

# Technical Summary Note

## Improvements to Roath Park Dam Structure



January 2022

## 1. Background

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Roath Park was opened in 1894 and became the first publicly owned park in Cardiff. Today it is one of Cardiff's largest and most popular parks. Roath Park Lake is manmade, formed by a dam structure to the south and fed by the Nant Fawr stream. Cardiff Council are responsible for the operation and maintenance of the dam.

The lake is classified as a Category A large raised reservoir under the Reservoirs Act (1975) due to the potential damage downstream, including likely loss of life, if the dam were to fail. Under this Act, a 'Section 10 Inspection' was carried out in May 2014 by a qualified All Reservoir Panel Engineer. This inspection highlighted that the dam spillway capacity is inadequate for an extreme flood event. Should such an event occur, water would overflow the dam crest (promenade) causing erosion of the grassed slope and breach of the dam. It was recommended by the Panel Engineer that improvements are made to ensure that extreme floods can be safely passed.

Cardiff Council are legally required to address the recommendations and Natural Resources Wales (NRW) are the regulatory authority who enforce the Reservoirs Act and ensure that any safety recommendations are carried into effect.

For a Category A dam, it is industry guidance<sup>1</sup> that the embankment and associated spillway arrangements are capable of:

1. Safely passing a flood event which has a 1 in 10,000 chance of occurring in any given year without any overtopping, and
2. Passing a Probable Maximum Flood (PMF) event without any overtopping that compromises the safety of the dam. A PMF event is considered to have a 1 in 400,000 chance of occurring in any given year.

<sup>1</sup> Floods and Reservoir Safety, Fourth Edition. Institution of Civil Engineers. 2015.

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In order to quantify the scale of the problem to be addressed, flood modelling for the lake was undertaken and a physical model of the spillway was produced (see Photograph 1). The results showed that the existing spillway (Photograph 2) is significantly undersized to safely pass a 1 in 10,000 or a PMF event. Therefore a solution to improve the flood conveyance through the dam is required.



**Photograph 1:** 1:20 scale model of Roath Park spillway (bridge omitted from the model)



**Photograph 2:** Existing Roath Park spillway

The primary aim of the Cardiff Council scheme is to make the necessary improvements to ensure the safe conveyance of extreme flood events. It focuses on the safety of the dam and the downstream population. The scope is not specifically to reduce downstream flood risk, nor does it address park maintenance. These aspects are managed by Natural Resources Wales and the Cardiff Parks Department respectively.

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## 2. Options considered

A long list of options was identified for potential solutions to improve extreme flood conveyance capacity. During initial screening, some were discounted for not achieving the necessary dam safety benefits, whilst others were discounted due to their significant impacts on the amenity value of the park. Below is a high-level summary of the discounted options:

Table 1: List of options discounted at initial screening stage

Option	Reason for discounting
Lower the top water level of the reservoir to provide more capacity during a flood event	Even if the reservoir was kept entirely empty, in a PMF event the reservoir would fill completely and still overtop the dam.
Reduce incoming flows by holding back water in the Wild Gardens	The volume of water that needs to be held back to provide benefit is too great for the limited area available upstream of the reservoir.
Use Lisvane & Llanishen Reservoirs to hold back water	The reservoirs are not impounding structures. Inflows are piped into them. The volume of water that they release into the watercourse is small when compared with the overall catchment and any flow control mechanism would not have a material impact on the works necessary. The cost of converting the reservoirs to provide flood storage would be disproportionately high.
Use natural flood management (NFM) techniques to hold back water, such as woody debris dams	These interventions do offer a number of benefits but due to size limitations, are not able to store significant volumes of water. The benefits are typically realised for smaller, more frequent events. As such, NFM is unsuitable to safely manage extreme events.
Raise the dam crest to provide more capacity during a flood event	This would involve either raising the promenade or installing a flood wall. For the height required to provide the required capacity, this is unfeasible due to constraints in the park and the impact on amenity value.
Add a secondary spillway to provide another route for a flood event to safely pass the dam	The additional flows that need to be passed would require another spillway of a similar size to the existing, which would be difficult to locate without causing significant disruption to the park.
Increase the capacity of the existing spillway, by replacing it with a single larger structure	A spillway to pass the PMF event would be much larger than the existing one, and would likely require the removal of the Terra Nova café and reconfiguration of the western end of the dam. As a result this would be excessively costly and disruptive.

The two short-listed options that were selected as the most viable solutions are those that address the risk to dam safety, have limited impact on the surrounding park, and are considered affordable. These options are outlined below.

Table 2: Options shortlist

Option	Primary Option to manage 1 in 10,000 flood event		Supplementary measure to manage flows in excess of 1 in 10,000 event
Option A	To increase the capacity of the existing spillway to safely pass a 1 in 10,000 event	AND	To allow safe overtopping of the dam in a PMF by reinforcing the downstream slope and installing training walls to direct the water over the dam
Option B			To allow safe overtopping of the dam in a PMF by reinforcing the embankment core to prevent breach of the dam if the downstream embankment is eroded by overflowing water

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### 3. Consideration of downstream flood risk

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As part of the planning application, it will be necessary to produce a Flood Consequence Assessment (FCA). As part of the FCA application process, Cardiff Council will need to demonstrate that any effects on downstream flooding as a result of the dam improvement works are manageable. The design is being developed in accordance with TAN15<sup>2</sup> requirements, which is the Welsh Government's technical advice note for development and flood risk.

For the extreme events that must be addressed for dam safety (1 in 10,000 chance and PMF), the downstream areas will already be significantly flooded and so the focus for these events is on ensuring that the flows are safely passed without excessive damage to the dam structure.

The design of the spillway will consider the competing requirements of these different scale events. It will seek to find an appropriate balance between managing flows in smaller events but ensuring adequate passage of flood water in more extreme events.

The designers are in consultation with the Natural Resources Wales Flood Management Team to identify if adjustments to the design can be made to attenuate some smaller flood flows and therefore assist in reducing NRW's requirements to safely manage downstream flood risk. Discussions are currently ongoing.

### 4. Next steps

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The next steps of the scheme are to undertake detailed hydraulic modelling of the preferred spillway design, in order to ensure that it will safely and efficiently pass the required flows.

The information gathered during the November 2021 ground investigation will be used to inform the design of the spillway, and any other remedial works to the dam and surrounding area.

Initial ecological surveys including those for protected species have been undertaken, and further surveys will be undertaken as the scheme progresses to ensure any potential impact on ecology and the environment can be mitigated.

Heritage and landscaping requirements will also be looked at in further detail, to ensure that the design is sympathetic to its surroundings, and any impacts to the promenade and play park are reduced as far as practical. Initial consultation has been held with Cardiff Heritage Officers and further meetings will be scheduled with CADW and other relevant stakeholders.

As the design is developed, drawings and images of the proposals will be shared with the community and stakeholders.

<sup>2</sup> Planning Policy Wales Technical Advice Note 15 Development and Flood Risk (TAN15), 2004.  
<https://gov.wales/sites/default/files/publications/2018-09/tan15-development-flood-risk.pdf>