**Houston area flooding August 2017**

**Background:**

Houston is the largest city in the state of Texas and the fourth largest city in the United States, with a population of approximately 2.5 million. Houston’s nickname is the “Bayou City” because it is criss-crossed by slow moving rivers called bayous – the main one being Buffalo Bayou. The San Jacinto River also flows through the Houston area. Houston is renowned for its urban sprawl and its rapid outward expansion has resulted in much of its surrounding prairie land being converted into roads, new housing estates and services for its growing suburban population. Houston frequently experiences flash flooding, often as a result of thunderstorms and tropical storms off the Gulf of Mexico.

**Causes of the flooding:**

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| **Physical** | **Human** |
| In August 2017, the outer rain bands of Hurricane Harvey dumped 50 inches of rain on the city over a 4-day period. The amount of rainfall was record breaking, with Harvey officially named the wettest tropical cyclone to make landfall in the United States. | Urban sprawl in Houston has resulted in the conversion of prairie land into concrete and tarmac. This has resulted in less space for flood waters to be absorbed. |
| The heavy rainfall quickly overwhelmed Houston’s Bayou systems and a third of the city was eventually flooded. | Houston’s flood waters are controlled partially by two large reservoirs – the Barker and Addicks reservoirs. These reservoirs are located in the upper watershed of Buffalo Bayou. Unfortunately, the reservoirs were unable to cope with the massive amounts of rainfall produced during the storm. There were concerns that the reservoirs would be breached and as a result the US Army Corp of Engineers ordered a controlled release of the reservoirs. This resulted in the flooding of 1000s of homes, but ultimately saved downtown Houston form the catastrophic flooding that would have ensued if the dams had been breached. |

**Impacts of the flooding:**

* $125 billion dollars in damage – one of the costliest natural disasters in US History
* 82 people died
* 1/3 of the city of Houston was flooded
* 95,000 homes were flooded
* 30,000 people were made temporarily homeless
* The George R Brown Convention Center was opened up to house evacuees – 9,000 people stayed here alone
* The flooding of petrochemical facilities located along Buffalo Bayou resulted in the release of toxic substances - people reported an awful smell as well as itchy eyes, throats and headaches
* Houston is at the centre of many industries, chief among them energy. The area is home to almost half of US refining capacity and a fifth of its oil production. But property damage stopped half the area's oil refineries from working, and the low supply pushed the US financial market price of petrol up 4% to a two-year high.

**Flood management strategies before Hurricane Harvey**

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| **Hard engineering** | **Soft engineering** |
| Houston uses artificial levees (flood embankments) to raise the height of the banks of its bayous and rivers to try to contain flood waters. | A strategy has been to demolish high-risk homes in floodplains to create absorbent green spaces. Harris County has the largest flood buyout program in the nation. |
| New flood channels are being planned to allow water to be released from dams when necessary. | River restoration has been taking place along Buffalo Bayou – river restoration means returning a river to its natural state by removing artificial flood control methods and allowing space for the river to flood. |
| Houston’s flood risk is partially controlled by two large reservoirs – the Barker and Addicks reservoirs. These reservoirs are located in the upper watershed of Buffalo Bayou.These two reservoirs were constructed in the 1970s. Reservoirs are large artificial lakes that can be used to store water. They are created through the use of construction of a dam that traps water, which builds up behind it, forming a reservoir. Water can be released in a controlled way into Buffalo Bayou. |
| There is discussion of constructing a third reservoir (but this is subject to further studies). |
| A $13 million project is in action to dredge the waterways leading to the Addicks Reservoir. |

**Flood management of Houston river systems post Hurricane Harvey 2017**

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| **Hard engineering** | **Soft engineering** |
| 20 levee systems are being upgraded to increase the amount of rainfall they can handle. | Greening neighborhoods by established pocket prairies. For example, by planting vacant lots or parking lots. This is to help relieve the stresses of flash flooding. |
| The 70-year-old flood gates on the Barker and Addicks Reservoirs are being replaced. | Since the storm, thousands of property owners who live in flood prone areas have volunteered for government buyouts. Homes on vulnerable land are demolished and then this land is used to create absorbent green spaces. |
| There is discussion of constructing a third reservoir (but this is subject to further studies). |
| A $13 million project is in action to dredge the waterways leading to the Addicks Reservoir. |
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