

School's Geology Challenge 2024 Problem Solving

Contents:

Teacher Materials

- Judges Info
- SGC 2024 Presentation

Student Materials

- SGC 2024 Presentation
- Brief
- Budget Sheet
- Summary Sheet
- Cross Section
- Site Visit Photos
- Map with Wind Prevalence (A3)
- Map with Grid (A3)
- Map Key (A4 cut to A5)

Judges Info:

The aim of this challenge is to balance social, economic and environmental factors to decide where a wind farm should be built in the town of Quinnston. The student's plans should reflect the depth of information they have managed to gather from the map and data available.






















They are required to:

- Assess the map to identify where in Quinnston is suitable for a wind farm and decide where they will propose one is built and then justify their reasoning
- Propose a budget for the project

They will have the following to help them:

- Map of area
- Preliminary site visit data: cross section and photographs
- Opinions
- A copy of the explanatory presentation
- A budget calculator
- A summary sheet – to make notes about their reasonings

Key for the map:

Key			
	Interbedded shale and siltstone		Historic monument
	Well cemented sandstone and gritstone		Transport tunnel
	Poorly sorted soil, 15% silt, 20% sand, other components organic matter and rock clasts		Elevation contour
	Well sorted mature soil, sand and gravel, <10% organic material		National park boundary
	silt and organic rich soil, some grit, well sorted		Site visit location
	Peat		Fault Fault F1 is inactive.
	Industrial urban		Line of section X-Y
	Residential / commercial urban		Major road
	Prevailing wind direction and avg speed (m/s)		Road
			Railway line
			Rail station
			River

Handy info for judges:

- Rock L is limestone – participants should be able to work this out through the site photo. If students want to build there they must do relevant geotechnical survey
- If they students want to build on Peat, they must do a seismic survey
- Area that is blue with dots is pretty much a no go area due to thin soil cover of limestone slops
- Site visits A and B show historic land slips – can be build there technically but group need to acknowledge risk of landslides
- Purple area contains a ridge and teams should assure it is rapidly eroding due to soft shale

Presentation:

- Students will present their findings to you as a 3 minute “elevator pitch” outlining where they have decided to build and why. They are encouraged to highlight things that make them stand out in this time – outside the box thinking, radical solutions, unusual proposals, etc.
- You can ask the students questions after their pitch, but we will limit each group’s time to five minutes.

General:

This activity should showcase how well students respond to the information they have been given and how they work under pressure.

- You can go around the groups while they are doing the activity to see how well they work as a team. Groups will be in the Council Room, William Buckland Room, Arthur Holmes room and Lower Library.

Ashley, Sarah or Louise can show you where to go if you’re not sure!

Marking criteria:

- Scientific application and reasoning – 20 marks. How well did they understand the information given them? Did they apply their own knowledge too? Did the students fully consider and justify the implications of building a dam in their chosen location?

- Teamwork – 10 marks. Did the students delegate according to their strengths? Did one student take over and lead the group, or was work divided equally?

- Presentation – 10 marks. Did the students use this time to effectively and confidently communicate their ideas to you?

- Innovation – 10 marks. Were there any unexpected or surprising solutions in the students' proposal



Schools Geology Challenge Final 2024

21st March 2024

Burlington House



The
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Society





Schools Geology Challenge Final 2024

Welcome



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Schedule

10:30 – 11:20 Welcome and Judges' Intro

11:20 – 11:45 Problem Solving explanation

11:45 – 12:45 Problem Solving Part 1

12:45 – 13:30 Lunch

13:30 – 14:15 Problem Solving Part 2

14:15 – 14:35 Judges Review Material

14:35 – 15:35 Presentations to Judges

15:35 – 16:15 Quiz

16:15 Winner announced!

16:30 Event Ends



Problem solving

Wind Power for Quinnston



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What is Wind Power?

Wind power is a renewable energy resource where the power of wind is used to generate electricity.

This involves using wind turbines to convert the turning motion of blades, pushed by moving air (kinetic energy) into electrical energy (electricity). A wind turbine is a modern windmill.



How do wind turbines work?

To connect to the national grid, the electrical energy is then passed through a transformer on the site that increases the voltage to that used by the national electricity system.

It's at this stage that the electricity usually moves onto the National Grid transmission network, ready to be used in homes and businesses.



Where can we put wind turbines?

- Somewhere windy! To work effectively, wind turbines need an average wind speed of no less than five metres per second (5m/s).
- Somewhere that can be easily accessed, or roads can be readily built to, for construction and later servicing purposes.



Where can we put wind turbines?

- Away from large built-up areas, minimum of 1000m away from residential buildings.
- On a maximum slope gradient of 10 degrees.
- A minimum distance apart from one another, depending on the size of the turbine.



Where can we put wind turbines? Suitable Geology:

As a rule, wind farms should be sited away from areas at risk of significant geological hazards, for example earthquakes, volcanic eruptions, landslides or widespread or flash flooding.



Where can we put wind turbines? Suitable Geology

Wind turbines can be sited in most rocks or soil, subject to certain conditions and investigations.



Where can we put wind turbines? Suitable Geology

- Hard rocks or strong soils are preferred. Strong soils include geologically older, well sorted and compacted soils, usually composed of sand, grit, or other rock pieces.
- Most rocks are suitable, except where there is a possibility of significant underground cavities.
- Soft soils, e.g. clays and silts, young unconsolidated soils, organic rich and peat may also be suitable; Engineering for this is more complicated and more extensive testing is required.

Where can we put wind turbines? Suitable Geology

Geotechnical tests for rock and soil conditions:

Hard rock	Strong soils	Soft soils
<p>One or both of:</p> <ul style="list-style-type: none">• Sample borehole drilling (1 for site this size)• Seismic refraction survey <p>Ground penetrating radar tests if underground cavity is possible.</p>	<p>Both:</p> <p>Sample borehole drilling (1 for site this size)</p> <p>Seismic refraction survey</p>	<p>Borehole drilling up to 30m depth in each turbine site</p> <p>Water table assessment</p> <p>Trial pits at each turbine site</p>

Why wind power?

The UK government has set a legally binding target of "Net Zero" greenhouse gas emissions by 2050. Net Zero means achieving a balance where the amount of carbon we add to the atmosphere is no more than the amount removed.

The UK has decreased emissions substantially since 1990, by moving towards higher renewable energy usage and wind power is one of the largest sources of renewable electricity in the UK. Wind power usage is expected to continue to grow, so will be important to meet "Net Zero".

Advantages of Wind Power

- An inexhaustible source of clean, secure, renewable energy.
- Reduction of dependance on fossil fuels.
- There is virtually no waste and they produce neither toxic gas nor radiation.
- Quick and mobile meaning the site can be recovered once the farm is dismantled.
- Minimal maintenance costs.
- No interfere with agriculture or livestock farming around the facilities.
- Job Creation.

Disadvantages of Wind Power

- Substantial start-up costs.
- The wind is not always predictable - some days have no wind.
- Pose a threat to local wildlife.
- Can affect local television reception.
- Not aesthetically pleasing to all.
- Can be noisy.



Welcome to Quinnston!

Wind Power for Quinnston



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Welcome to Quinnston

- Town of Approx 50,000 people, with 20,000 homes
- The local industry was previously agriculture
- Looking to also boost tourism to the area



Welcome to Quinnston

- Quinnston are hoping to become the first town ever to run solely on wind power as inspiration for others to help the UK reach net zero.
- Council's energy advisory panel have calculated that 6 5Mw wind turbines will be sufficient to provide enough power for the town at its current size.



Welcome to Quinnston

- The council have announced a £1 billion fund to build a wind farm to the south of the town and are seeking proposals from contractors to build it.



Quinnston

- Quinnston is home to St Catherine's national park.
- The national park aims to protect vulnerable flora species.
- Building in the park is carefully regulated and subject to surcharges.



Quinnston

King Burleys

- Magnificent species of migratory birds.
- Known for their bright feathers and majestic flights across vast distances.
- Their annual migration route is through Quinnston and many people travel to Quinnston to catch sight of them.



Your Task

Your team are contractors, seeking to build a wind farm in Quinnston. You need to:

1. Assess Quinnston using the resources given to you.
2. Use this information to propose a suitable location for a wind farm and any geotechnical assessment required of that site.
3. Propose a budget for the project.
4. Justify your decisions, by completing a summary sheet and presenting to the Town Council of Quinnston – aka, the judges!

Materials to help you

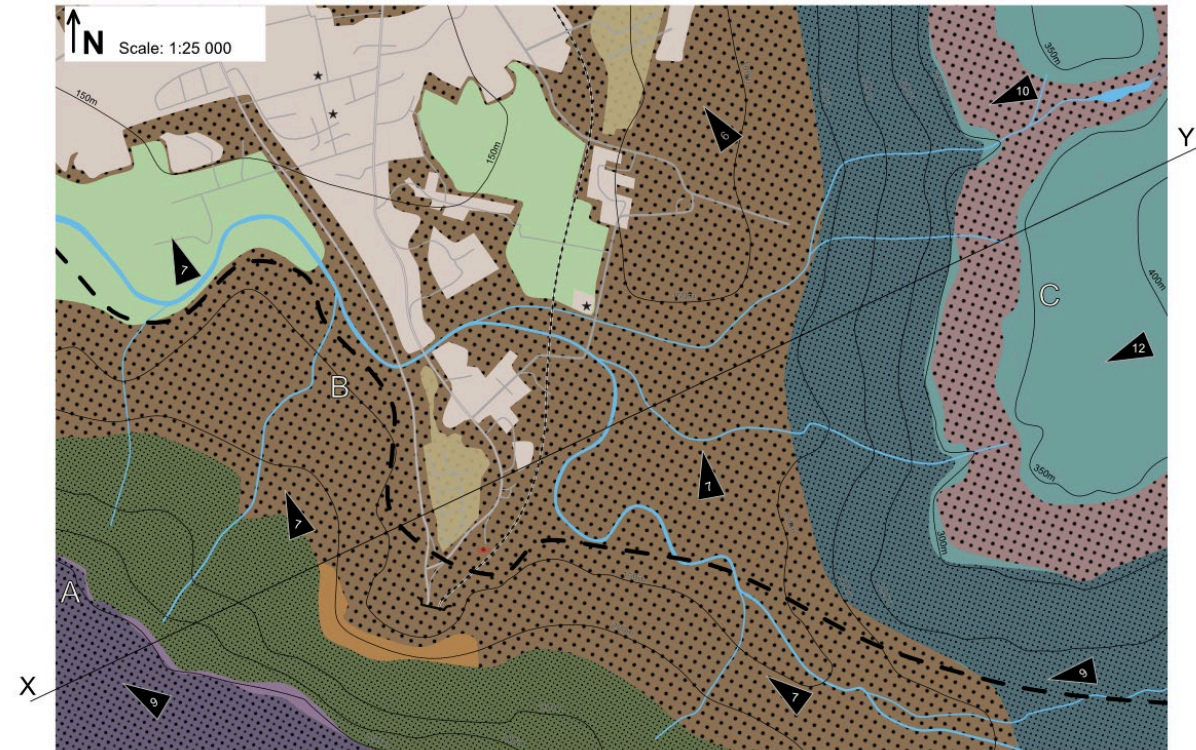
- Map of area
- Preliminary site visit data: cross section and photographs
- Opinions
- A copy of the explanatory presentation
- A sheet to help you calculate your budget, which you will hand to the judges
- An A4 summary sheet to write your conclusions on, which you will hand in to the judges

How will this be marked?

You have a total of 1 hour and 45 minutes to complete the task.

When time is up, you will hand in your summary sheet, your budget sheet and your map with the proposed area for your wind turbines marked with 6 X's.

You will then be called in a random order to present to the judges. You have 3 minutes to communicate your key points! Where did you choose to build, and why?



Budget

Part of the assessment is the budget you produce for your project, and how wisely you spend money

The maximum you can spend is £1 billion; marks are not gained for saving money!

Finally, some tips!

- You can use your phones, e.g. for calculations and looking up simple terms
- There are suggested timings to complete this activity in the Brief – make sure you read them! Time management is key; divide tasks among your team, and try to narrow down your options quickly.
- There are some wrong answers, but there is more than one “right” answer. Decide which is the best option as a team; use prior knowledge, common sense, and the information given to you
- 3 minutes is not long for a presentation. Highlight the information which is most important!
- Think outside the box to make your team stand out to the judges – highlight any unconventional solutions you propose during this time



Questions

Wind Power for Quinnston



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BRIEF: Your team is a contractor vying for the deal to build six wind turbines to supply wind energy to the town of Quinnston. You should propose a site for the wind farm in the area to the south of Quinnston and propose a geotechnical assessment for the site. The project must meet the following criteria:

- The budget for the project must not exceed £1.5 billion
- The wind farms must be placed in an area with suitable wind exposure
- Your project must adhere to the following key measurements:
 - No wind turbine can be within 1000m of residential or commercial property
 - The turbines must not be within a 250m radius of one another
 - The turbines must be a maximum of 500m apart from one another
- You must include in your budget appropriate geotechnical assessment for your proposed site.

You have the following resources to help you make your decision:

- A copy of the explanatory presentation
- Geological and drift map of area
- Preliminary site visit data: borehole logs and photographs
- Cross section
- Opinions
- A sheet to help you calculate your budget, which you will hand to the judges
- An A4 summary sheet to write your conclusions on, which you will hand in to the judges

It is recommended you stick to the following timings:

- 10 mins: Read Brief
- 15 mins: Assess the map to identify where in Quinnston is geologically suitable for a wind farm
- 30 mins: Identify where you are going to build your wind farm. Discuss advantages and disadvantages of building on these areas.
- 45 minutes: Annotate the map with your chosen wind farm site. Prepare and write up budget, write up your summary sheet. Prepare key points for your presentation to the judges.

You will be marked on the following:

- Science application and reasoning – 20 marks
- Teamwork- 10 marks
- Innovation – 10 marks
- Presentation to judges – 10 marks

After 1 hour, you will be collected from the room you are working in and brought back to the lecture theatre for lunch. At 13:30 you will return to your workspaces for a further 45 minutes. You need to hand the following to the member of staff who collects you from your work room:

- Your budget sheet
- Your summary sheet
- Your map, on which you should mark 6 X's to show the proposed wind turbine locations When all materials are handed in, teams will be called in a random order to pitch to the judges. You have three minutes to summarise the information on your sheet and show why you should be offered the building contract.

SGC 2024 Budget

BUDGET TEAM NAME:

Below are costs you need to consider. This will help you estimate the cost of your management plan. The government has offered a budget of £ 1 billion.

Compulsory Costs			
Item	Cost per unit	Quantity	Total
Turbine	£1,300,000 each	6	
Connection to the Electric Grid	£1,000,000		
Infrastructure: Access roads, foundations, substations (flat rate)	£15,000,000		
Land Purchase fee (km ²)	£500,000		
Transmission infrastructure	£1,000,000		
Optional Costs			
Geotechnical Survey: Sample borehole drilling	£150,000		
Geotechnical Survey: Seismic refraction survey	£150,000		
Geotechnical Survey: Ground penetrating radar tests	£350,000		
Water Table Assessment	£200,000		
Trial Pits	£50,000		
National Park Surcharge	£1,000,000 per wind turbine		
Media campaign	£3,500,000		
Wildlife survey	£100,000		
Build a bridge to cross a river	£4,000,000		
Rewilding management for flora and Fauna	£1,500,000 per year after turbine construction. Choose how many years you would like.		

SGC 2024 Budget

Anti vibration mount	£50,000 per wind turbine		
Renovation of the road used to access construction site; this would make it accessible to the public for use such as cycling access.	£2,000,000		
Education Centre	£30 000 000		
Optional Credit			
£1 million government subsidy – Groups can receive this if there is proof of improving the area socially or environmentally.			

Calculations:

Summary:

SUMMARY SHEET

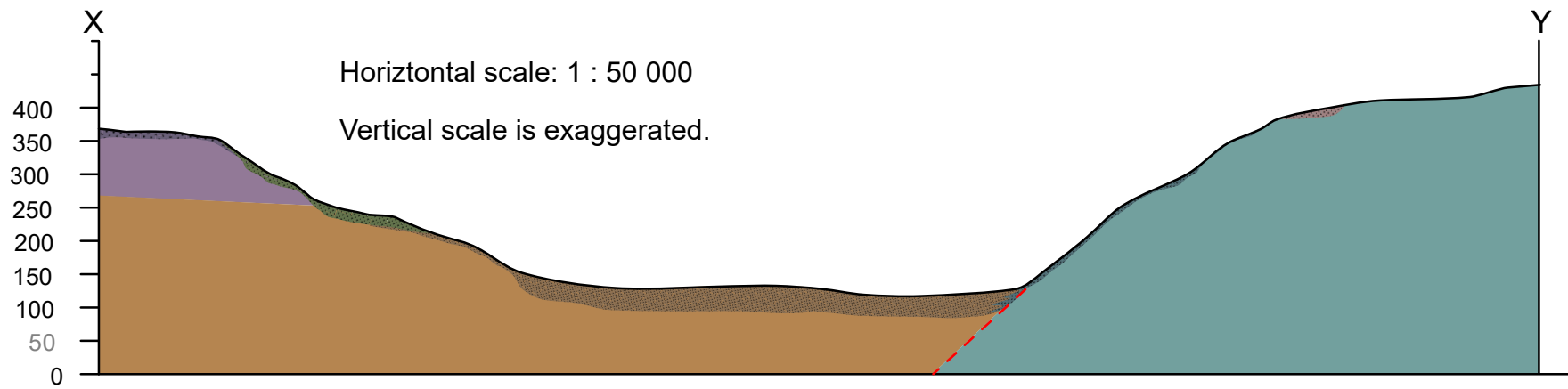
TEAM NAME

Please briefly outline why this was your choice; include your scientific conclusions for the site chosen, advantages of building here, and any other information you feel is relevant.

Please note any disadvantages to building on this site. Please explain how or if you will address these issues.

Which optional items did you include in your budget?

Line of section X-Y



Site visit photos

Location A: looking south east



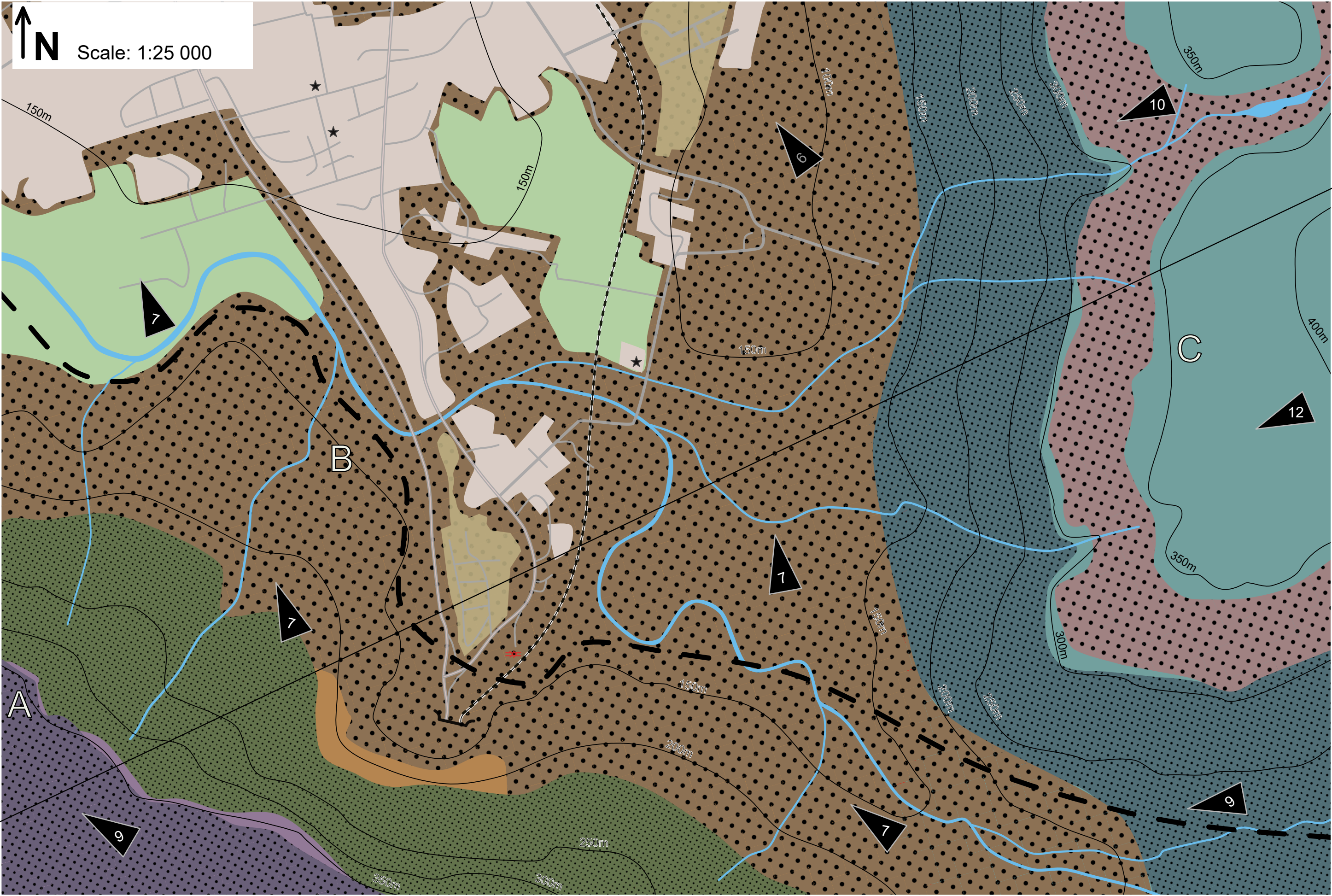
Location B: looking southwest



Location C: view looking south



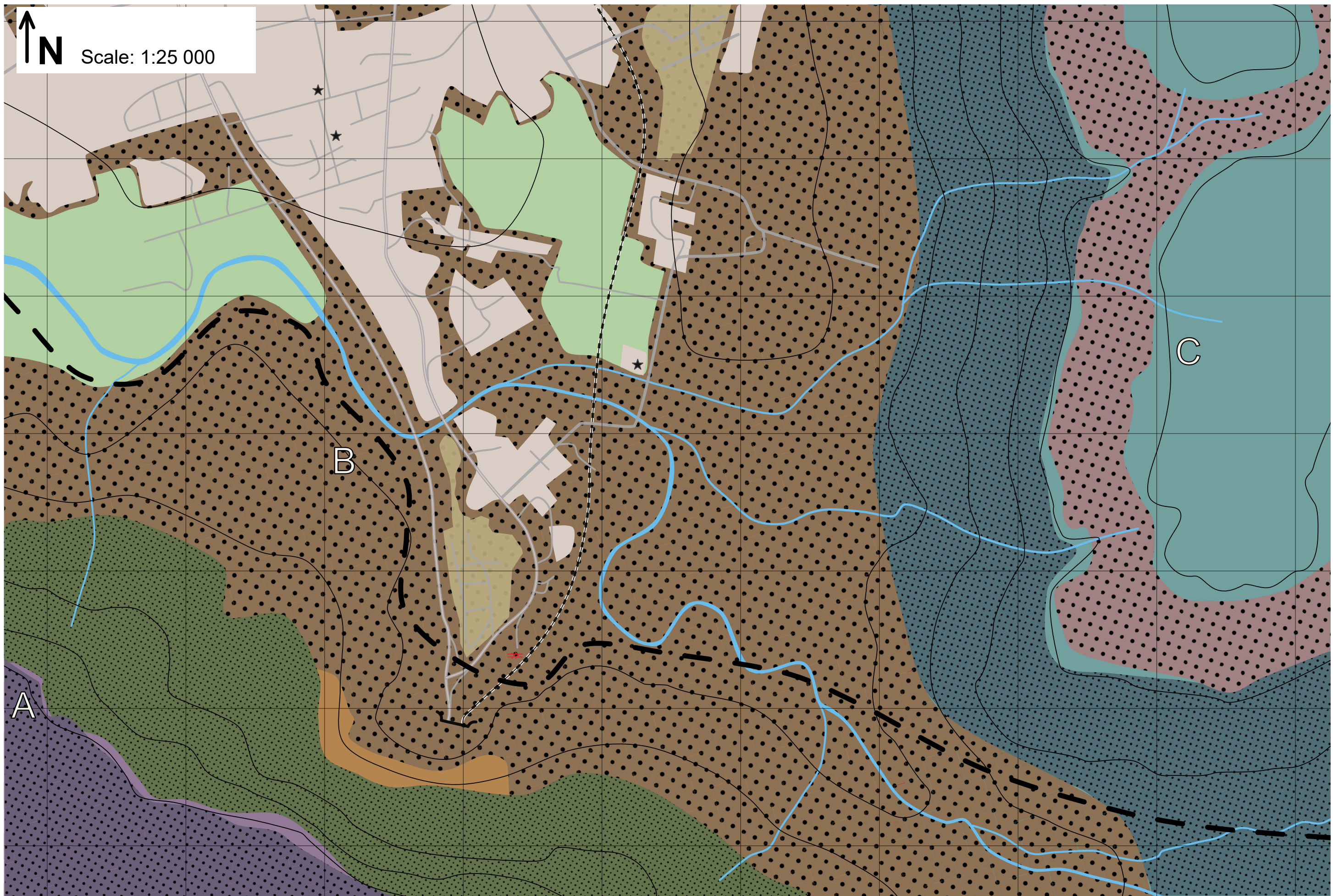
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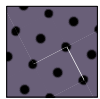
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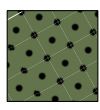
Y

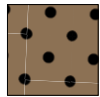
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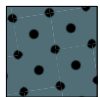


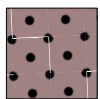
Key

 silt, clay and organic material rich soil, well sorted

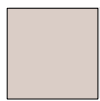
 Poorly sorted soil; 15% silt, 20% sand, other components organic matter and rock clasts

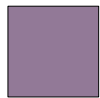
 Well sorted mature soil, sand and gravel, <10% organic material


 silt and organic rich soil, some grit, well sorted

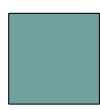
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 Industrial urban

 Residential / commercial urban

 Interbedded shale and siltstone

 Well cemented sandstone and gritstone

 Rock L


 Major road


 Road


 Railway line


 Rail station

 River

 Prevailing wind direction and avg speed (m/s)


 Historic monument


 Transport tunnel

 Elevation contour


 National park boundary

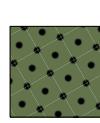
 Site visit location

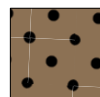
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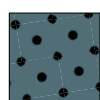
 Line of section X-Y

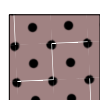
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