations with the formula below.

$$M = Q \int_0^\infty (\phi(t) - \phi_1)\,\mathrm{d}t \tag{1}$$

The measurements and the calculated discharges can be seen in the figures below.

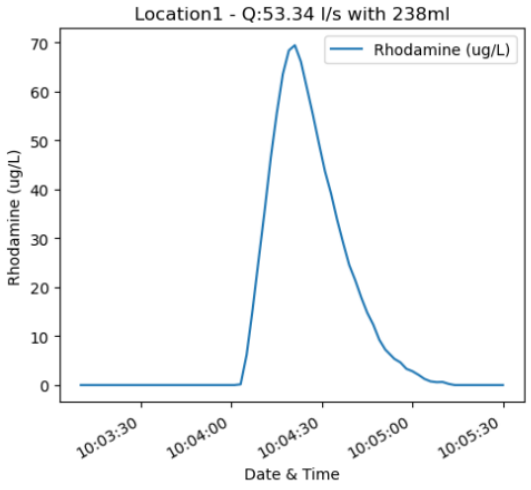

Figure 3: Rhodamine experiment – Location 1

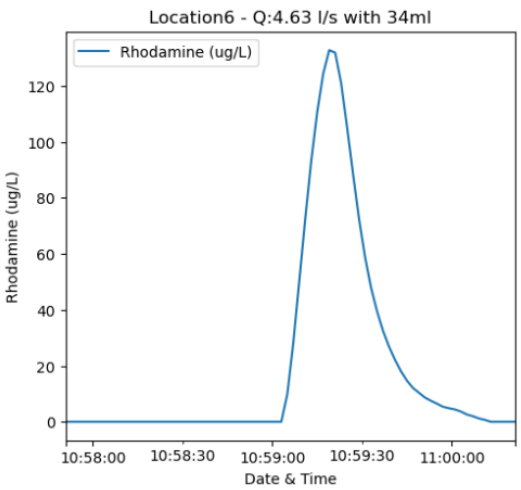

Figure 4: Rhodamine experiment – Location 6

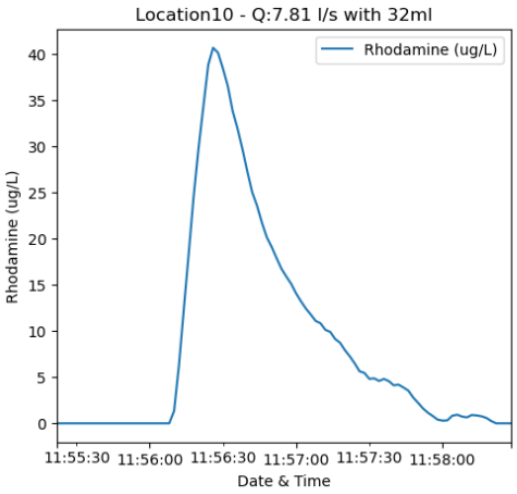

Figure 5: Rhodamine experiment – Location 10

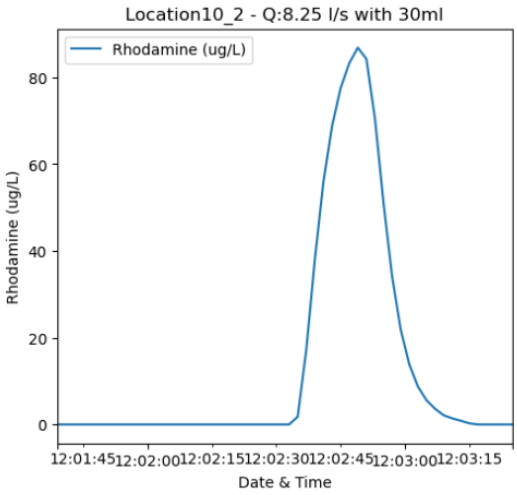

Figure 6: Rhodamine experiment – Location 10 (2nd try)

Conclusion/discussion

In this experiment, EC measurements were conducted at twelve different locations along the Mechelback and its tributaries. Our findings revealed interesting patterns and associations between the EC values and various factors in the surrounding areas.

At the most downstream point (location 1), an EC value of 223 µS/cm was recorded. Moving slightly upstream to location 3, a slightly higher EC value was observed. This increase can be attributed to the low EC value of the sublateral flow (location 2) originating from the slopes between the plateau and the wetland. Despite its relatively low inflow, this flow with an EC of 73.4 µS/cm causes a decrease in the EC of the main stream.

Upon reaching the first intersection (between points 4 and 6), a slight increase in the EC of the main stream could be noted. This elevation was primarily due to the tributary at location 6, which had an EC value of 271 µS/cm. The higher EC value can be attributed to the presence of the town of Merscheid upstream, which is known for its agricultural activities.

Moving to the second intersection (between points 7 and 9), the group encountered a tributary (location 7) with a significantly higher EC value. This increase was a direct result of the treated wastewater released by the nearby wastewater treatment plant into the tributary. The EC value at this location reached 413 µS/cm, significantly impacting the EC values both upstream and downstream in the main stream.

At the final intersection, another tributary with a higher EC value was identified, which was primarily influenced by agricultural practices near the town of Heiderscheid.

Additionally, our analysis of the rhodamine measurements allowed us to estimate the discharges at various locations. The discharge at location 1 was found to be approximately 53.33 L/s, while at location 6 it was around 4.6 L/s, and at location 10 it was around 8 L/s. Comparing these estimates to the field measurements, the order of magnitude was observed to be consistent.

However, it is worth noting that at location 10, two discharge measurements were conducted. The first measurement was taken before a culvert, resulting in a longer tail in the data shown in Figure 5. To address this issue, the experiment was repeated and the solution was released downstream of the culvert, ensuring more accurate results.