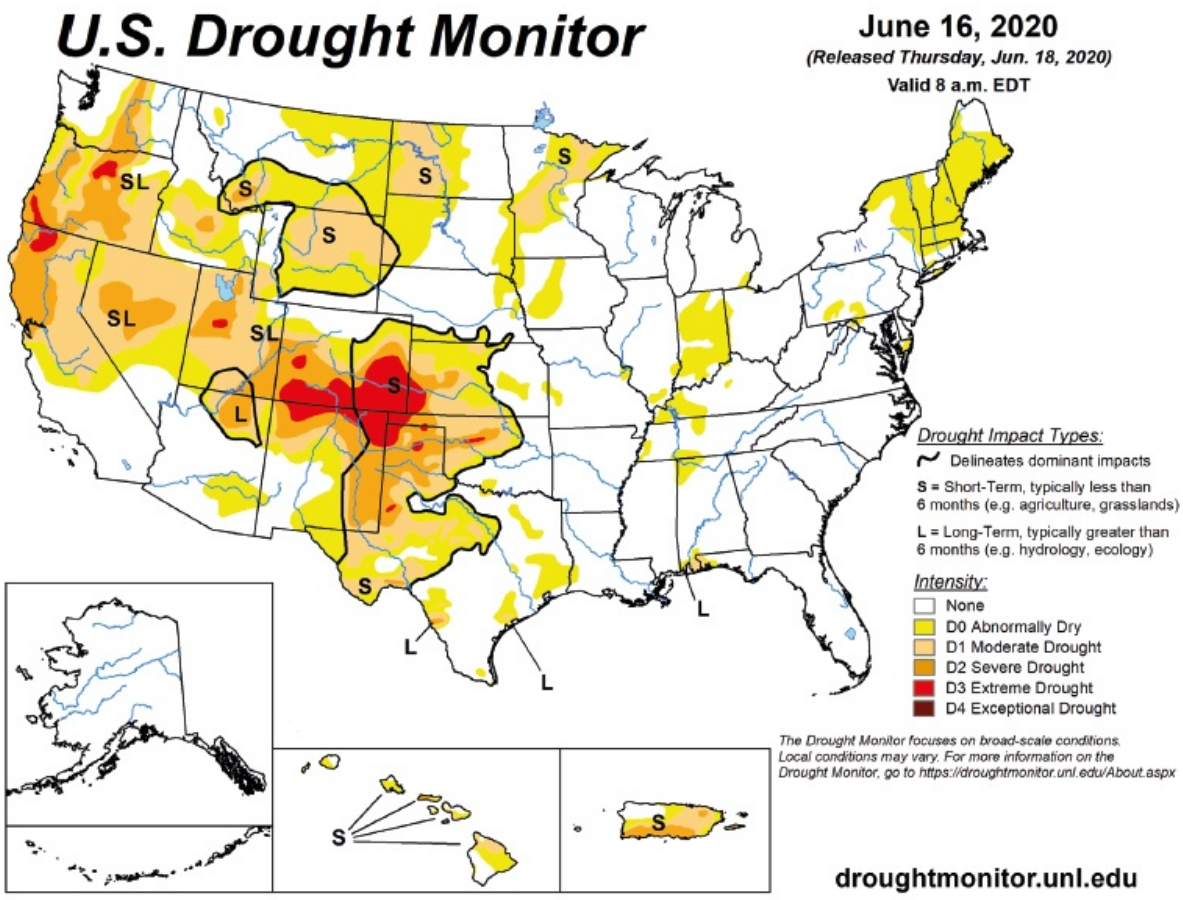
Freshwater Revision *[160 marks]*

The map shows the drought intensity in mainland USA for 16 June 2020.



[Source: The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center
at the University of Nebraska-Lincoln, the United States Department of Agriculture, and
the National Oceanic and Atmospheric Administration. Map courtesy of NDMC.]

1a. Describe the distribution of areas of extreme drought shown on the map. *[2 marks]*

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Markscheme

*Award **[1]** for each correct point, up to **[2]**.*

Possibilities include:

- Concentrated between 100–110°W **[1]**
- West coast **[1]** (**or** named west coast states – parts of Colorado, Utah, New Mexico, California, Oregon etc. **[1]**)
- Generally between latitude lines 30–40° N **[1]**
- Large area of extreme drought in central USA **[1]**.

Do not accept right/left, top/bottom/middle etc.

1b. Outline **one** economic impact of drought on agriculture. *[2 marks]*

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Markscheme

Award **[1]** for a named impact and **[1]** for explanation/development.

For example: Farmers receive reduced income / loss of livelihoods **[1]** as agriculture/growing of crops may be destroyed / produce lower yields **[1]**.

Other possible impacts include:

- More money needed to be spent on irrigation / drilling new wells
- Food prices may increase
- Out-migration (if linked to decline in agriculture)
- Unemployment

1c. Explain **two** ways in which **local** communities could improve the sustainability of water use. *[6 marks]*

Markscheme

In each case, award **[1]** for the way and a further **[2]** for development/explanation

Reference to sustainability is not required although it may be implied.

For example: Installation/retrofitting of water-efficient equipment **[1]** for example, rainwater run off tanks / low-pressure household appliances **[1]** in order to reduce consumption of fresh water supplies (in the future) **[1]**.

Other ways include:

- government-imposed restrictions / quotas on water use e.g. golf courses
- building artificial aquifers
- recycling water
- domestic pricing / water metering
- more efficient irrigation systems
- building dams (national build but managed locally)
- intra basin water transfer
- leakage detection and repair programmes / pressure reduction
- regulation of the efficiency of water using appliances
- reducing water pollution.
- desalinization plants at a local scale.

2a. Examine the reasons why the integrated management of water resources within drainage basins is becoming more important. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

The effective management of water resources is becoming increasingly important. This is due to factors such as increasing pressures and demands on water, population increase, economic development, climate change, and potential conflicts between different user groups. The drainage basin is a logical geographical unit for the management of water resources. An integrated approach is essential, ensuring close co-operation between users and players, including planners, environmentalists and water companies. Integrated management may not work too well in larger basins, especially where international boundaries are involved.

Possible **applied** themes (AO2) demonstrating **knowledge and understanding** (AO1):

- Increasing pressures and demands on water resources – water scarcity; supply and demand; deterioration of water quality; pollution.
- Integration of policies, decisions and costs across stakeholders – agriculture industry, urban development; navigation, fishery, conservation.
- Integrated approach to ensure close co-operation between users and players, to ensure that management is sustainable and effective.
- Differing views of various stakeholders must be reconciled, with a long-term vision for the river basin, ideally agreed by all major stakeholders.
- Use of water resources for a sustainable and long-term future.
- Protection and long-term sustainable use of water resources (affordability/water quality might be considered).

Good answers may be **well structured** (AO4) and may additionally offer a **critical evaluation** (AO3) of the statement in a way that reaches evidenced judgment and shows understanding of reasons why management of water resources is becoming increasingly important. The viewpoints and power of different stakeholders; the varying possibilities regarding the extent to which management of water resources may lead to a sustainable future. They may also examine the importance of different spatial scales; that management may be more difficult in larger basins crossing international boundaries. Also possibly compare more than one drainage basin, recognizing that management may be more difficult in larger basins crossing international boundaries.

For 5–6 marks, expect weakly evidenced outlining of drainage basin management.

For 7–8 marks, expect a structured account that includes:

- either an evidenced explanation of reasons why the integrated management of water resources is becoming more important
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives.

For 9–10 marks, expect both of these traits.

2b. To what extent are human factors more important than physical factors *[10 marks]* in increasing the risk of flooding in different places?

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

The focus of the response should be why risk of flooding, including frequency and magnitude, might be increasing in different places, and the relative importance of human and physical factors. Climate change, exacerbated by human action, might be identified as the factor making flooding more likely in most places and is the hardest to mitigate against.

Possible **applied** themes (AO2) demonstrating **knowledge and understanding** (AO1):

- Understanding of flood risk, frequency and magnitude; flood hydrographs.
- Human factors might include changes in agricultural land use, terracing; changes in forest cover, urbanization; building on steep slopes.
- Channel modification might increase, rather than reduce, flood risk in different parts of the drainage basin.
- Physical factors might include climate change, rainfall frequency and intensity.
- Physical characteristics of some places, such as relief and geology might make some places more prone to the risk of flooding.

Good answers may be **well structured** (AO4) and **evaluate** (AO3) the relative importance of physical and human processes as mechanisms for increasing the risk of flooding and **examine** (AO3) how the relative importance of the factors may vary in different places. They might also examine the possibility that human actions might adapt to change and reduce, rather than increase, the risk of flooding in the future.

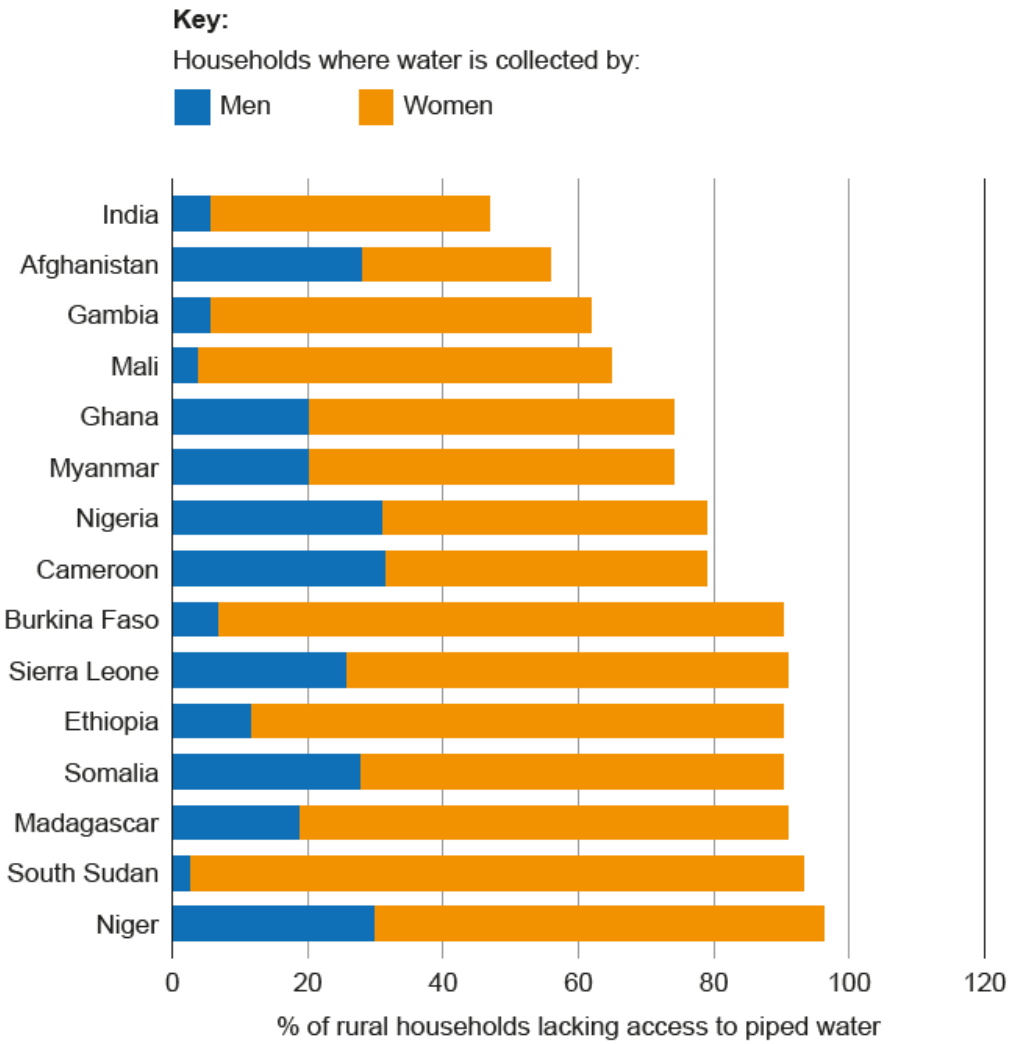
For 5–6 marks, expect some weakly evidenced outlining of how human and/or physical factors contribute to increasing flood risk.

For 7–8 marks, expect a structured account that includes:

•either an evidenced explanation of how human and physical factors contribute to increasing flood risk
•or a discursive conclusion (or ongoing evaluation) regarding the relative importance of human and physical factors.

For 9–10 marks, expect both of these traits.

The graph shows who has responsibility for collecting water from outside the home in countries where a high percentage of rural households lack access to piped water.



[Source: Adapted from *Safely managed drinking water: thematic report on drinking water 2017*, World Health Organization & United Nations Children's Fund (UNICEF), p. 31, 2017. https://apps.who.int/iris/handle/10665/325897. Accessed 6 May 2020.]

3a. State the number of countries where more than 60 % of rural households rely on water from outside the home. *[1 mark]*

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Markscheme

13

3b. Identify the country where men and women have equal responsibility for collecting water from outside the home. *[1 mark]*

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Markscheme

Afghanistan

3c. Outline **one** environmental impact of increased human pressure on aquifers. *[2 marks]*

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Markscheme

Award **[1]** for a valid impact and an additional **[1]** for development.

Ground subsidence **[1]** due to all the water having been removed/over-abstraction **[1]**.

Other impacts include:

- Pollution from agricultural chemicals / industry
- rivers/lakes drying up due to lowering of water table.

3d. Explain **two** ways in which water can be managed to provide a more sustainable future for local communities in countries such as these. *[6 marks]*

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Markscheme

Award **[1]** for each way and a further **[2]** for development / explanation / exemplification.

For example, pipes/sewers/water filters can be built **[1]** in order to separate sewage and drinking water **[1]** thereby reducing the risk of disease for future generations **[1]**.

Reference to sustainability is not required although it may be implied.

Other ways include, but are not limited to:

- recycling water
- tube wells
- more efficient irrigation systems
- training local people to take responsibility for repairs
- building dams provides irrigation water for local communities
- alternative energy developed.

4a. Examine why geographers use a systems approach in the study of drainage basins. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

Drainage basins operate as open systems, in which inputs, stores, flows and outputs are inter-related. The relationships between these will vary depending on the characteristics of the drainage basin, including geology, slope, shape, and land use, and the nature of the inputs, including type, intensity and variability of precipitation.

Possible **applied themes** (AO2) demonstrating **knowledge and understanding** (AO1):

- Drainage basins function as open systems, in which inputs, stores, flows and outputs are inter-related. The systems approach helps us understand these interrelationships.
- River discharge varies over time within drainage basins, and over space between different drainage basins, which produces knock on effects elsewhere in the system.
- The characteristics of drainage basins, such as geology, slope, vegetation cover and land use will affect flows and stores, which, in turn affect discharge: e.g. permeable rocks and low relief will result in underground flows and stores and a more even discharge.
- Stores may be on the surface, as lakes or wetlands, or underground as aquifers.
- Changes in land use, such as deforestation and urbanization, will affect flows and stores, and in turn affect discharge.
- The systems approach can help planners anticipate flooding and/or shortages.

Good answers may be **well structured** (AO4) and may additionally offer a **critical evaluation** (AO3) of the statement in a way that examines the importance of a systems approach in the study of processes within a drainage basin. Another approach might be to examine drainage basins at different time and spatial scales, for example with changes in land use or climate.

For 5–6 marks, expect weakly-evidenced outlining of a systems approach to a drainage basin.

For 7–8 marks, expect a structured account that includes:

- either evidenced explanation of why a systems approach is useful to the study of drainage basins
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives.

For 9–10 marks, expect both of these traits.

4b. Examine how conflicts between different stakeholders in the management of wetlands might be resolved. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

There are growing pressures on wetlands, and it is important that they are managed for a sustainable future. The focus of the response should be on the varied and often conflicting pressures from different stakeholders, and the future possibilities for management.

Possible **applied themes** (AO2) demonstrating **knowledge and understanding** (AO1):

- The importance of wetlands as major ecosystems which form a critical part of the natural environment: diverse ecosystems, flood control, improving water quality, carbon sinks, fertile farmland, recreation and tourism.
- Increasing pressures on wetlands include: water abstraction, land drainage, chemical and physical pollution, eutrophication.
- Different stakeholders at local, national and international scales, who may be in conflict, include: environmentalists, water management organisations, farmers, tourist organisations, local and national governments.
- The purpose of management from different perspectives – e.g. biodiversity, water security, flood control, tourism, climate change.
- Strategies for management of wetlands, including the roles of international (e.g. Ramsar Convention), national and local stakeholders.

Good answers may be **well structured** (AO4) and may additionally offer a **critical evaluation** (AO3) of the statement in a way that examines the different perspectives and varying power of stakeholders for the future management possibilities of wetlands. Another approach might be to focus on how conflicts may partly depend on the scale of the issues.

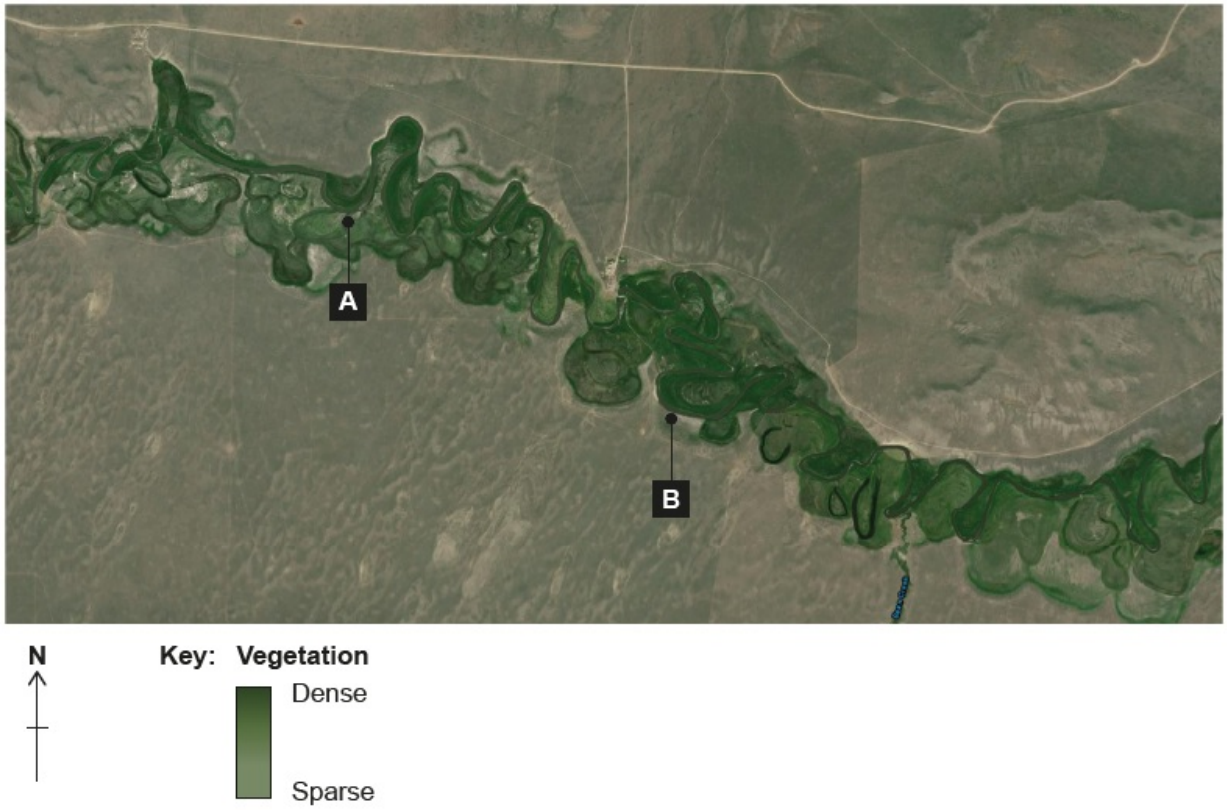
For 5–6 marks, expect weakly-evidenced outlining of at least one conflict and/or how it could be resolved.

For 7–8 marks, expect a structured account that includes:

- either an evidenced explanation of the conflicts between different stakeholders on wetlands including some idea of resolution.
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives, examining future management possibilities.

For 9–10 marks, expect both of these traits.

The satellite image shows part of the Red Rock River in Montana, USA.



[Source: U.S. Geological Survey, n.d. Site map for Montana. [online] Available at: https://waterdata.usgs.gov/mt/nwis/nwismap/?site_no=06011500&agency_cd=USGS [Accessed 1 October 2020]. Source adapted.]

5a. State the direction from point **A** to point **B**. *[1 mark]*

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Markscheme

South-east

5b. Estimate the percentage of the satellite image that is covered by dense vegetation. *[1 mark]*

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Markscheme

About 20 % (accept 10–30 %)

5c. Outline the relationship between river discharge and hydraulic radius. *[2 marks]*

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Markscheme

Award **[1]** for the basic relationship and **[1]** for further development (either explanation or other outlined development, e.g. mention of Bradshaw model).

For example: The relationship is positive **[1]** / they both increase with distance downstream **[1]** as the river's size and energy increases **[1]**.

Do not award marks for definitions.

5d. Suggest **two** landform changes that could be caused by river processes in an environment such as this. *[6 marks]*

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Markscheme

In each case, award **[1]** for a valid landform change resulting from fluvial processes, and up to **[2]** for development / explanation / exemplification.

For example: a meander develops into an ox-bow lake **[1]** when river erosion cuts through the neck of the meander **[1]** and deposition continues to isolate the lake **[1]**.

Other possibilities which are appropriate for the lowland fluvial environment shown in the photograph include:

- Meanders - accept increasing, more sinuosity, formation implying change
- Levees - formation implying change
- Floodplains - formation implying change
- Deltas
- Slip-off slope / river cliff
- River terraces.

6a. Examine the management challenges that internationally shared water resources can create. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

The focus of the essay is on the management challenges facing the use of internationally shared water resources (rivers, lakes, wetlands and aquifers). Conflicts over shared water resources may be serious and difficult to resolve, especially where resources are scarce and demand is high. There are competing demands for water, which should be allocated on an equitable basis, to satisfy all users. Increasing demands from agriculture, industry and urban. Water scarcity is becoming an important issue; physical and economic water scarcity is increasing. The varying power of different stakeholders should be considered in relation to water management.

Possible **applied** themes (AO2) demonstrating **knowledge and understanding** (AO1):

- Conflicts over aquifers, lakes and rivers which cross international boundaries.
- Conflicts over water for human consumption, irrigation and power generation; pollution resulting from such activities.
- Conflicts over access to scarce water resources, especially in arid regions.
- The power of different stakeholders varies between local people, water management organisations, and local and national governments.
- Disputes over water are an increasing source of international tension.
- Resolution of the conflict is difficult, and relies on international treaties regarding water management in drainage basins.

Good answers may be **well structured** (AO4) and may additionally offer a **critical evaluation** (AO3) of the statement in a way that examines the management challenges, and may show that perspectives (e.g., political, economic, social and environmental) may differ between stakeholders. Another approach might be to examine which stakeholders gain greater benefits, perhaps in relation to the varying power over the management process.

For 5–6 marks, expect weakly evidenced outlining of one or more management challenges created by internationally shared water resources.

For 7–8 marks, expect a structured account which includes:

- either an evidenced explanation of two or more management challenges created by internationally shared water resources
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives.

For 9–10 marks, expect both of these traits.

6b. Examine why some communities and environments may benefit more than others from the building of large dams. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

The construction of large dams for multi-purpose water schemes can have significant benefits, but often come at a considerable cost. The cost and benefits are shared unevenly between different communities and environments, and some will benefit more than others.

Possible **applied** themes (AO2) demonstrating **knowledge and understanding** (AO1):

- The benefits and costs of building large dams vary between different stakeholders, including local communities, farmers, environmentalists, organizations such as water management and power companies, national governments.
- The benefits and costs also vary between different environments/places.
- Benefits include: reducing flood risk, improved water supplies, and economic development through irrigation, power generation, recreation and tourism.
- There are also significant environmental, social and economic costs, which vary between different stakeholders and places.

Good answers may be **well structured** (AO4) and may additionally offer a **critical evaluation** (AO3) of the statement in a way that examines the varying benefits of large dam construction for communities and environments, and may show that perspectives (e.g. political, economic, social and environmental) may differ between stakeholders. Another approach might be to examine which stakeholders gain greater benefits, perhaps in relation to their varying power over future management possibilities.

For 5–6 marks, expect weakly evidenced outlining of one or more benefits of large dam construction for communities and/or environments (places).

For 7–8 marks, expect a structured account which includes:

- either an evidenced explanation of two or more reasons why some communities and environments (places) benefit more than others
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives, possibly examining future possibilities for management.

For 9–10 marks, expect both of these traits.

The table shows the location and height, in metres, of the world's tallest waterfalls.

	Name	Location	Height of waterfall (m)
1	Kerepakupai Merú	Venezuela	979
2	Tugela Falls	South Africa	948
3	Tres Hermanas	Peru	914
4	Olo'upena Falls	USA	900
5	Yumbilla	Peru	896
6	Vinnufallet	Norway	865
7	Skorga	Norway	865
8	Pu'uka'oka Falls	USA	840
9	Mattenbachfälle	Switzerland	840
10	James Bruce Falls	Canada	840
11	Browne Falls	New Zealand	836
12	Kjerrskredfossen	Norway	830
13	Los Chorros de Cura	Venezuela	821
14	Waihilau Falls	USA	792
15	Colonial Creek Falls	USA	783
16	Mongefossen	Norway	773
17	Gocta	Peru	771
18	Balåifossen	Norway	765
19	Johannesburg Falls	USA	751
20	Terror Falls	New Zealand	750

[Source: Adapted from https://www.worldwaterfalldatabase.com/tallest-waterfalls/total-height. Information presented on the World Waterfall Database is constantly being re-evaluated and while we strive to keep it as accurate as possible, there are entries in our Tallest list(s) which need to be more closely scrutinized and as such the heights we currently have presented may or may not be entirely accurate.]

7a. Identify which country has the most waterfalls between 780m and 860m in height. *[1 mark]*

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Markscheme

USA.

7b. State the mode for height from the table. *[1 mark]*

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Markscheme

840 (*"m" not needed*).

7c. Outline the main features of **one** landform, **other than** a waterfall, created by river erosion. *[2 marks]*

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Markscheme

*Award **[1]** for a basic outline of a valid landform and **[1]** for further development of its main feature(s) or the process relating to its formation.*

For example: A meander is a winding/sinuous section of a river **[1]** with a steep river cliff on the outside bend **[1]**.

Other erosional landforms include:

- gorges
- v-shaped valleys
- plunge pools
- rapids
- potholes
- terraces
- ox-bow lakes.

7d. Explain **two** reasons why rates of erosion could vary at different waterfalls, such as those shown in the table. *[6 marks]*

Markscheme

*In each case, award **[1]** for a valid reason and **[2]** for further explanation/development of variation in rates of erosion at different waterfalls*.

For example: If the drop in height is great **[1]**, the water will be very fast **[1]**; therefore, there will be more rapid abrasion/hydraulic action **[1]**.

Other possible reasons include:

- geology
- scale / size of drainage basin
- variations in discharge levels
- load causing abrasion in plunge pool.

8a. Examine how human **and** physical factors can contribute to a low risk of river flooding. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

River flooding continues to cause serious human and environmental problems, especially in urban and densely populated rural areas. In order to reduce the impact, severity and frequency of flooding it is important that there should be an understanding of the physical and human causes of river flooding.

Possible **applied themes** (AO2) demonstrating **knowledge and understanding** (AO1):

Human factors that may contribute to low flood risk include:

- flood mitigation schemes, such as structural changes to river systems, including levees, channel modification, dams and flood reservoirs
- land use planning and zoning; changes in land use, agricultural techniques and afforestation
- changes in land use and afforestation
- also important are factors such as weather forecasting and flood prediction.

Physical factors that may contribute to low flood risk include: • geology, including rock permeability

- relief, including slope steepness
- rainfall amounts and seasonality
- land use, including types of vegetation cover.

Good answers may be **well structured** (AO4) and may examine the relative importance (AO3) of the two sets of processes, or the interaction of the two sets of processes, or how influences may vary from place to place.

For 5–6 marks, expect some weakly evidenced outlining of how human and/or physical factors contribute to a low flood risk.

For 7–8 marks, expect a structured account that includes:

- either an evidenced explanation of how human and physical factors (do not expect balance) contribute to a low flood risk
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives.

For 9–10 marks, expect both of these traits.

8b. Examine why it can be difficult to achieve stakeholder agreement over how best to manage **one or more** water resources. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

As the quantity of water resources available to meet rising demands over time intensifies, and the quality of water degrades, there is increasing competition and possible conflict between water users. The rising demands include freshwater supplies from rivers, lakes and aquifers, fishing, irrigation and navigation. Many river basins cross political boundaries and there is a need for international agreements and cooperation to avoid possible conflicts over increasingly scarce resources.

Possible **applied themes** (AO2) demonstrating **knowledge and understanding** (AO1):

- Freshwater resources include rivers, lakes, reservoirs and aquifers.
- Many large river basins cross political boundaries, and there is potential conflict over the use of water resources.
- Increasing demands for water resources come from meeting the needs of water supply, fishing, agriculture, energy and navigation, and there is a potential for conflict between different stakeholders.
- There is a need for international treaties and agreements to resolve the potential conflicts.
- The different stakeholders involved in resolving possible conflicts include local populations, national governments and international associations like the UN, FAO and UNESCO.
- International agreements may also be important in water management, conservation and protection.

Good answers may be **well structured** (AO4) and may additionally offer a critical evaluation (AO3) of the roles and power of different stakeholders in relation to water management issues. Perspectives can differ so greatly that no consensus can be arrived at. Different stakeholders have unequal power, which means that some views are ignored. The scale and complexity of the issue affects outcomes.

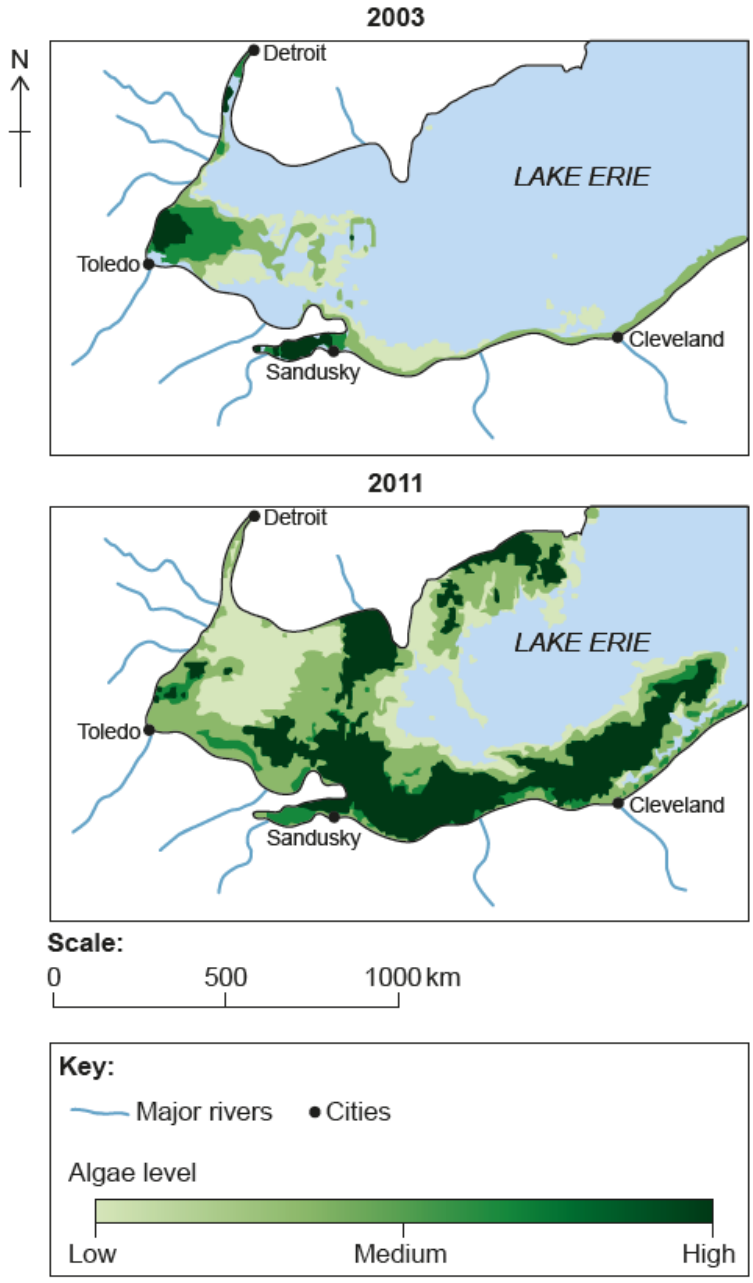
For 5–6 marks, expect some weakly evidenced outlining of the management of one or more water resources.

For 7–8 marks, expect a structured account that includes:

- either an evidenced explanation of the management of one or more water resources, and why it is difficult to get stakeholder agreement
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives.

For 9–10 marks, expect both of these traits.

The maps show the growth of algae in a freshwater lake where eutrophication is occurring. Algae growth is caused by high levels of nutrients.



[Source: NOAA.]

9a. Identify **two** changes between 2003 and 2011 along the southern shore of the lake between Sandusky and Cleveland. *[2 marks]*

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Markscheme

- Increased severity **[1]**.
- Greater area of water affected **[1]**.
- Increased distance from shore affected **[1]** / 100-150 km distance **[1]**.

9b. Outline **one** environmental problem caused by eutrophication. *[2 marks]*

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Markscheme

*Award **[1]** for the problem and **[1]** for development.*

For example: Fish die **[1]** due to oxygen depletion **[1]**.

Possible problems include:

- declining biodiversity
- creation of dead zones
- excessive vegetation on surface.

9c. Explain **one** human reason **and one** physical reason why some areas of a freshwater lake such as this experience high levels of eutrophication. *[6 marks]*

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Markscheme

*In each case, award **[1]** for the reason and up to **[2]** for development / explanation.*

Possible human reasons include:

- agricultural
- industrial
- settlement.

For example: Runoff from farming into particular parts of the lake **[1]** carries high amounts of nitrates **[1]** that were used as fertilizer **[1]**.

Possible physical reasons include:

- drainage patterns
- wind / storms / currents
- hydrological flows
- relief
- depth/temperature of water.

For example: An area of water with many rivers draining into it **[1]** will receive more inputs of dissolved nutrients in solution **[1]**, leading to excessive algae growth in that part of the lake **[1]**.

10a. Examine the role of local communities in the management of water resources. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

Freshwater is an essential resource that has come under increasing pressure due to growth in demand, especially from increased population and urbanization, industry and intensive agriculture. Water quality is also under threat from physical and chemical pollution and salinization. Scarce and poor water quality can seriously affect the health of local communities.

Possible **applied themes** (AO2) demonstrating **knowledge and understanding** (AO1):

- Local management strategies aimed at providing fresh, sustainable water quality; access to clean and affordable water.
- Local communities play an important role in the improvement of health and well-being, and adequate supplies for agriculture and irrigation.
- Local efforts or strategies to reduce pollution from urban areas and agricultural run-off.
- Construction of wells, boreholes and small reservoirs.
- The role of different stakeholders, for example national governments, international organizations, TNCs, in assisting local communities in management of water resources.

Good answers may be **well structured** (AO4) and may additionally offer a **critical evaluation** (AO3) that examines the role and power of different stakeholders. Another approach might be to critically evaluate the importance of interactions between different scales of management using a sustainability framework.

For 5–6 marks, expect some weakly evidenced outlining of some local strategies in relation to management of water resources.

For 7–8 marks, expect a structured account that includes:

- either an evidenced explanation of the role/importance/work of local communities managing different water resources
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives.

For 9–10 marks, expect both of these traits.

10b. Examine the ways in which different physical factors can affect the characteristics of hydrographs. *[10 marks]*

Markscheme

Marks should be allocated according to the Paper 1 markbands (available under the "Your tests" tab > supplemental materials).

A range of different physical factors affect the characteristics of river hydrographs. Many physical factors may be inter-related to affect the shape of the hydrograph. Physical factors may vary between rivers in different places, and also within the same large river basin. They may vary over different time scales, from seasonal to annual and long term. Climate change may have a long-term influence.

Possible **applied themes** (AO2) **demonstrating knowledge and understanding** (AO1):

- Characteristics of the hydrograph include peak discharge, lag time, steepness of rising and falling limbs, and baseflow.
- Physical factors that affect the characteristics of hydrographs include:
  - rock permeability and soil type/thickness; topography and relief; the type and amount of vegetation cover
  - climatic factors, such as rainfall amount, duration and intensity
  - snowfall (precipitation held in storage)
  - drainage basin characteristics, such as basin shape, drainage density and bifurcation ratio.
- Climate change may cause the character of the hydrographs to change overtime, *eg* the impact of reduced rainfall, or more intense rainfall.

Good answers may be **well structured** (AO4) and may additionally offer a **critical evaluation** (AO3) that examines the different scales/importance of physical factors, and the interactions between different physical factors, *eg* the impact of climate change on local water systems.

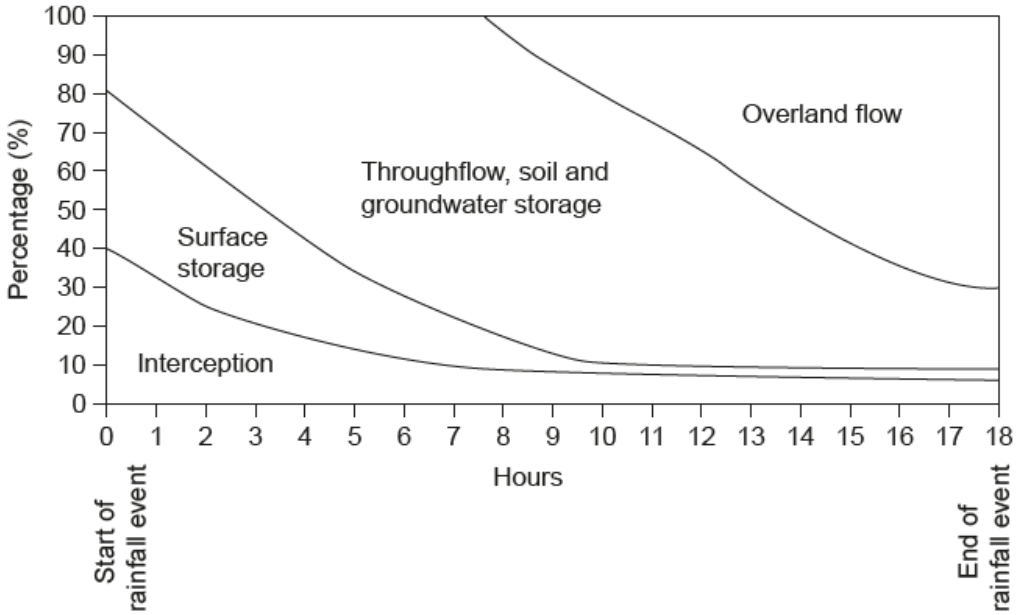
For 5–6 marks, expect some weakly evidenced outlining of the influence of two different physical factors.

For 7–8 marks, expect a structured account that includes:

- either an evidenced explanation of two or more physical factors affecting hydrograph characteristics
- or a discursive conclusion (or ongoing evaluation) grounded in geographical concepts and/or perspectives.

For 9–10 marks, expect both of these traits.

The following diagram shows the rainfall stores and flows within a drainage basin during a rainfall event.



[Source: International Baccalaureate Organization, 2019]

11a. Estimate the percentage of rainfall shown as surface storage at the start of the rainfall event. *[1 mark]*

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Markscheme

Around 40 (*accept 39 to 41*)

11b. Estimate the number of hours during which overland flow is present in the drainage basin. *[1 mark]*

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Markscheme

10 (hours)15 (minutes) (*allow 10 to 10 hours 30 minutes*)
Accept answers in decimal points (10.0–10.5)

11c. Outline **one** reason why interception decreases over time during the rainfall event shown in the diagram. *[2 marks]*

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Markscheme

There is a limit to how much water can be stored on leaf surfaces / on vegetation **[1]**, and after a few hours of rainfall no more interception storage can occur **[1]**.

11d. Explain **three** possible ways in which urban development might change how rainwater moves through a drainage basin such as this. *[6 marks]*

Markscheme

*Award **[1]** for each valid effect and **[1]** for further development of how this might change the movement/flow/storage of rainwater*.

For example: Urbanization would remove vegetation and thus interception storage **[1]**; as a result, more rain will flow through the drainage basin **[1]**.

Do not accept reference to dams and reservoirs.

Other possibilities include:

- May be more surface storage, as rainwater cannot drain away due to impermeable surfaces.
- Little infiltration of rainfall due to impervious concrete surfaces, increasing run-off
- Small soil storage, as little rainwater will filter downwards from the surface.
- Altered overland flow of rainfall due to drainage channels and gutters.