

Design Study Two: River Gaunless Flood Control Dam**Background**

Following severe flooding in June 2000 the Environment Agency fast tracked a flood defence scheme for Bishop Auckland and West Auckland to protect around 600 homes. Construction works commenced in 2003 and consisted of 2.1km of river training walls and embankment and the construction of a flood storage area to the west of West Auckland. The dam is approximately 315m long and contains approximately $90,000\text{m}^3$ of material. The overall scheme costs were around £9.5m.

The dam is designed to hold back the 1 in 200year flood and by using “Hydrobrakes” in the flow-through culvert to restrict the outflow so that it will be equivalent to only a 1 in 2 year event.

Design Brief

Using the site and design data given below, answer the following questions to evaluate aspects of the design:

1. What is the length of time it will take the reservoir to fill to a level of 127 mAOD from a level of 123 mAOD, if the inflow is the 1 in 200 year flow rate of $48\text{m}^3/\text{s}$ and the culverts are both flowing full at velocity of 1m/s ?

What would this time be for the 1000 year flood flow?

(Hint: calculate volume available from the table or graph; calculate the net inflow, then the time to fill this volume.)

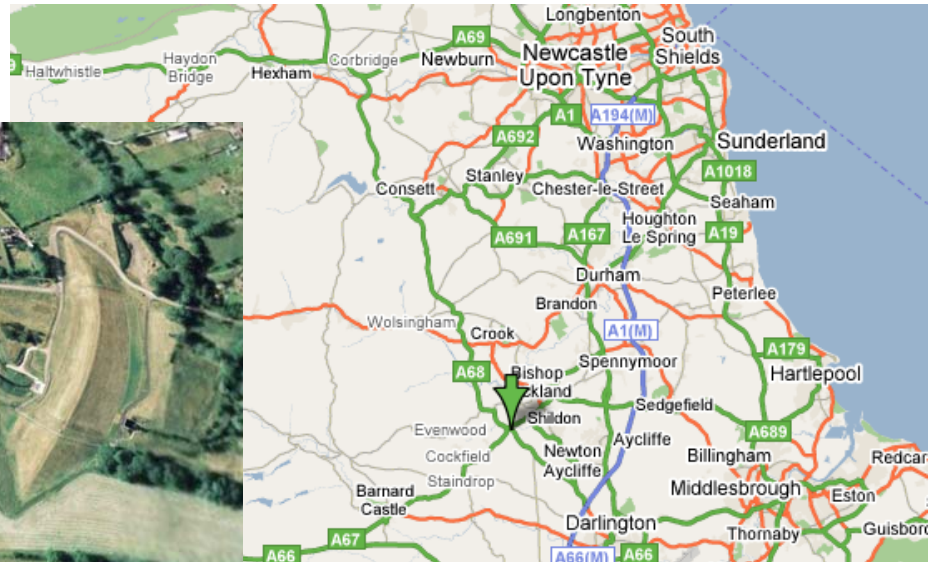
2. To prevent erosion of the downstream dam face when there is flow over the dam the design limit is a velocity of flow of 8m/s . Assuming that the velocity on the slope is approximately 4 times the velocity over the weir, calculate the allowable height of flow, H , over the weir crest.

Calculate the height over the crest for the 1000 year flood.

Is the design limit for erosion protection exceeded?

3. An alternative design for the outlet culverts was to pipe the water further downstream. In this design the pipe would connect to the exit of the existing culvert and immediately form a bend of 45° . The pipe would reduce in diameter to 1.5m . What would be the force be on this bend when the water is flowing at the maximum rate of 1.0m/s and the reservoir surface is 13m above the bend's entrance?

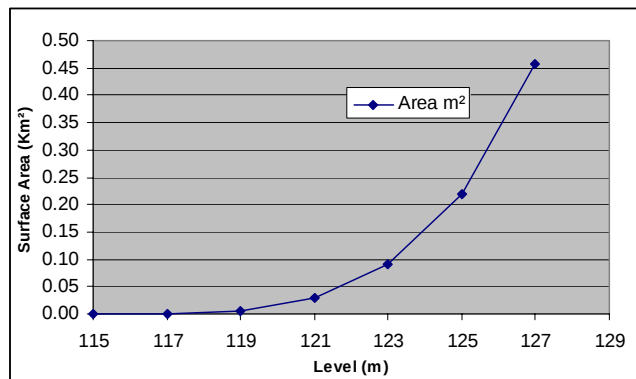
Assume Atmospheric pressure is equal to 10m of water.

Site Data:

Dam location and surrounding area

Surface Area Data:

Level mAOD	Surface Area m ²
115	0
117	352
119	5632
121	28512
123	90112
125	220000
127	456192



Culvert Diameter 2.6 m

Number of culverts 2

Maximum culvert velocity 1 m/s

Spillway weir Cd 0.73

Spillway weir width 150 m

1 in 200 year design flow 48 m³/s1 in 1000 year design flow 242 m³/s

Maximum velocity on spillway 8 m/s

Rectangular Weir equation: $Q_{\text{actual}} = C_d \frac{2}{3} B \sqrt{2g} H^{3/2}$