Curriculum-based Outdoor Learning Programme in Country Parks

Fluvial Fieldwork Student's Handbook

Name:_____ **Group:**_____

Date:	
Location:	The Bride's Pool
Duration:	3 hours

Things to Note

- ✧ Wear water-friendly and non-slippery shoes (will get wet wading)
- ✧ Bring sunblock lotion, windbreaker, umbrella, spare clothing
- ✧ Stay away deep pools and rapid flowing water with depths above knees
- ✧ Be careful when students wade the channel particularly on slippery rock surfaces
- ✧ Students to stay with their respective groups

Equipment & Materials Checklist

Equipment/Materials	Quantity for each group
Clinometers/Abney Level	2
Measuring Tape	1
Ranging pole	2
Meter Ruler	1
Flow Meter	1
Float (e.g. ping-pong balls)	3-4
Stopwatch	1
Clipboard	1
Pencil/Pen	1-2
Gloves (in pairs) (optional)	2-4

Learning Objectives	
Knowledge:	✧ Investigate the shape and morphology of a river ✧ Examine how fluvial processes vary along the courses of the river
Skills:	✧ Apply fluvial field work data collection methods ✧ Be able to use GIS, aerial photographs and satellite images to analyse the change of fluvial environment
Attitude:	✧ Appreciate the beauty of nature in country parks and special areas ✧ Recognize the need for sustainable management of our physical environment ✧ Be more aware of the unique and spectacular natural resource in country parks and special areas and recognize the need of conservation

Part 1. Inquiry Questions

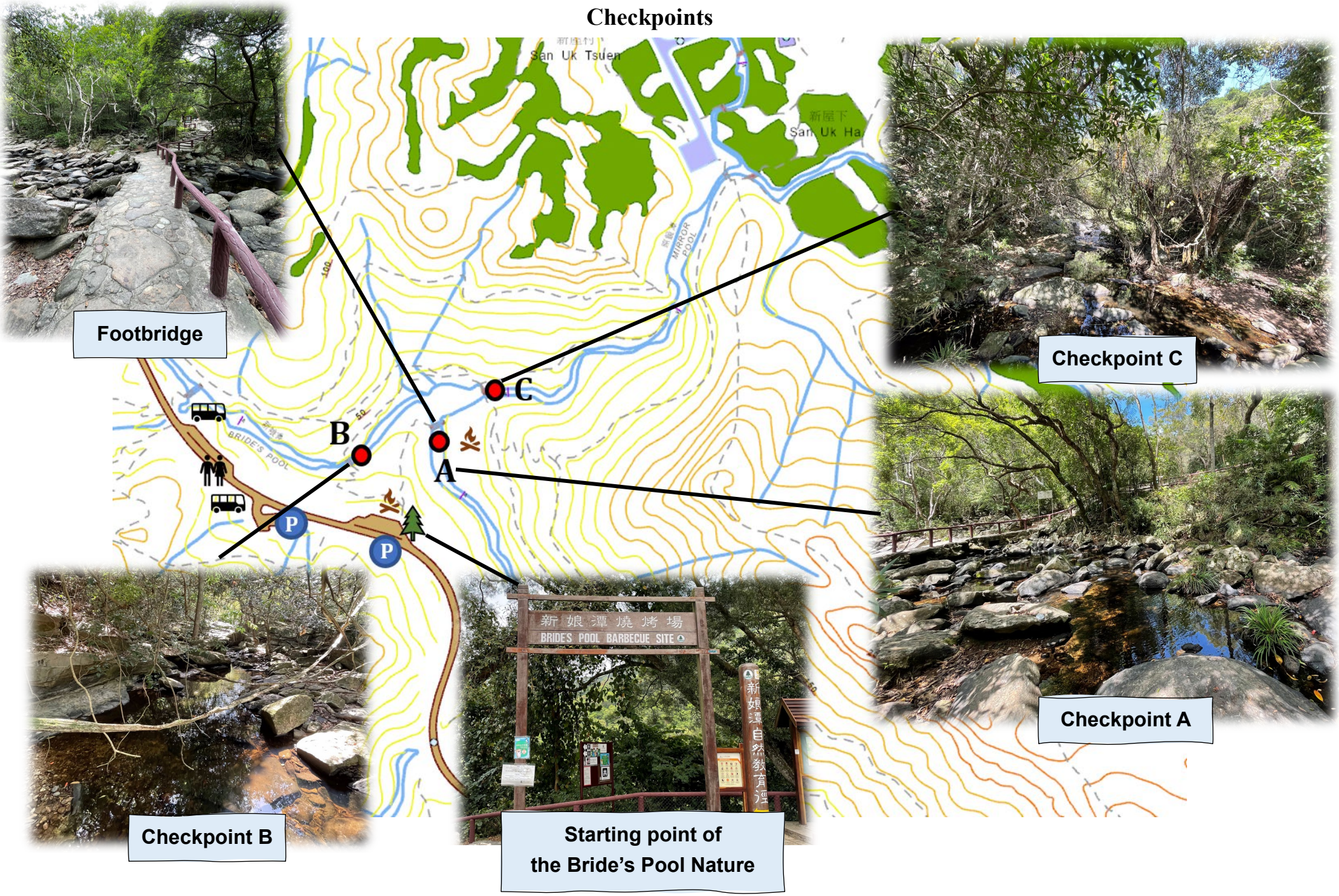
How do fluvial processes of a river shape the land?

1. How are channels shaped at the Bride's Pool?
2. How does the channel gradient affect the fluvial process at the Bride's Pool?
3. How does the river velocity affect the fluvial process at the Bride's Pool?

Think Over:

How can we develop hypothesis from our inquiry questions and our presumed answers to them?
Try to develop hypothesis from the inquiry questions provided above

Checkpoints



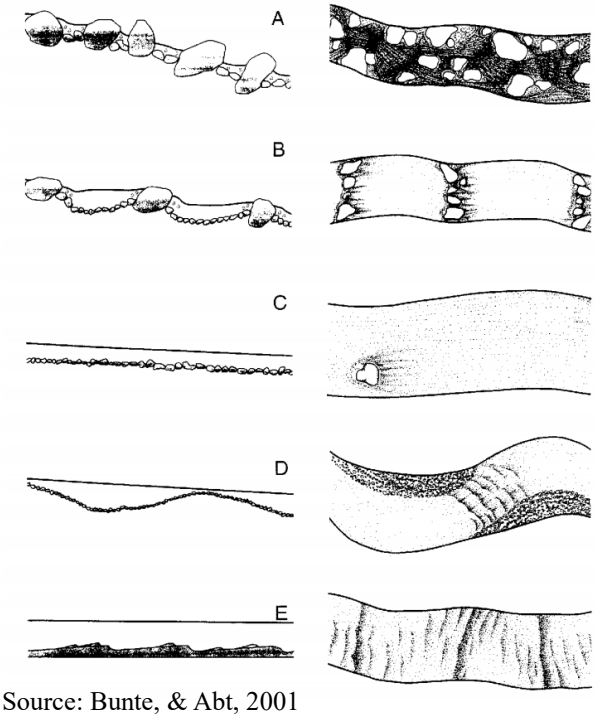
Part 2. Data Collection

Inquiry question 1:
How are channels shaped at the Bride's Pool?

By Observation: Which channel type below best describe the field site at the Bride's Pool?

Key	-	A	B
Type	Bedrock	Cascade	Step-pool
Bed material[1]	Bedrock	B/C/G	B/C/G
Bedform	Variable	Chaotic	Vertically oscillatory
Typical slope	2 – 37%	8 – 26%	3 – 8%
Valley setting	Strongly confined	Strongly confined	Moderately confined
Type	**C**	**D**	**E**
Name	Plane-bed	Pool-riffle	Dune-ripple
Bed material	C/G	G	S
Bedform	None	Laterally oscillatory	Multilayered
Typical slope	1 – 3%	0.2 – 1%	0.02 – 0.1%
Valley setting	Variable	Unconfined	Unconfined

Table 1. Classification of channel types



Source: Bunte, & Abt, 2001

Figure 1. Channel types

Types of Channels:

A. **Cascade**: Nearly continuous turbulent flow around large particles
B. **Step-pool** channel: Sequential turbulent flow over steps & tranquil flows through intervening pools
C. **Plane-bed** channel: Isolated boulder protruding through otherwise uniform flow
D. **Pool-riffle**: Exposed bars, turbulent over riffles, & tranquil flow through pools
E. **Dune-ripple**: Dune-ripple bedforms

Answer:

[1] Grain size classes: **B**oulder >256 mm; **C**obble 64 – 256 mm; **G**ravel 2 – 63 mm; **S**and 63 μm – 2 mm.

Primary Data Needed	Equipment Needed
• Channel width • Channel depth	• Ranging pole X2 • Meter ruler X1 • Measuring tape X1

✧ **Measuring channel cross-section and parameters**

Instructions:

1. Put a measuring tape across your channel section
2. Measure the **channel width** (See Figure 2; W = length XY). Make sure the width of the *water surface* is measured *perpendicular* to the river bank. The tape measure should be pulled tight
3. Divide W by 11, this will be your **interval of measurement** (q)
4. Start the measurement of **channel depth** from left bank (facing downstream). Place the meter ruler *vertically* on the river bed. In case the ruler hit an obstacle (such as a large rock), measure the depth immediately upstream of the obstacle. Mark the reading of water depth on the record sheet
5. Repeat step 4 ten times at different locations of equal interval q across the channel
6. Record your measurements in *Record sheet 1a-1c* provided in ***The Bride's Pool Field Study Record Sheet P.4***

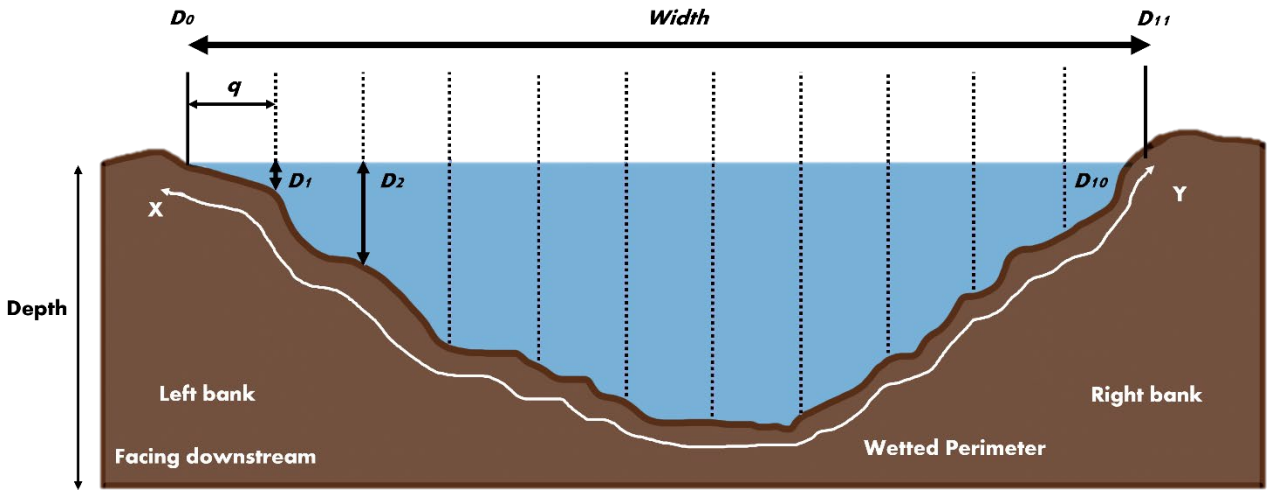


Figure 2. Measuring channel width and depth

The following calculation helps you to further analyze the data collected. please calculate the following parameters in ***The Bride's Pool Field Study Record Sheet P.10-11***:

Calculation Guide	
Average channel depth (AD)	$D_1+D_2+D_3+....-D_{11}/11$
Cross-section area (A)	*W* X *AD*
Wetter perimeter (P)	Refer to the length of surface in contact with water (that is length XY in Figure 2) Measure the length of the cross-section by a piece of paper (See Figure 3)
Hydraulic radius (HR)	*A/P*

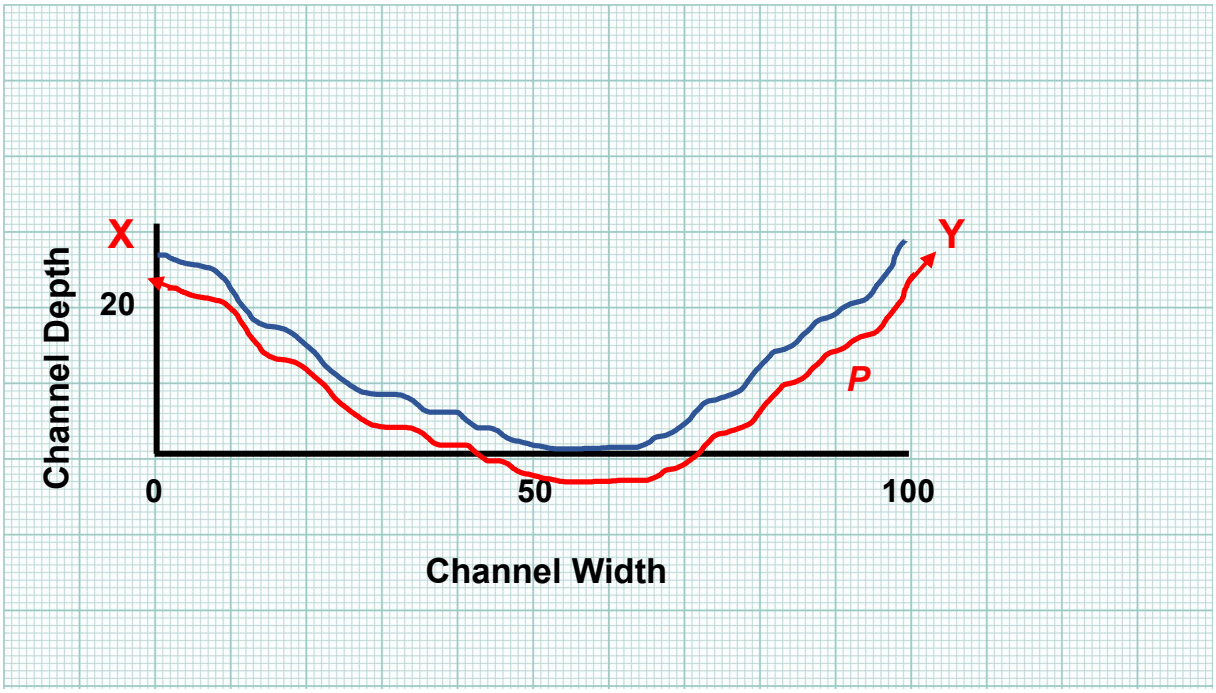


Figure 3. Measuring the wetted parameter by a piece of paper

Conclusion:

Answer the inquiry question:

How are channels shaped at the Bride's Pool?

Inquiry question 2:
How does the channel velocity affect the fluvial process at the Bride's Pool?

Primary Data Needed	Equipment Needed

• Channel velocity	• Float Method:
	  • Ranging pole X2
	  • Measuring tape X1
	  • Float (e.g. ping-pong balls X4)
	  • Stopwatch X1

✧ **Measuring channel velocity using Float method**

Instructions:

1. Measure the **distance** along the channel section (See Figure 4; L = distance FG;). If possible, the L should be at least longer than 5m, depending on the situation of the channel section
2. Place a **float** at point F (upstream) and use a stopwatch to time the float to reach point G (downstream). If possible, **travel time** should be more than 10 seconds. Adjust L if needed
3. Calculate the average travel time $(\bar{T} = T1 + T2 + T3/3)$
4. Calculate the average **river velocity** $(\mathrm{V} = L/\bar{T} \cdot 0.85)$
5. Calculate **discharge** $(Q = V \cdot A)$. The length unit used for Q is different from that of V and A. Note: 1 meter = 100 cm
6. In order to make sure the accuracy of the data, it is suggested that students should step 2 at the same section of channel for at least 3 times and get the average travel time for further calculation
7. Record your measurement in the *Record Sheet 2a* provided in ***The Bride's Pool Field Study Record Sheet P.5***

Think Over:
Why a correction factor of 0.85 is used for the calculation of average river velocity?

(Check the answer with reference to Figure 5)

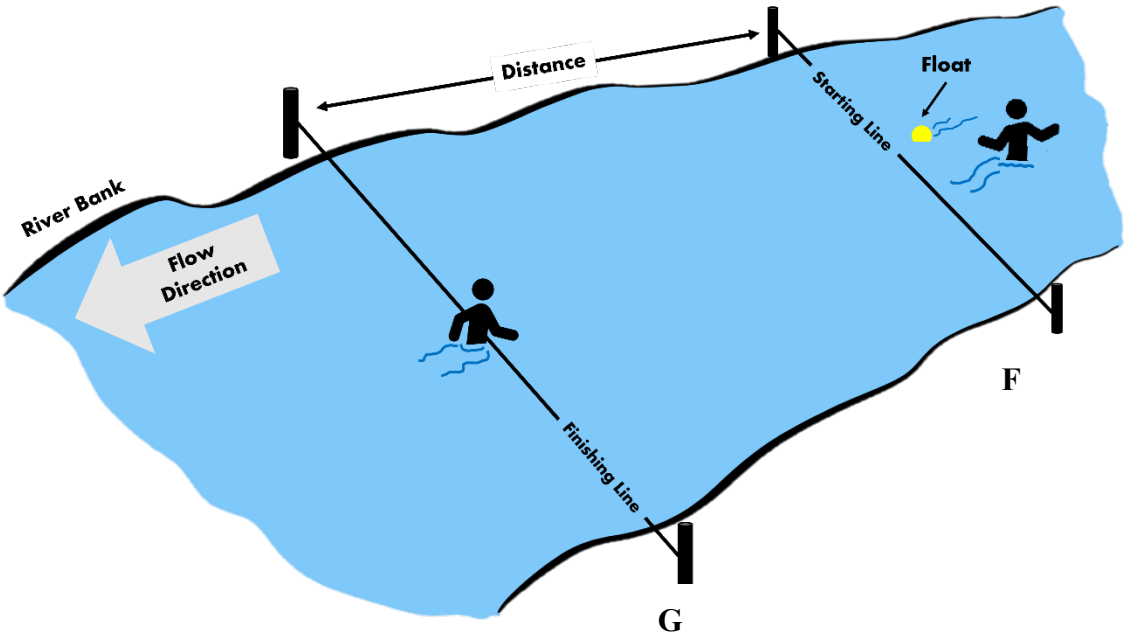


Figure 4. Measuring river velocity

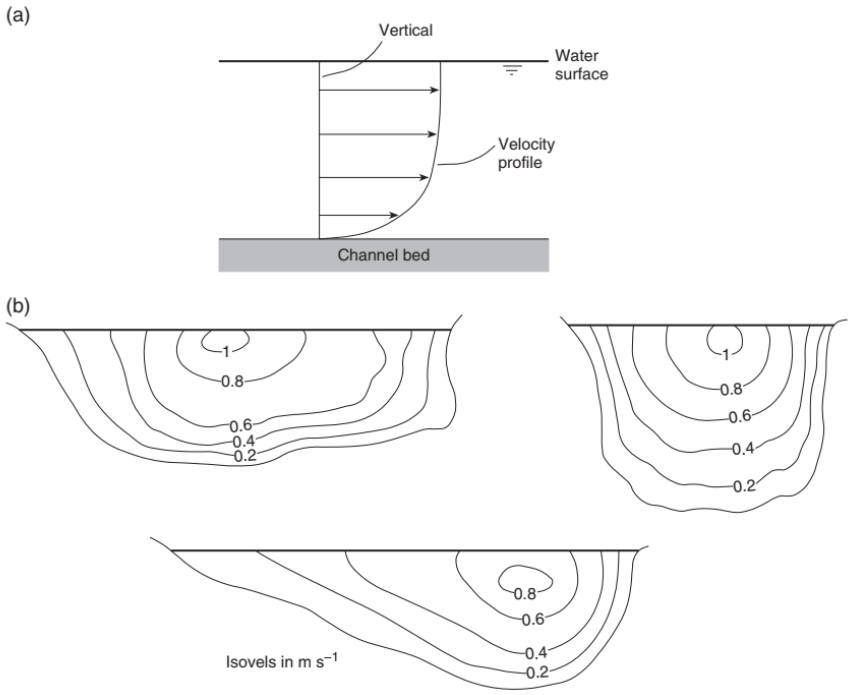


Figure 5. Variation in streamflow velocity. Isovels (isolines of equal flow velocity) shown in the above channel cross-sections are in m/sec. Note that due to differences in friction within the cross-section, flow velocities are usually the highest in the center and close to the water surface. Therefore, a correction factor of 0.85 is used here to account for the difference between surface and average flow velocity

✧ **Measuring channel velocity using Flow Meter method**

Instructions:

1. Measure the length of the channel section
2. Divide the channel section into 5, this will be the interval of measurement (***q***)
3. Start the measurement of channel depth from left bank (facing downstream). Place the impeller stick into the flow of moving water for at least 1 minute. Then mark down the readings on the flow meter onto record sheet
4. The sensor of the impeller stick should be placed at half of the channel depth, that is the point between the surface and the river bed
5. It gives an average velocity in m/s. Then mark down the readings on the flow meter onto record sheet
6. In order to make sure the accuracy of the data, it is suggested that students should repeat step 3 at same location for at least three times in order to get the average velocity for further calculation
7. Repeat step 3 and 4 five times at different locations of equal interval ***q*** across the channel
8. Record your measurement in Record Sheet 2b in ***The Bride's Pool Field Study Record Sheet P.6***

The following calculation helps you to further analyze the data collected. please calculate the following parameters in ***The Bride's Pool Field Study Record Sheet P.12***:

Calculation Guide	
Average travel time (sec)	$T_1+T_2+T_3$ /3
Average river velocity (cm/sec)	*[L/Average travel time (sec)] X 0.85*
River discharge (m3/sec)	*A* x *Average river velocity*

Think Over:

Suggest the reason why the river discharge of checkpoints A, B and C has to be measured despite the fact that they are both located at the upstream?

Conclusion:

Answer the inquiry question:

How does the river velocity affect the fluvial process at the Bride's Pool?

Inquiry question 3:
How does the channel gradient affect the fluvial process at the Bride's Pool?

✧ **Measuring channel gradient**

Instructions:

1. Along the same chosen channel section, have two students stand at upstream and downstream ends. Hold the meter rules upright (See Figure 6)
2. Measure the slope angle using an Abney level[2] or clinometer[3] by sighting at the *same height* of the opposite meter rule
3. Read off the angles of elevation (a; facing upstream) and depression (b; facing downstream)
4. Calculate the average **slope angle** ($\theta = \frac{a+b}{2}$) and **channel gradient**[4] $(1/\tan\theta)$
5. Record your measurement in the *Record Sheet 3* provided in ***The Bride's Pool Field Study Record Sheet P.7***

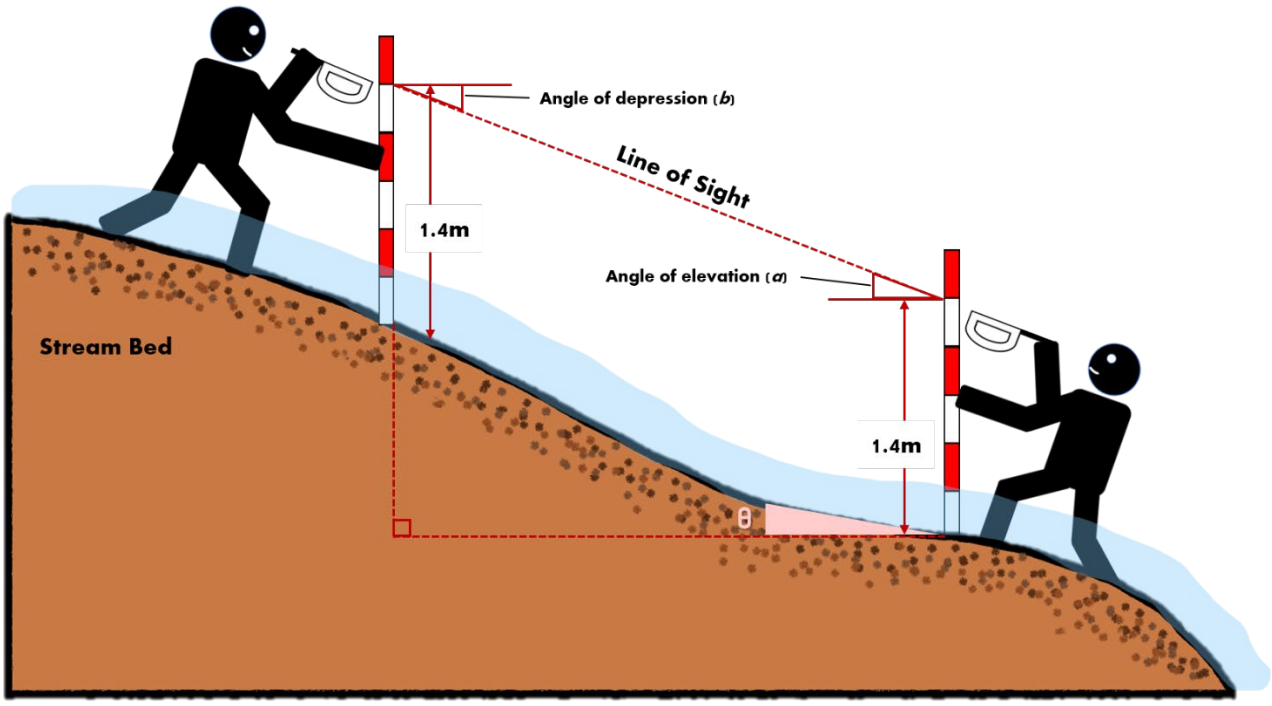


Figure 6. Measuring the channel gradient

[2] Abney level measures the angel between the line of sight and the horizontal level.

[3] Clinometer measures the angle of the line of sight with respect to gravity's direction.

[4] Gradient can be expressed as an angle or grade. Grade refers to unit change of vertical height to a certain horizontal distance and can be expressed in per cent or a ratio.

Conclusion:

Answer the inquiry question:

How does the channel gradient affect the fluvial process at the Bride's Pool?

Final Conclusion:

Taking into account of all the primary data collected, answer the inquiry question:

How do fluvial processes of a river shape the land?

Part 3. Field Sketching

The Bride's Pool is located at the upstream which is a natural stream with minimal human disturbance. Please sketch the geographical features of the field site and its surrounding area. Remember to label and annotate your sketches with proper geographical terms. Also, please identify what measures have AFCD conducted in order to reduce the human disturbance to the river and sketch the measures.

Please sketch the field site in ***The Bride's Pool Field Study Record Sheet P.8***

Part 4. Conservation of Country Parks

The Bride's Pool is also a famous tourist spot where many people go visiting, and a BBQ site is located nearby. There is concern that human activities may pollute the water quality of the Bride's Pool or affect the river channel shape and sediment load. In order to preserve the natural channel shape and sediment load on river bed, and protect the water quality of the Bride's Pool for both recreational and conservation purpose, what conservation measures have been implemented by AFCD? Please locate these conservation measures at the field site and record them down in the box below.

Type of conservation measures	Purpose of conservation measures

Part 5. Field Work Evaluation

After conducting the fluvial fieldwork, you may need to reflect upon the **accuracy** and **precision** of the data collected in the following area:

- Channel cross-section
- Channel velocity
- Channel gradient

And please **suggest ways** to minimize/improve the potential errors.

Reference:

Bunte, K., and Abt, S. R. (2001). Sampling surface and subsurface particle-size distributions in wadable gravel-and cobble-bed streams for analyses in sediment transport, hydraulics, and streambed monitoring. US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Group members: _____ **Group:** _____

Date:	
Location:	The Bride's Pool, Plover Cove Country Parks
Duration:	3 hours
Weather: Please find the weather information on the field study date on the website of HK Observatory and fill in the blank on the right	✧ Temperature: ✧ Rainfall:
Inquiry questions:	**How do fluvial processes of a river shape the land?** **1. How are channels shaped at the Bride's Pool?** **2. How does the channel gradient affect the fluvial process at the Bride's Pool?** **3. How does the river velocity affect the fluvial process at the Bride's Pool?**

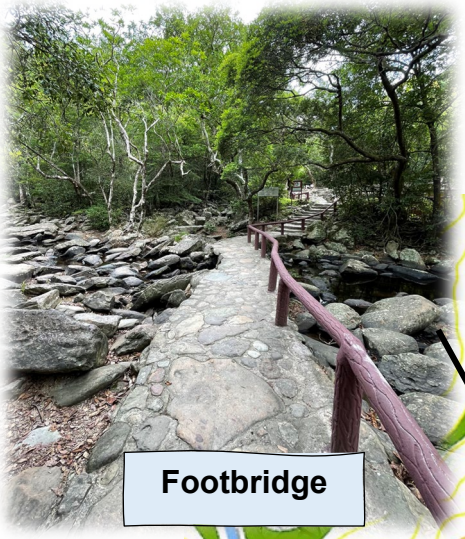
Things to Note

- ✧ Wear water-friendly and non-slippery shoes (will get wet wading)
- ✧ Bring sunblock lotion, windbreaker, umbrella, spare clothing
- ✧ Stay away deep pools and rapid flowing water with depths above knees
- ✧ Be careful when students wade the channel particularly on slippery rock surfaces
- ✧ Students to stay with their respective groups

Equipment & Materials Checklist

Equipment/Materials	Quantity for each group
Clinometers/Abney Level	2
Measuring Tape	1
Ranging pole	2
Meter Ruler	1
Flow Meter	1
Float (e.g. ping-pong balls)	2
Stopwatch	1
Clipboard	1
Pencil/Pen	1-2
Gloves (in pairs) (optional)	2-4

Checkpoints



Footbridge

Checkpoint C

Checkpoint A

Checkpoint B

Starting point of
the Bride's Pool Nature

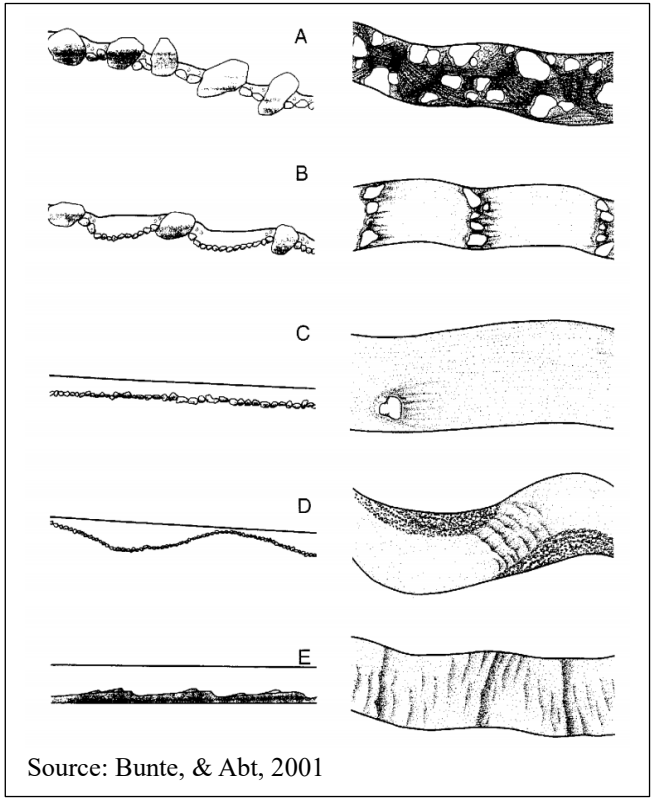
Data Collection

Inquiry question 1:
How are channels shaped at the Bride's Pool?

By Observation: Which channel type below best describe the field site at the Bride's Pool?

Key	-	A	B
Type	Bedrock	Cascade	Step-pool
Bed material[5]	Bedrock	B/C/G	B/C/G
Bedform	Variable	Chaotic	Vertically oscillatory
Typical slope	2 – 37%	8 – 26%	3 – 8%
Valley setting	Strongly confined	Strongly confined	Moderately confined
Type	**C**	**D**	**E**
Name	Plane-bed	Pool-riffle	Dune-ripple
Bed material	C/G	G	S
Bedform	None	Laterally oscillatory	Multilayered
Typical slope	1 – 3%	0.2 – 1%	0.02 – 0.1%
Valley setting	Variable	Unconfined	Unconfined

Table 1. Classification of channel types



Source: Bunte, & Abt, 2001

Figure 1. Channel types

Types of Channels:

F. **Cascade**: Nearly continuous turbulent flow around large particles
G. **Step-pool** channel: Sequential turbulent flow over steps & tranquil flows through intervening pools
H. **Plane-bed** channel: Isolated boulder protruding through otherwise uniform flow
I. **Pool-riffle**: Exposed bars, turbulent over riffles, & tranquil flow through pools
J. **Dune-ripple**: Dune-ripple bedforms

Answer

[5] Grain size classes: **B**oulder >256 mm; **C**obble 64 – 256 mm; **G**ravel 2 – 63 mm; **S**and 63 μm – 2 mm.

Primary Data Needed

- **Channel width**
- **Channel depth**

Equipment Needed

- **Ranging pole X2**
- **Meter ruler X1**
- **Measuring tape X1**

Checkpoint _____ Record Sheet 1a

Channel width (cm)	***W***											
Interval (cm)	***q***											
Distance from the left bank (cm)	***L***											
Channel depth (cm)	***D***	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}

Checkpoint _____ Record Sheet 1b

Channel width (cm)	***W***											
Interval (cm)	***q***											
Distance from the left bank (cm)	***L***											
Channel depth (cm)	***D***	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}

Checkpoint _____ Record Sheet 1c

Channel width (cm)	***W***											
Interval (cm)	***q***											
Distance from the left bank (cm)	***L***											
Channel depth (cm)	***D***	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}

Inquiry question 2:
How does the channel velocity affect the fluvial process at the Bride's Pool?

Primary Data Needed

- **Channel velocity**

Equipment Needed

- **Float Method:**
  - **Ranging pole X2**
  - **Measuring tape X1**
  - **Float (e.g. ping-pong balls X4)**
  - **Stopwatch X1**

Using Float Method

Record Sheet 2a

Checkpoint	Distance of channel section (m)	Travel time of object along channel section (sec)			Average travel time (sec)	Average river velocity (m/sec)	River discharge (m^3/sec)
		T_1	T_2	T_3			
A							
B							
C							

Primary Data Needed
- **Channel velocity**

Equipment Needed
- **Flow Meter Method:**
- **Flow Meter X1**

Using Flow Meter Method

Record Sheet 2b

Checkpoint	Distance of channel section (m)	Interval	Distance from the left bank (cm)	Reading from Flow Meter (m/sec)			Average river velocity (m/sec)	River discharge (m^3/sec)
				T_1	T_2	T_3		
A								
B								
C								

Inquiry question 3:
How does the channel gradient affect the fluvial process at the Bride's Pool?

Primary Data Needed

- Channel gradient

Equipment Needed

- Ranging pole X2
- Abney level or Clinometer X2
- Measuring tape X1

Record Sheet 3

Checkpoint	Angle of elevation (a)	Angle of depression (b)	Average slope angle of channel section *(θ = a+b/2)*	Channel gradient (1 in…)
A				
B				
C				

Channel Gradient Reference

Average slope angle (θ)	Channel gradient	Description
<1º	NA	Flat
1º-3º	1:60	Undulating
3º-6º	1:20	Moderately sloping
6º-12º	1:10	Hilly
12º-20º	1:3	Moderately steep
20º-35º	1:2	Steep
35º-45º	1:1	Very steep

Field Sketching

The Bride's Pool is located at the upstream which is a natural stream with minimal human disturbance. Please sketch the geographical features of the field site and its surrounding area. Remember to label and annotate your sketches with proper geographical terms. Also, please identify what measures have AFCD conducted in order to reduce the human disturbance to the river and sketch the measures.

Conservation of Country Parks

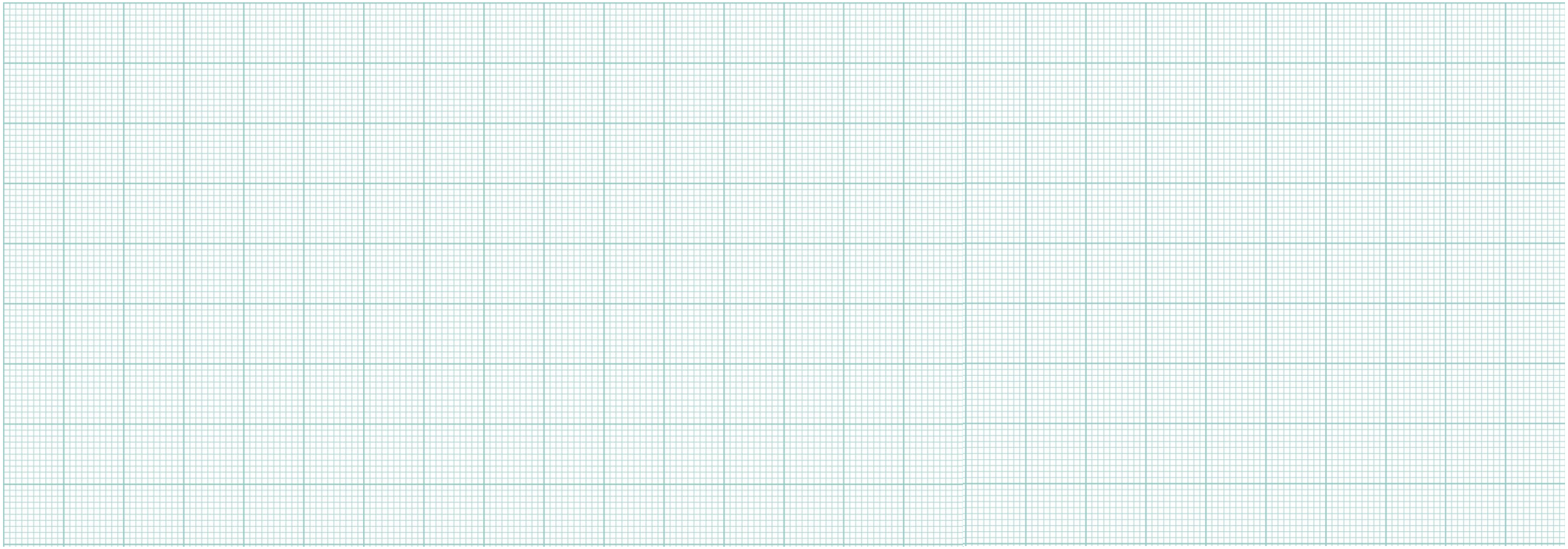
The Bride's Pool is also a famous tourist spot where many people go visiting, and a BBQ site is located nearby. There is concern that human activities may pollute the water quality of the Bride's Pool or affect the river channel shape and sediment load. In order to preserve the natural channel shape and sediment load on river bed, and protect the water quality of the Bride's Pool for both recreational and conservation purpose, what conservation measures have been implemented by AFCD? Please locate these conservation measures at the field site and record them down in the box below.

Type of conservation measures	Purpose of the conservation measures

Data Presentation and Analysis

Answering *Inquiry Question 1a*:
Based on the collected data (refer to ***record sheet 1a-1c***), draw the **cross sections** for the three checkpoints on the grid graph paper provided below.

Scale of grid: 1 cm = [ ].



To further analyze the data collected on ***record sheet 1a-1c***, please calculate the following parameters:

Calculation Guide	
Average channel depth (AD)	$D_1+D_2+D_3+….-D_{11}/11$
Cross-section area (A)	*W* X *AD*
Wetter perimeter (P)	Measure the length of the cross-section by a piece of paper (refer to student fieldwork handbook)
Hydraulic radius (HR)	*A/P*

	Checkpoints		
Parameters	***A***	***B***	***C***
Average channel depth (m)			
Cross-section area (m^2)			
Wetted perimeter (m)			
Hydraulic radius (m)			

Conclusion:
Answer the inquiry question:
How are the channels shaped at the Bride's Pool?

Answering *Inquiry Question 2*:
To further analyze the data collected on ***record sheet 2a or 2b*** (depending on which method you use for measuring channel flow), please calculate the following parameters:

Calculation Guide	
Average travel time (sec)	$T_1+T_2+T_3$ /3
Average river velocity (m/sec)	*[L/Average travel time (sec)] X 0.85*
River discharge (m3/sec)	*A x Average river velocity*

	Checkpoints		
Parameters	***A***	***B***	***C***
Average travel time (sec)			
Average river velocity (m/sec)			
River discharge (m^3/sec)			

checkpoints B and C are tributaries of checkpoint A. Is the sum of discharges of B and C equals to that of A? If not, please explain why.

Conclusion:
Answer the inquiry question:
How does the river velocity affect the fluvial process at the Bride's Pool?

Answering *Inquiry Question 3*:

Calculation Guide	
Average slope angle of channel section	$\theta = a+b/2$
$\tan\theta$	e.g. if $\theta = 30^o$
	$\tan 30^o = 0.58 = 1/0.58 = 1.72$
	Channel gradient = 1 in 1.72

	Checkpoints		
Parameters	***A***	***B***	***C***
Angle of elevation			
Angle of depression			
Average slope angle of channel section			
Channel gradient (1 in…)			

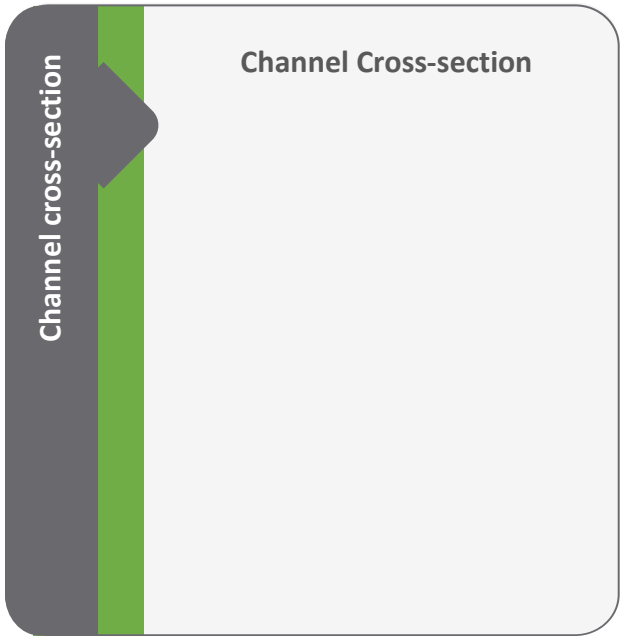
Conclusion:
Answer the inquiry question:
How does the channel gradient affect the fluvial process at the Bride's Pool?

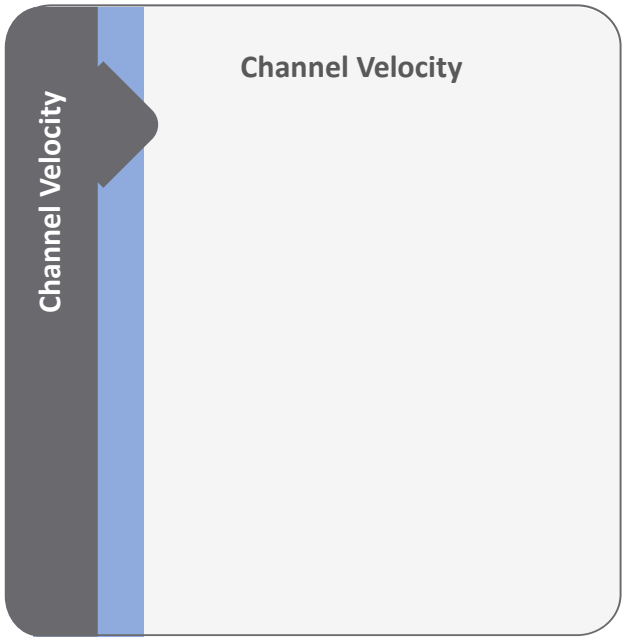
Conclusions

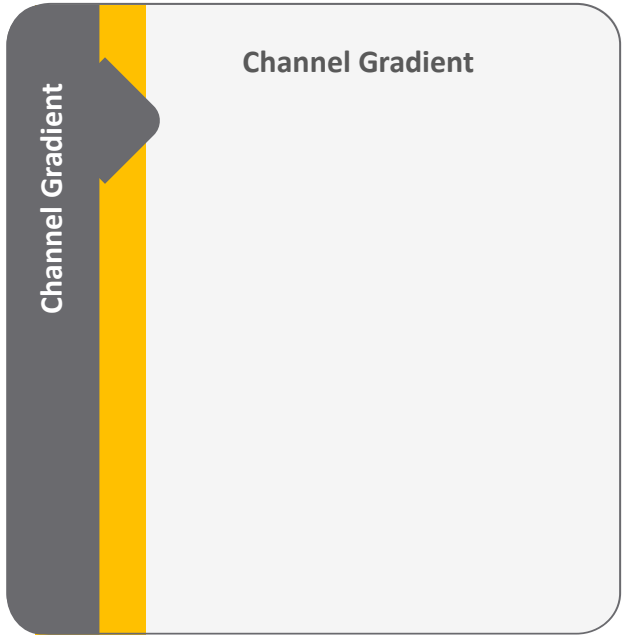
Final Conclusion:
Taking into account of all the primary data collected, answer the inquiry question:
How do fluvial processes of a river shape the land?

Evaluations

After conducting the fluvial fieldwork, you may need to evaluate the **accuracy** and **precision** of the data collected. You should support your answer by referring to actual examples from your own fieldwork.







Please suggest ways to improve the data collection