

Investigating the presence of standing water at the highest point of elevation on Troopers Hill Field

Executive Summary



Avon Project: Hanna Welzel, Laura Simmons, Emily Howe, Aidan Bradley, Joshua Morgan, Edward Pullen

Background

In our project, we investigated the causes behind the standing water that occurs every winter at the point of highest elevation on Troopers Hill Field, a grassed recreation area adjacent to Troopers Hill Local Nature Reserve in the East of Bristol. Troopers Hill has a long and interesting history and was used for smelting and mining, among other things. The field was covered with a clay cap after being used as a landfill for tipped rubble. Standing water on top of the hill has created a very boggy area which can restrict access. Our research aims to identify the source of water in order to solve the problem and guarantee access for everybody. Friends of Troopers Hill were specifically interested in whether the source of the lying water was natural or treated.

Hypothesis

Based on our problem we created several hypotheses. Firstly, we hypothesised that the source of the water is from a broken pipe lying underneath the area and is therefore treated. Secondly, we hypothesised that the water is a result of upwelling from a natural spring in the Avon valley. In both cases, we would expect to see that the water is from a point source. Finally, we wondered whether the water is from precipitation that is exceeding the infiltration capacity at the boggiest region on the field.



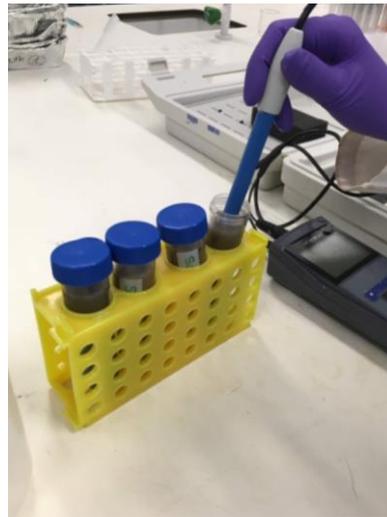
Standing water at the highest point of Troopers Hill Field

Methods

During our study, we took soil and water samples along the boggiest area for analysis in the lab to determine the source of the water. Lab studies involved pH and grainsize measurements. We took Theta probe measurements of soil moisture in quadrants to identify whether the water is coming from a point source. We also tested for heavy metals and used ion chromatography to try and see whether the water may have been treated. Lastly, we measured the infiltration rate at the boggiest area and a control site across the field.



Soil samples in the lab



pH measurement of water



Theta probe measurement

Results

The results of the Theta probe have shown that there is no point source and that the moisture is distributed irregularly. Therefore the hypothesis of a natural spring is rejected. However, we do see a diagonal relationship across our quadrant, which is a common footpath that people take across the hill. The frequent walking could cause compaction of the soil and make it more difficult for rainwater to infiltrate. The chloride and fluoride results, which are an indication for treated water, are well below that of the Bristol Water data. This, together with the Theta probe results, leads to supporting the idea that rainwater is, in fact, the cause of the standing water at Troopers Hill Field. Soil samples and infiltration capacity results explain why the water cannot infiltrate. A high proportion of silt and clay at the top of the hill make the soil impermeable and the water stands on top. The infiltration capacity was measured at a control site and the muddiest area. The control site showed that 4.6 cm infiltrated the ground in 93 minutes. At the wettest point, however, 0 cm infiltrated over the same duration.

Limitations

Our capacities did not allow us to dig deeper than the shovelhead, which is why we could not see the depth of the clay layer or a possible pipe. Since our research was limited in time, we could not take as many replicates to conduct an in-depth statistical analysis. Future research could include more infiltration tests at more sites to increase the statistical significance of our results.

Conclusion

Our measurement results lead us to believe that the water is not treated and is a result of heavy rainfall in winter which is being trapped above a clay cap layer that has been placed on top of a tipping site. This is exacerbated by the thin soil layer on top of the clay cap in the boggiest area which may have been compacted by people walking over it.

Recommendations

There are several ways to prevent water from accumulating. More soil could be placed on top of the clay layer to get a better infiltration capacity. This would also change the angle of the slope so that the water gravitates downhill with greater ease.

Another solution is the path that is currently being built, but it must guide the water away from the boggiest area, for example through a drainage system right next to the path. For a drainage system to work, it would need to be placed above the clay cap and regularly cleaned.



Visible clay layer at the test site