

## **Ilston River Study**

### **Introduction**

The river Ilston, located in Swansea in South Wales, is a freshwater stream sourced near Swansea Airfield that meanders through the towns of Ilston and Parkmill before discharging into the ocean at Three Cliffs Bay. In the summer, parts of the river tend to dry up completely leaving a dried river bed shortly after Ilston church so that only the mouth and tail end of the river remain in full regular flow.

The geology of the area is predominantly made up of limestone and subsequently the river in this valley often finds itself below ground level into cracks and cave systems that have been eroded by water processes over the years. (Edwards, 2005).

On Tuesday the 17<sup>th</sup> of October a group of nine undergraduate students from The University of Wales Trinity Saint David: Mount Pleasant Campus went to Ilston River in order to analyse it and its processes. Each group was assigned three points to measure along the river's course from the source near Ilston to the point of discharge at Three Cliffs Bay, with a total of ten analysable sites being surveyed that day. These points were labelled chronologically with the first point being at the source of the river and the final point, point ten, being at the mouth of the river. The data collected by the students was then drawn together to create one large finalised data sheet.

Due to unfortunate weather conditions and subsequently higher, and faster waters, students deemed some points of the river too dangerous to analyse and as a result, in order to preserve the concern for safety and hazard analysis, not all parts of the river had data collected from them. However, in order to protect the data that the group had managed to collect, data sourced from previous year's field trips was used in the finalisation of the data chart.

The aim of the study was to examine the changing characteristics of the river Ilston, and to prove or disprove the provided hypotheses, which are listed as follows:

1. The river becomes wider and deeper downstream
2. The cross-sectional area of the river increases downstream
3. The river velocity increases on the outside of a meander
4. The highest velocity is to be found in the centre of the river
5. The river velocity decreases downstream
6. The size of the bedload gets smaller downstream
7. The shape of the bedload becomes more rounded downstream
8. The discharge of water in the river increases downstream

Students were also asked to demonstrate the relationship of ecological form and behaviour to the physical setting.



*Figure 1: Ilston river route from source to mouth. Image from google maps with red marker dots added to show river route more clearly.*

## **Methodology**

The students were provided with a variety of equipment in order to collect data successfully and as accurately as possible, shown below is a list of apparatus that students were given access to for this experiment:

- 1:25000 Map
- Data sheets
- 25M measuring tape
- Metre rule
- Clipboard
- Stop watch
- 2 surveying poles
- Bottles
- Current flow meter
- Waders
- Powers scale of roundness chart

Students were asked to dress appropriately in waterproof clothing and to bring their own food in order to prepare for a long day of data collection.

### *Hypothesis 1 + 2*

The first hypotheses required the use of a tape measure, a metre rule and surveying poles in order to secure the tape. Students were made to measure the width of the river from bank to bank and from there, measure the depth of the river every 25cm using a metre rule, recording the data on a provided table. It was important that students used the correct techniques in order to get the best results, this included doing things such as turning the metre rule to the side, following the stream of water, rather than facing flat against the stream to prevent water build up from water resistance. Students also had to be aware of rocks and sediment in the river bed which could prove to cause anomalies in results.

### **River Cross Section Measurements**

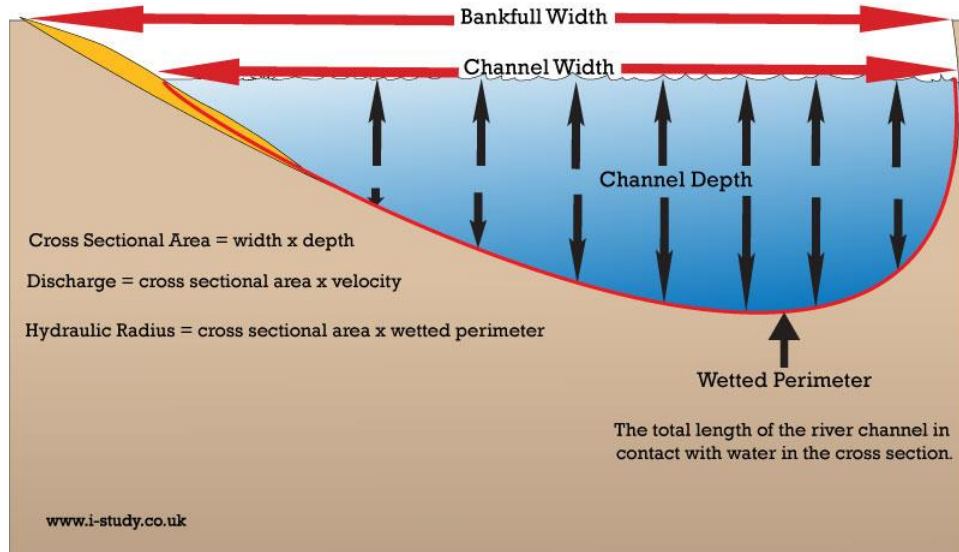


Figure 2: River cross section example including relevant equations. Sourced from google images.

### *Hypothesis 3 + 4*

To prove or disprove the third and fourth hypotheses a current flow metre was used, this measured the water velocity in m/s across the width of the river at five separate points. The flow metre was placed into separate parts of the river, careful not to be lodged on any large sediment and the spinning wheel was made to face down stream and then held still until a reading was available on the handheld monitor.

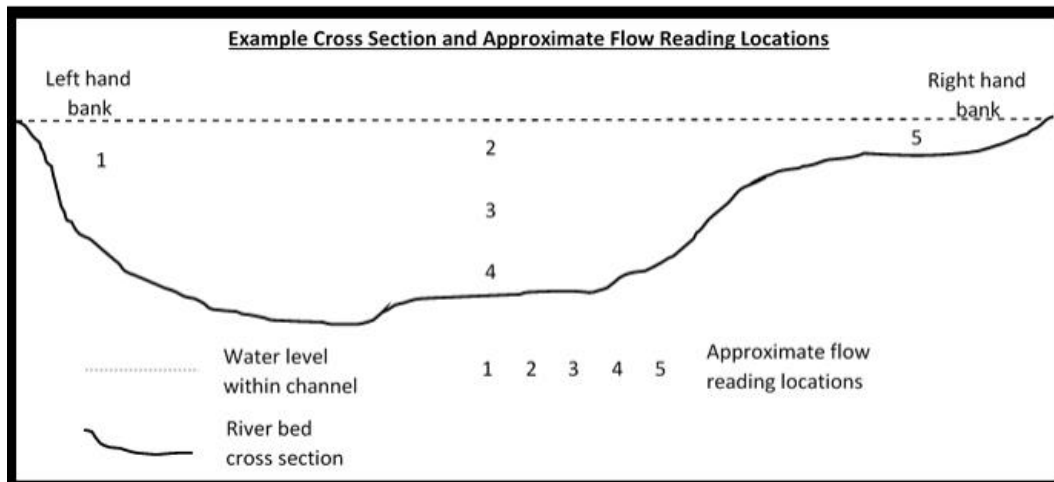


Figure 3: Example of flow reading locations in river. Sourced from previous years paper.



Figure 4: Reading a flow metre. Sourced from google images.

### Hypothesis 5

Using a tape measure and a bottle with a small pebble inside, students marked out a five metre distance and then dropped the bottle from the first point upstream, timing on their phones how long it took to reach the final point heading downstream. Groups were made to repeat this procedure at least five times and were instructed to repeat the measurement in the bottle got stuck or slowed by sediment during the test.

The average velocity in m/s could then easily be calculated by taking the distance travelled and dividing it by the time it took in seconds.



Figure 5: Testing river velocity using an empty bottle with a small weight inside. Picture is representative and instead uses an orange to complete the same task. Picture sourced from google images.

#### Hypothesis 6 + 7

These hypotheses were investigated by taking five representative samples from each of the 5 cross sectional points in the river, the rocks selected were measured for their long axis and also analysed by the students to assess their roundness according to a powers scale of roundness chart.

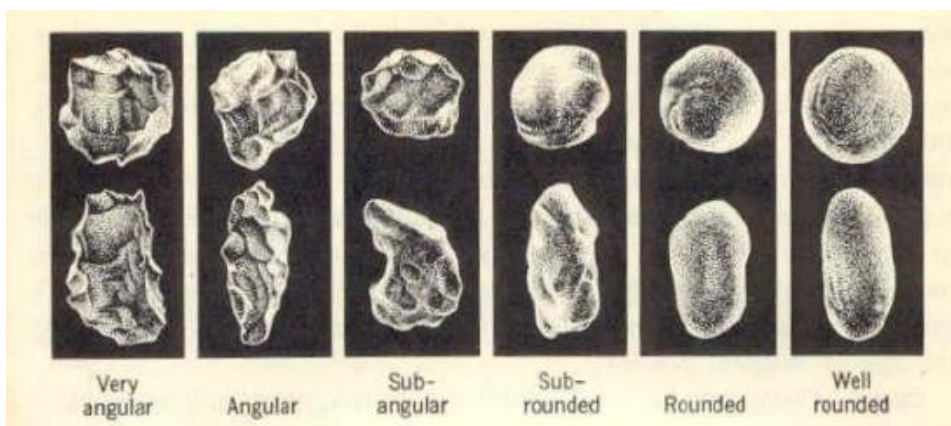


Figure 6: Powers scale of roundness chart. Sourced from assignment brief.



Figure 7: Measuring pebbles axis. Sourced from google images.

#### Hypothesis 8

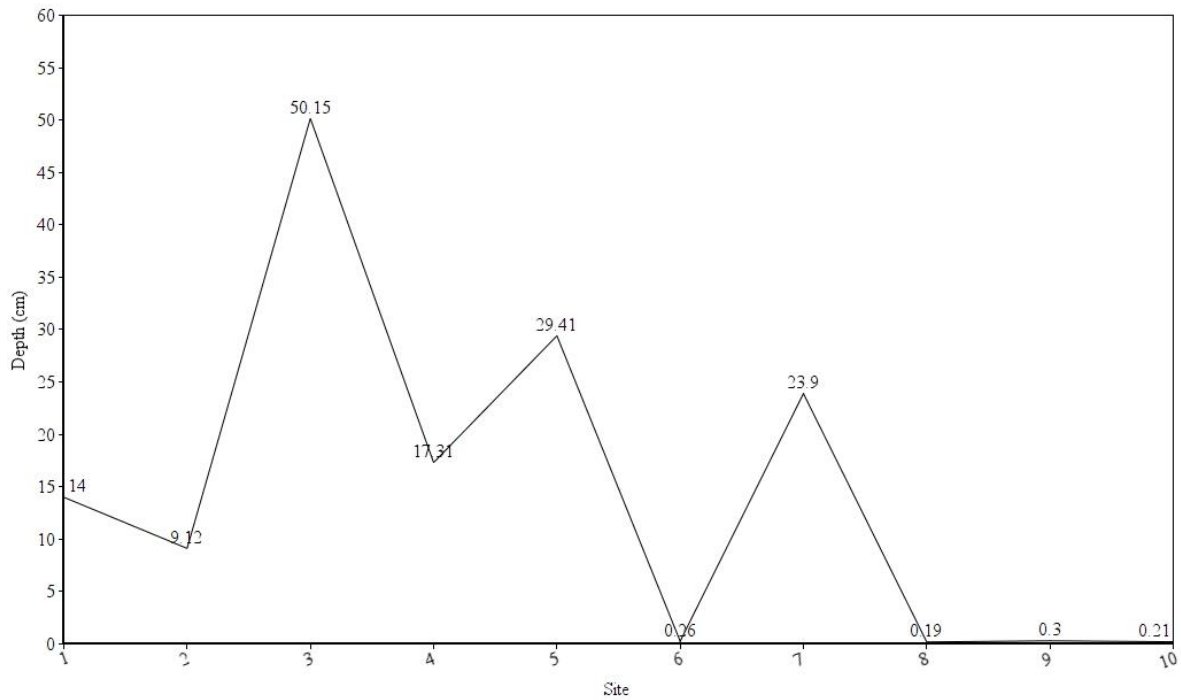
This hypothesis could be proven by using some simple math in which the velocity multiplied by the cross-sectional area is equal to cubic metres per second.

#### Results and analysis

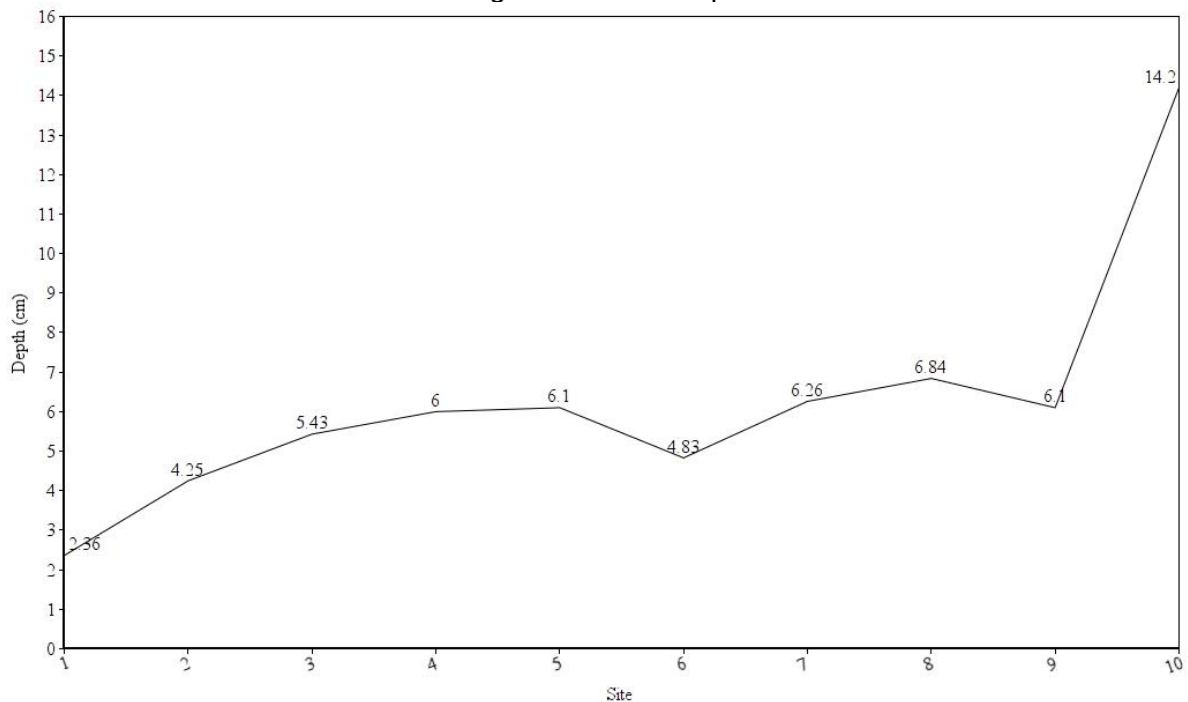
*Hypothesis 1 - The river becomes wider and deeper downstream.*

| Site | Average Width (m) | Average Depth (cm) |
|------|-------------------|--------------------|
| 1    | 2.36              | 14.00              |
| 2    | 4.25              | 9.12               |
| 3    | 5.43              | 50.15              |
| 4    | 6.00              | 17.31              |
| 5    | 6.10              | 29.41              |
| 6    | 4.83              | 0.26               |
| 7    | 6.26              | 23.90              |
| 8    | 6.84              | 0.19               |
| 9    | 6.10              | 0.30               |
| 10   | 14.2              | 0.21               |

Average depth at each point:



Average width at each point:



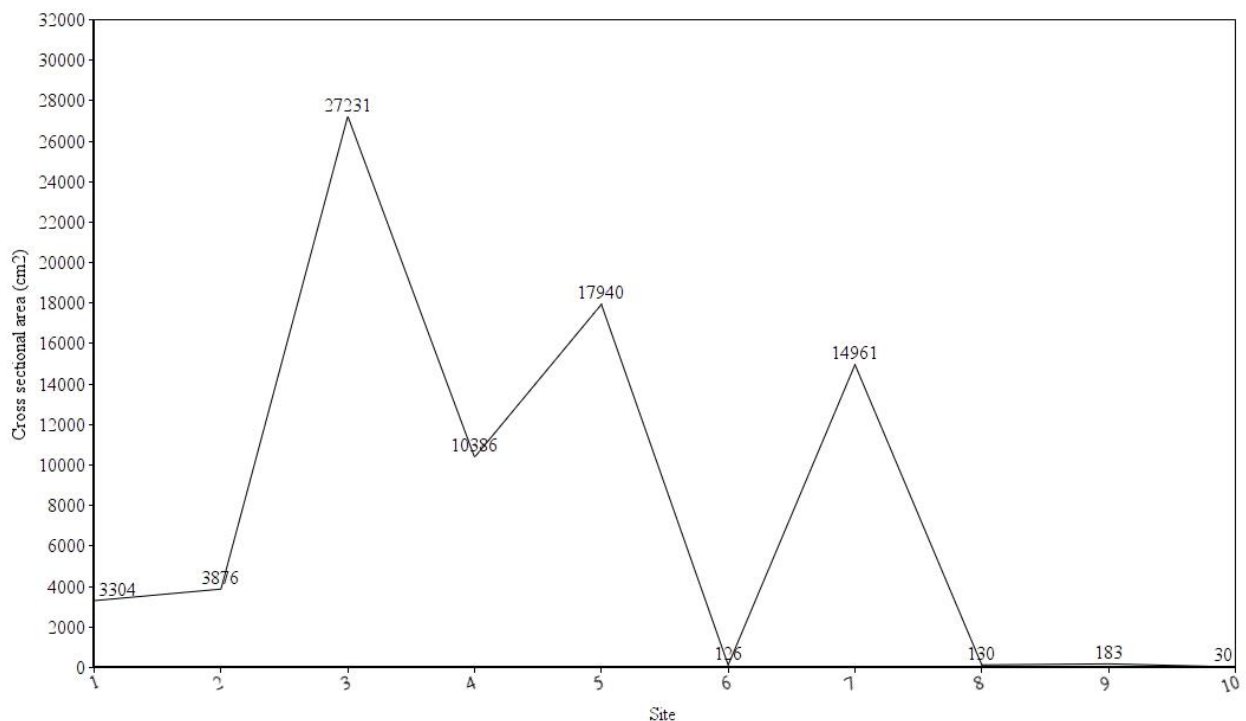
From the data provided there is not much evidence to prove this hypothesis. The average width of the river, though it shows to increase in general over a large distance, is not exclusive to an increasing pattern and has varying tendencies, such as at point 6 the average width decreases instead of increases. Additionally, from point 9 to point 10 there is a large increase which does not correlate with the increase patterns for the rest of the river, suggesting that the data has been collected incorrectly and is an anomaly. For depth, the data does not provide a concise pattern and, as shown by the graph, varies wildly. The depth does also not correlate well with its

respective width and serves as no evidence to this hypothesis. In conclusion, this data is too weak to confirm or reject this hypothesis.

*Hypothesis 2 - The cross-sectional area of the river increases downstream.*

| Site | Average Cross-Sectional Area (m <sup>2</sup> ) |
|------|------------------------------------------------|
| 1    | 33.04                                          |
| 2    | 38.76                                          |
| 3    | 272.31                                         |
| 4    | 103.86                                         |
| 5    | 179.40                                         |
| 6    | 12.6                                           |
| 7    | 149.61                                         |
| 8    | 13.0                                           |
| 9    | 18.3                                           |
| 10   | 3.0                                            |

Cross-Sectional Area at each point



For this hypothesis it is again very difficult to draw a conclusion due to the lack of strong evidence. Though there are signs of an increase downstream from points 1 to 7, with the exception of point 6, points 8, 9 and 10 are significantly lower and could provide a potential argument for the opposite of this hypothesis.

*Hypothesis 3 – The river velocity increases on the outside of a meander.*

There is no data to prove or disprove this hypothesis as no sites with a meander were measured.

*Hypothesis 4 - The highest velocity is to be found in the centre of the river.*

| Site | Average Velocity (m/s) Pt.1 | Average Velocity (m/s) Pt.2 | Average Velocity (m/s) Pt.3 | Average Velocity (m/s) Pt.4 | Total average (m/s) All pts |
|------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 3    | 0.74                        | 0.19                        | 0.16                        | 0.10                        | 0.17                        |
| 7    | 0.62                        | 1.16                        | 0.93                        | 0.65                        | 0.76                        |

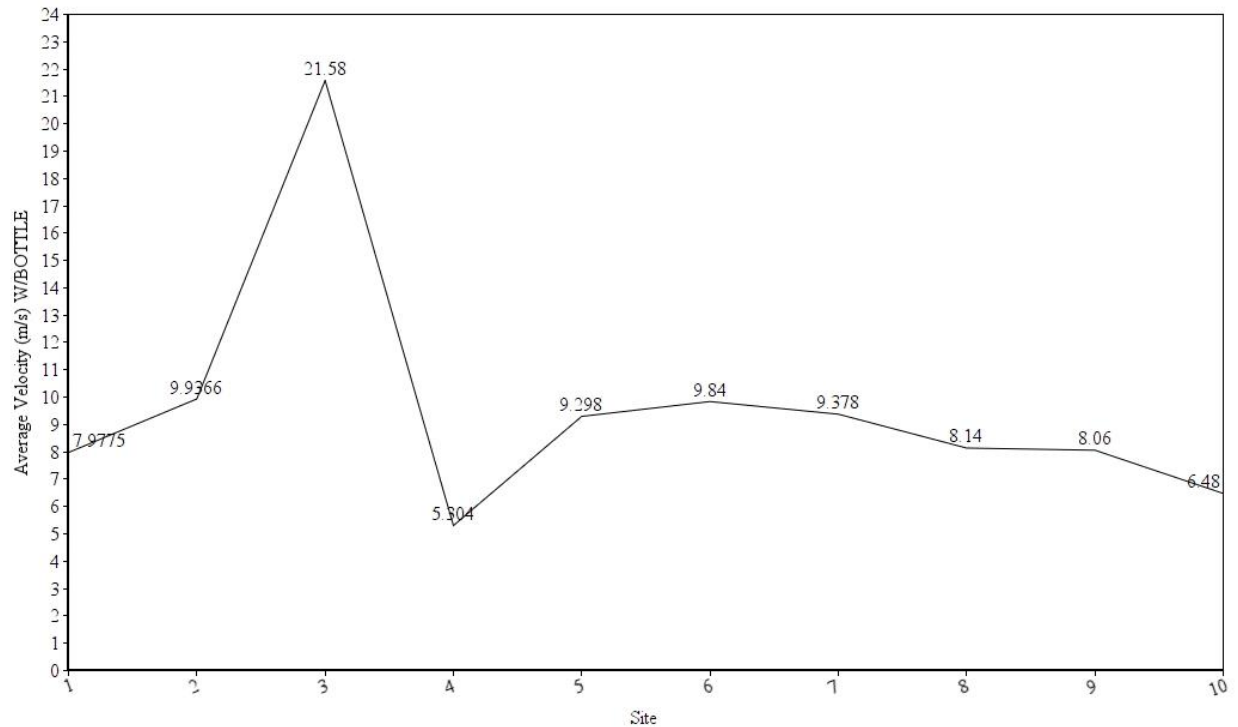
For this hypothesis it would be unsuitable to draw a conclusion based on the limited data. However, from the provided, site 7 would seem to confirm the hypothesis due to the higher velocity at points 2,3 and 4 (taken from the center of the river from surface to bed respectively) than at point 1 (taken from the far edge of the river.) At site 3, the opposite of this could be concluded due to the fact the outward edge appears to be fast than the middle. In summary, both sites give opposing results and therefore this hypothesis, once again cannot be proved or disproved.

To improve results and accuracy for this set of data the students could have taken more measurements, more frequently.

*Hypothesis 5 - The river velocity decreases downstream.*

| Site | Average Velocity (m/s) (with bottle) |
|------|--------------------------------------|
| 1    | 7.9775                               |
| 2    | 9.9366                               |
| 3    | 21.58                                |
| 4    | 5.304                                |
| 5    | 9.298                                |
| 6    | 9.840                                |
| 7    | 9.378                                |
| 8    | 8.140                                |
| 9    | 8.060                                |
| 10   | 6.480                                |

Average Velocity using a weighted bottle

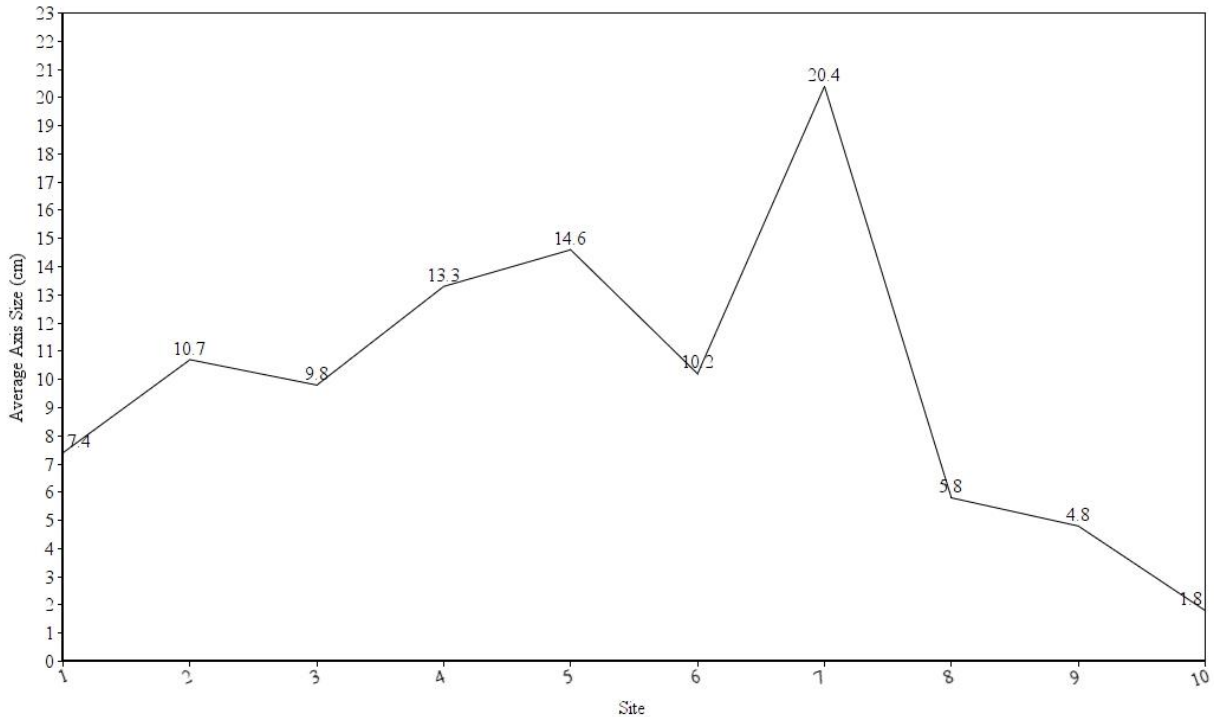


Beyond point 5, the velocity shows a steady pattern of decrease with a negative correlation and with the exclusion of points 1, 3 and 4, could provide sufficient evidence to support the given hypothesis. Based off the pattern of the surrounding data it can be concluded that points 3 and 4 are probable anomalies as they dramatically alter an otherwise correlation.

*Hypothesis 6 - The size of the bedload gets smaller downstream.*

| Site | Long Axis Average (Cm) |
|------|------------------------|
| 1    | 7.4                    |
| 2    | 10.7                   |
| 3    | 9.8                    |
| 4    | 13.3                   |
| 5    | 14.6                   |
| 6    | 10.2                   |
| 7    | 20.4                   |
| 8    | 5.8                    |
| 9    | 4.8                    |
| 10   | 1.8                    |

Average sediment size (Long axis)



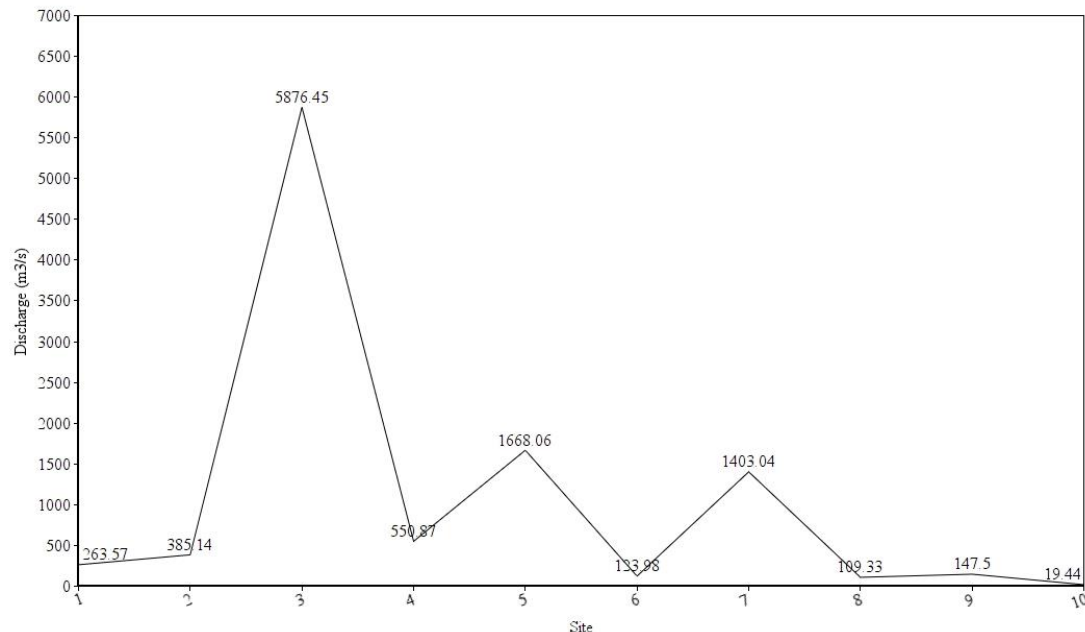
The sediment appears to increase in size from the first site to the fifth site, from there sediment size then decreases at a steady pace with the exception of site 7 which is assumed to be a mistake in data collection. Despite this being a clear pattern, it does not correlate with the hypothesis and therefore a result cannot be drawn.

*Hypothesis 7 - The shape of the bedload becomes more rounded downstream.*

| Site | 1 <sup>st</sup> Sample | 2 <sup>nd</sup> Sample | 3 <sup>rd</sup> Sample | 4 <sup>th</sup> Sample | 5 <sup>th</sup> Sample |
|------|------------------------|------------------------|------------------------|------------------------|------------------------|
| 1    | Ang                    | S.Ang                  | S.Ang                  | S.Ang                  | S.Ang                  |
| 2    | S.Round                | S.Ang                  | V.Ang                  | Ang                    | Round                  |
| 3    | Round                  | S.Round                | Ang                    | S.Round                | Ang                    |
| 4    | Round                  | S.Round                | S.Ang                  | S.Round                | S.Ang                  |
| 5    | V.Ang                  | Ang                    | S.Ang                  | S.Ang                  | S.Ang                  |
| 6    | S.Ang                  | S.Ang                  | S.Round                | S.Round                | Round                  |
| 7    | Ang                    | S.Ang                  | S.Ang                  | S.Ang                  | Ang                    |
| 8    | Round                  | Round                  | S.Round                | V.Round                | V.Round                |
| 9    | S.Ang                  | S.Round                | Round                  | V.Round                | V.Round                |
| 10   | S.Round                | Round                  | Round                  | V.Round                | S.Round                |

In general, this set of data supports the hypothesis and has a positive correlation in that sediment appears to start off as angular or sub angular in the majority and then become more rounded downstream, with the exception yet again of site 7. Since classifying the rocks is up to the student's own interpretation and can be subject to misplaced sediment due to human intervention, the above is sufficient data to draw a final conclusion and deem the hypothesis to be correct.

*Hypothesis 8 - The discharge of water in the river increases downstream.*



The data provided is very unconcise and shows no clear pattern, it does not prove the hypothesis as it appears discharge is less at the mouth of the river. It can be concluded that this data set is incorrect.

## Conclusion

In conclusion, arguably all of the hypothesis could not be strictly proven or disproven and this is due to the fact that all rivers do not behave as they are 'supposed' to, meaning these hypotheses are provided to give a general idea of how a river behaves but however, are not necessarily true. Despite there being some weak correlations, none of the data sets showed an exact pattern that could link directly to the goal.

The results were subject to many variables such as time of year and the inexperience of the pupils studying so suggestions can be made in order to improve future research.

- Conduct same experiment multiple times for more accuracy
- Measure elements more frequently
- Visit at an appropriate time of year that represents the river's averages best (e.g not after heavy rainfall.)
- Repeat experiment multiple times a year

## References

Online -

[http://moodle.uwtsd.ac.uk/pluginfile.php/76190/mod\\_resource/content/0/Example%20of%20previous%20Ilston River Study.pdf](http://moodle.uwtsd.ac.uk/pluginfile.php/76190/mod_resource/content/0/Example%20of%20previous%20Ilston%20River%20Study.pdf)

- [https://www.field-studies-council.org/media/3317094/swic\\_2017\\_freshwater\\_riverilston.pdf](https://www.field-studies-council.org/media/3317094/swic_2017_freshwater_riverilston.pdf)
- <http://parc-le-breos.co.uk/wp-content/uploads/pdf-walking-guides/gower-walks/Pwll-Du-Ilston-and-3-Cliffs-Walk-Gower.pdf>
- <https://www.ordnancesurvey.co.uk/getoutside/local/ilston-swanssea-abertawe>
- [www.onlinecharttool.com](http://www.onlinecharttool.com)

## Appendices

[https://uowtsd-my.sharepoint.com/:x:/g/personal/1704516\\_student\\_uwtsd\\_ac\\_uk/EWxqCdDUrFtFornPgp7ZSzIBl6-aE-3r9lUow6ZCtHUAA?e=c1c4c2dcb87a44e589f137a5dcf280d0](https://uowtsd-my.sharepoint.com/:x:/g/personal/1704516_student_uwtsd_ac_uk/EWxqCdDUrFtFornPgp7ZSzIBl6-aE-3r9lUow6ZCtHUAA?e=c1c4c2dcb87a44e589f137a5dcf280d0)