

**Forestry England**  
**Upper Cannop Pond**  
**Lydney, Gloucestershire**

**Report on an Inspection under Section 10(3) of the  
Reservoirs Act 1975**

**December 2022**

Client:	Forestry England
Project:	Upper Cannop Pond
Document Title:	Report on an Inspection under Section 10 of the Reservoirs Act 1975
Project No:	P2380

ORIGINAL	Originator	Checked by	Reviewed by
	[REDACTED]	[REDACTED]	[REDACTED]
Signature:			
Issue Date:	29 <sup>th</sup> September 2022		
Document Status	Draft issued for client review		

REVISION	Originator	Checked by	Reviewed by
	[REDACTED]	[REDACTED]	[REDACTED]
Signature:	[REDACTED]		
Issue Date:	7 <sup>th</sup> December 2022		
Document Status	Final		

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## 1.6 Name and Address of the Enforcement Authority

Reservoir Safety - Technical Manager  
The Environment Agency  
Manley House  
Kestrel Way  
Sowton Industrial Estate  
EXETER  
EX2 7LQ

Phone: [REDACTED]

Fax: [REDACTED]

## 1.7 Date of Inspection

The Inspection was carried out on 24<sup>th</sup> May 2022 and was attended by the following:

- [REDACTED] Forestry England
- [REDACTED] Stillwater Associates

## 1.8 Name and Address of the Supervising Engineer

[REDACTED]  
Stillwater Associates Limited  
Chapter House  
33 London Road  
Reigate  
Surrey  
RH2 9HZ

Tel: [REDACTED]

Mobile: [REDACTED]

Email: [REDACTED]

As the reservoir was only registered in 2022 [REDACTED] is the first Supervising Engineer.

[REDACTED] combined the S10 Inspection and annual Supervising Engineer's visit on the 24<sup>th</sup> May 2022.

## **2 INFORMATION PROVIDED TO THE INSPECTING ENGINEER**

### **2.1 Reports and Certificates**

There are no previous statutory reports or certificates for Upper Cannop Pond.

### **2.2 Reservoir Record**

There is no Prescribed Form of Record (PFR) available for Upper Cannop Pond.

### **2.3 Supervising Engineer's Statements under Section 12**

There are no previous Supervising Engineer statements for Upper Cannop Pond.

### **2.4 Other Information**

Various other documents and background information on the reservoir were provided and have been referred to during the preparation of this report. These documents are listed as follows:

- Upper Cannop Pond – Notification of provisional high risk designation letter, 5<sup>h</sup> April 2022 (Environment Agency).
- Upper Cannop Pond - Pre-Section 10 Visit Report, 11<sup>th</sup> March 2022 (Binnies).
- Upper Cannop Pond - Flood Study, January 2022 (Binnies).
- Topographic and bathymetric survey of Upper Cannop Pond, November 2021(H D Surveying).
- Upper Cannop Pond – Dam Visit Report Statement, 18<sup>th</sup> February 2021 (Forestry England).
- Upper Cannop Pond – Sketch, 18<sup>th</sup> February 2021 (Forestry England).
- Upper Cannop Pond – Dam Visit Report Statement, 23<sup>rd</sup> April 2018 (Forestry England).

### **3 DESCRIPTION OF THE RESERVOIR**

#### **3.1 General**

##### **3.1.1 Information on the Reservoir**

Upper Cannop Pond is a conventional impounding reservoir that is located in the forest of Dean, about 8km north of Lydney, Gloucestershire, as shown in Figure 3.1.

The reservoir was constructed in 1829 to support the increasing power demands associated with the expansion and modernisation of the Parkend Ironworks south of the reservoir. It followed the construction of Lower Cannop in 1825, which fed water, via a leet, to the ironworks to power a waterwheel. The reservoirs have since also served the needs of the stone cutting, wood distillation, and railways industries.

Upper Cannop Pond is the uppermost reservoir in a series of two reservoirs in cascade on the Cannop Brook. Lower Cannop Pond, a registered large raised reservoir, is located about 150m downstream of Upper Cannop Pond dam. The distance between the Upper and Lower Cannop Pond embankment dams is approximately 750m.

The reservoir is broadly rectangular in shape and is aligned roughly north south. The spillway is located on the east side of the embankment dam (left abutment) and outflows pass into Lower Cannop Pond via a small brook. The reservoir is divided into two connected ponds by an embankment 'causeway' that was constructed around 1984 to create a 'silt settling lagoon' to the north of the causeway. A 2.5m wide opening in the causeway joins the two ponds. The opening consists of a deep masonry walled channel structure spanned by a timber footbridge. The pond to the north of the causeway is part of the Cannop Marsh Nature Reserve.

According to the bathymetric survey carried out in 2021 by H R Surveying (in Appendix B), the capacity of the reservoir is 27,972m<sup>3</sup> when it is full to a Top Water Level (TWL) of 69.04m AOD (Above Ordnance Datum), however this volume is only that of the section of the reservoir south of the causeway. The volume includes soft silt. At this level the total surface water area of the south section of the reservoir is 18,053m<sup>2</sup>.





**Figure 3.1: Location map of Upper Cannop Pond**

Key levels are given in Table 3.1. Available photographs taken during this Inspection are included in Appendix A.

**Table 3.1: Key dimensions and levels relating to Upper Cannop Pool**

Feature	Units	Value	Source/comment
<b>Dimensions</b>			
Reservoir capacity	m <sup>3</sup>	27,972	2021 bathymetric survey
Reservoir area at TWL	m <sup>2</sup>	18,053	2021 topographic survey
Catchment area	km <sup>2</sup>	12.64	FEH Website
Embankment crest length	m	170	2021 topographic survey
Spillway weir width	m	8.7	2021 topographic survey
<b>Levels</b>			
Embankment crest level (minimum)	m AOD	69.54	2021 topographic survey
Spillway weir level (TWL)	m AOD	69.04	2021 topographic survey
Minimum Freeboard (relative to TWL)	m	0.5	

### 3.1.2 Details of Modifications, Remedial Works and History

The following modifications / repairs are known to have been undertaken at Upper Cannop Pond:

Date	Modification / Repair works
1829	An earth embankment dam was constructed upstream across Cannop Brook to form <b>Upper Cannop Pond</b> . The pond was used by Cannop Colliery with water pumped into the stream which feeds the pond.
1907	Following reports of [REDACTED] the dams were in a poor state or repair. Significant repair works and modifications were undertaken to make the dams safe and raise the water level by approximately 4ft, enabling additional use by the Bixlade Stone Works (now the Forest of Dean Stone Firms Ltd).
1958	Towards the end of use of the reservoirs for industrial purposes (Wood Distillery demolished in 1966), Upper Cannop reservoir appears to have been largely drained with only a minimal area of water remaining. Lower Cannop remained at its raised level.
1965	Reports of [REDACTED] and costly remedial measures required.
1968	Cannop Colliery closes. Reports of significant siltation of the pond [REDACTED] [REDACTED] Reports of angling club involvement with the lake.
1973	Repair works to Upper and Lower Cannop dam recorded. [REDACTED] [REDACTED] It is likely this was also when Upper Cannop reservoir was returned to its current water level.
1984	An embankment 'causeway' that was constructed to provide a silt settling lagoon to the north of the causeway. This divided the pond into two water bodies that are joined via a 2.5m wide opening in the causeway. The opening consists of a masonry walled structure spanned by a timber footbridge.
2019	Embankment upstream slope protection works including placement of randomly placed stone revetment.
2020	Tree removal works and vegetation management at the downstream toe of embankment.

### 3.1.3 Current Use

The reservoir is maintained as an amenity lake and accommodates an active angling club. The northern part of the reservoir forms part of the Cannop Bridge Marsh nature reserve, which is managed by the Gloucestershire Wildlife Trust.

## 3.2 Geology

According to the British Geological Survey maps, the reservoir is underlain by sedimentary rock of the Cinderford Member including mudstone, siltstone and sandstone formed between during the Carboniferous period. The formation is mainly grey mudstone and siltstone, with some reddening, coal and sandstone. The lower part of the succession is dominantly argillaceous and included relatively thick coals, including the Brazilly and Crow coals. The middle part of the member includes the Serridge Sandstone, which passes from exclusively sandstone in the north to interbedded sandstone and shale to the south. The upper argillaceous part of the member includes further coal seams (Woodgreen Coals).

The Cinderford Member is overlain by alluvium consisting of clay, silt, sand and gravel formed during the Quaternary period.

There are two geological faults running north to south either side of Upper Cannop Pond. The fault to the west of the reservoir is the closest and runs approximately 20m west of the embankment right abutment.

As part of the preparation of this Section 10 report a 'Coal Mining Report' was requested through Landmark (Envirocheck) and provided by The Coal Authority. According to the official mining information records held by the Coal Authority at the time of preparation of this report there is evidence of, or the potential for, coal mining related features near to Upper Cannop Pond. A summary of the findings of the report is provided below in relation to the area around the Upper Cannop Pond embankment dam:

- The property is in a surface area that could be affected by underground mining in 1 seam of coal at 210m to 260m depth, and last worked in 1954. Any movement in the ground due to coal mining activity associated with these workings should have stopped by now.
- The property is not within a surface area that could be affected by present underground mining.
- The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods.
- The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.
- The property is not in an area likely to be affected from any planned future underground coal mining. However, reserves of coal exist in the local area which could be worked at some time in the future.
- No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.
- There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.
- The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.
- The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since the 31<sup>st</sup> October 1994.

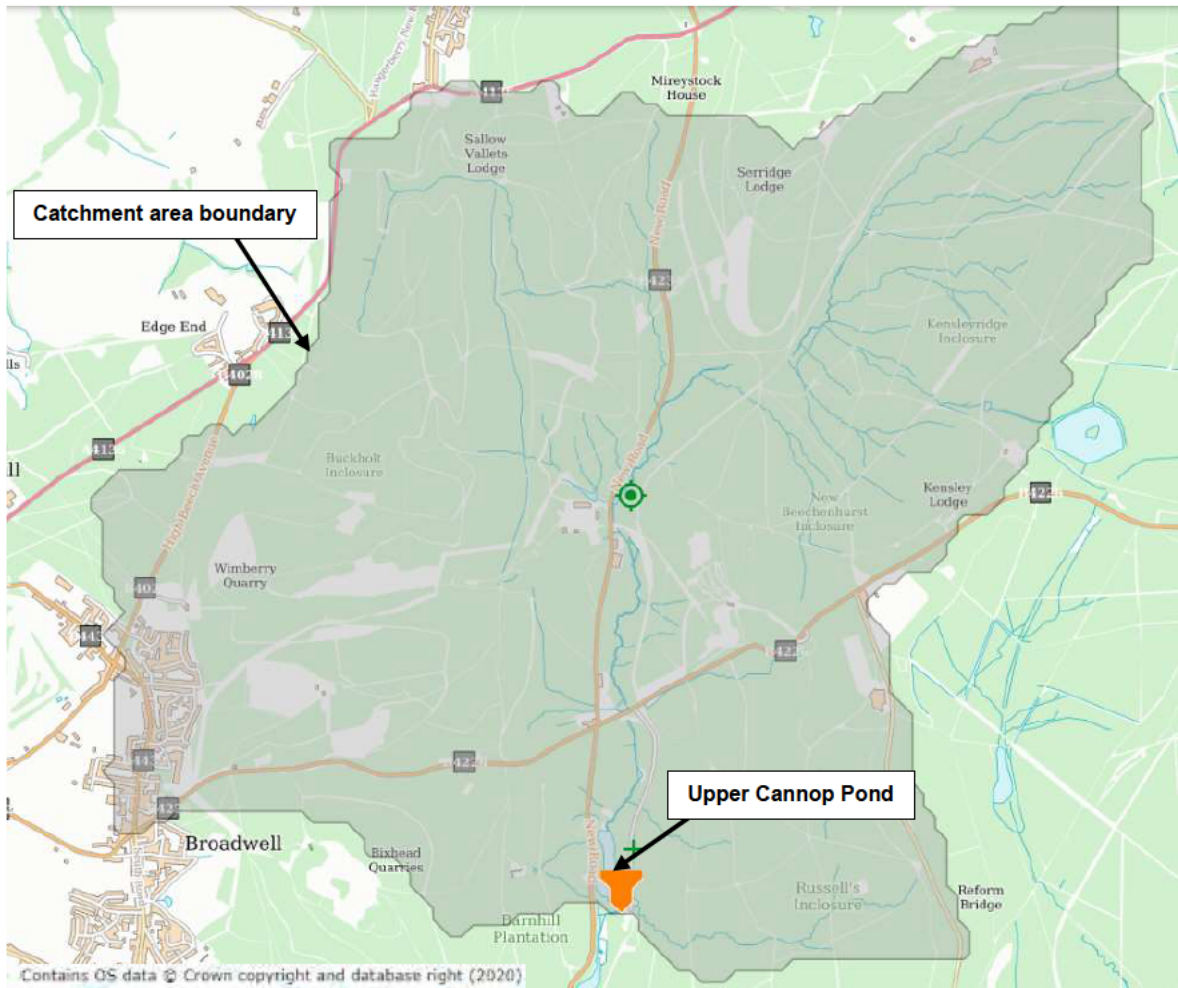
### 3.3 Catchment

Upper Cannop Pond is fed from the direct catchment of the Cannop Brook. The area local to Cannop Brook was used for mine workings and this previous industry is likely to have made the catchment operation more complex as stated in the Binnies 2022 Flood Study (see Appendix C):

*'From available information there is no evidence that there are any indirect catchments that enter Upper Cannop. Information provided by Forestry England staff suggest that there is a complex system of surface channels and leats that historically diverted water away from the mines so they did not flood and some of these may enter the reservoir. Estimates of these potential flows have not been possible and no prior readings have been taken. Therefore, the findings of the report are based on the assumption that there is only the direct catchment entering Upper Cannop.'*

The direct catchment area of Upper Cannop Pond is 12.64km<sup>2</sup> according to the Flood Estimation Handbook (FEH) Web Service and this was the value adopted in the 2022 flood study.

The catchment area is shown in Figure 3.2 and consists of mostly heavily forested woodland with a small area of urban development in the west.



**Figure 3.2: Catchment area of Upper Cannop Pond (FEH, 2022)**

### 3.4 Embankment

The dam comprises a 170m long earthfill embankment with a maximum height of around 4m. The embankment is located at the south-west side of the reservoir, and in plan, has a linear alignment with an approximate south-east (left) to north-west (right) direction.

There are no details available to show the construction details or the internal arrangement of the dam. However, given its age it is likely that it is a simple, homogeneous structure that was built from locally won silty clay material.

#### 3.4.1 Upstream face

The upstream face slope is not known as this is generally submerged beneath the water and the margin between the dam crest and the waterline is partially hidden beneath reeds and vegetation. The upstream face includes sandstone blocks that form a sub-vertical wall at the reservoir TWL. The voids between the blocks are filled with 50mm diameter stone. The vegetation on the upstream face is managed but significant regrowth of some trees is evident.

### 3.4.2 Crest

The embankment crest width varies from around 2m up to around 5m in places. An earth / stone footpath is present along the embankment crest and the verges either side of the path are grassed.

### 3.4.3 Downstream face

The slope of the downstream face varies across the length of the embankment with various undulations however the steepest slope is around 2H:1V. The downstream face is clear of trees but covered in a variety of thick low growing vegetation. There are a lot of old tree stumps on the downstream face.

Several large cut tree logs are located just off the toe of the embankment.

## 3.5 Spillway

The spillway is located on the left abutment and consists of a 8.7m wide broad crested masonry weir and spillway chute that tapers slightly as it passes over the embankment crest and then drops away into a stilling basin at the toe of the embankment. The spillway chute is around 8m wide at its narrowest and has a slope of around 20H:1V as it passes over the crest then steepens to around 8H:1V as it drops away to the toe of the stilling basin at the toe of the chute. The spillway chute walls are around 0.9m high.

The stilling basin is formed by a smaller weir on the brook approximately 20m downstream of the toe of the spillway chute. Flow from the spillway is turned through around 50 degrees at the stilling basin and is directed towards the centre of the embankment via an unlined, meandering, channel. The channel eventually joins the original brook alignment around 50m downstream of the toe of the embankment.

## 3.6 Outlets

There are no known operational outlets at the reservoir. [REDACTED]

[REDACTED]

## 3.7 Inlets

There are no formal inlet structures at the headwaters of the reservoir that are designed to control inflows into Upper Cannop Pond.

There are several pipes that could restrict flows from the catchment to the east of the reservoir behind a small embankment that forms the access road to the left abutment, formally a railway embankment. The arrangement consists of two 450mm diameter and one 300mm diameter HDPE twinwall pipes. It is understood that there was once a direct hydraulic connection between this area to the east of the access road and the reservoir, as indicated in the old map from 1878 in Figure 3.3. It is to be noted that the 1959 OS map shows a much reduced reservoir footprint to that shown in Figure 3.3, however this was subsequently reinstated to the current footprint which is similar to that in Figure 3.3.



**Figure 3.3: 1878 map of Upper Cannop Pond**

### **3.8 Instrumentation**

There is no internal or external instrumentation installed at the dam.

### **3.9 Access**

Vehicle access to the east side of the reservoir and the embankment left abutment is via a forestry track off the B4226 (Speech House Road) to the north of the reservoir.

Vehicle access near to the west side of the reservoir, and the embankment right abutment, is directly off the B4234 (New Road) to the west of the reservoir. However, there is very limited vehicle parking along the B4234.

Access to the remainder of the embankment can only be made on foot.

### **3.10 Downstream Conditions**

Outflows from the spillway discharge into Lower Cannop Pond reservoir approximately 150m to the south. Downstream of Upper Cannop Pond is a narrow valley that contains the B4234 (New Road). Approximately 2km downstream of Upper Cannop Pond the valley opens out to the village of Parkend. The village of Whitecroft is another 1.5km downstream.

## 4 CONDITION OF THE RESERVOIR

### 4.1 General

I inspected the reservoir on 24<sup>th</sup> May 2022. The weather at the time of the visit was fine and mild with some cloud and a temperature of around 15°C. There was very little wind and hence the surface of the reservoir was calm. The conditions for carrying out the inspection were good.

I was accompanied by:

- [REDACTED] Forestry England
- [REDACTED] Stillwater Associates

The reservoir was full at the time of the inspection with approximately 20mm depth of flow over the spillway.

A number of photographs were taken during the inspection and a selection of these is included in Appendix A to illustrate the conditions that were observed.

### 4.2 Catchment Area

The immediate catchment upstream of the reservoir was viewed during the visit and there did not appear to be any major recent changes.

The wider catchment was viewed by driving around the catchment and viewing recent aerial photography. There did not appear to be any major recent changes within the catchment.

### 4.3 Embankment

#### 4.3.1 Upstream face

The upstream face could only be inspected above water level and a detailed inspection was not possible due to the extent of vegetation. However, from what could be seen, the upper section of the upstream face appeared to be in a reasonable condition with no clear signs of any significant settlement, movement or damage due to wave action. The current erosion protection along the upstream face consists of large stone blockwork infilled with smaller stone. The blockwork appeared to be in a satisfactory condition and reducing wave erosion of the face.



#### 4.3.2 Crest

The crest is in a satisfactory condition with a reasonable line and level. The majority of the crest is at a level of around 70m AOD although the right end of the embankment is generally higher than this and the left, by the spillway, is lower. The lowest point of the embankment is immediately to the left of the spillway (69.54m AOD).

The footpath roughly follows the crest of the embankment and whilst in a good condition it is mainly of stone and bare earth which could be susceptible to erosion over time. The grass verges on either side of the footpath were well kept.

#### 4.3.3 Downstream face

The downstream face of the embankment is undulating with several changes in slope across the length of the embankment and is relatively steep in places.

The face is covered in variety of thick low growing vegetation including ferns, bracken, brambles, sedges, reeds and some saplings. There are a lot of old tree stumps on the downstream face where it appears that the large trees were cut down in the past but the stumps and root balls were left in place.

[REDACTED]

**I recommend that grass growth be encouraged on the downstream face of the embankment through regular cutting and that it be maintained at a length of between 50mm and 200mm to allow adequate inspection.**

It is understood that there are wild boar in the area and that they can dig in embankments and disturb grass cover. Whilst there were no specific signs of this during the visit, **I recommend that wild boar activity be monitored at the reservoir and appropriate action be taken if damage to the embankment is occurring.**

[REDACTED]

The toe of the embankment is also covered in thick low growing vegetation and a lot of large cut tree logs which again makes adequate inspection difficult. The toe did appear to be relatively wet with standing water in areas but the whole area downstream of the embankment is low lying and marshy and is unlikely to drain well. There were no signs of flowing or discoloured / turbid water in the area.

**I recommend that all tree logs be removed from at least 5m out from the toe of the embankment and grass growth be encouraged through regular cutting and that it be maintained at a length of between 50mm and 200mm to allow adequate inspection.**

[REDACTED]

In addition, there is a drainage ditch downstream of the right embankment mitre associated with a drainage pipe that passes under the B4234. It appears that this pipe takes drainage flows from the catchment on the west side of the road. This drain could bring a reasonable amount of water into the area downstream of the embankment so it is essential that it is maintained so that it does not contribute to the drainage issues in the area as far as possible. **I recommend that the drainage ditch from the pipe that passes under the B4234 downstream of the right abutment is maintained to assist the drainage of the area and take water away from the embankment.**

4.4

[REDACTED]



[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

#### 4.5 Outlets

There are no operable outlets at the reservoir. [Redacted]  
[Redacted]  
[Redacted]

#### 4.6 Reservoir Rim Stability

There did not appear to be any movement of surrounding land which might affect the stability of the reservoir.

#### 4.7 Area Downstream of the Reservoir

The valley downstream of the reservoir is described in Section 3.10. There does not appear to have been any recent major changes to the properties or land use downstream of the reservoir that would affect its flood categorisation.

## 5 ADEQUACY OF THE DAM

### 5.1

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

### 5.2

[REDACTED]

[REDACTED]

[REDACTED]

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**5.2.2** [Redacted text]

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[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

**5.3**

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



#### 5.4 Adequacy under Seismic Loading

Seismic risk to UK dams is assessed using “*An application note to an engineering guide to seismic risk to dams in the United Kingdom*” published in 1998 by the ICE. This amplified and to a large extent superseded, the original guide published by BRE in 1991.

From Figure N1 of the application note the reservoir is situated in a zone of the UK where the expected peak horizontal ground acceleration for a 1 in 10,000 probability event would be approximately 0.16g. One then needs to assess the dam category based on the classification factors stated in Table G2 of the application note as summarised in Table 5.3.

**Table 5.3: Seismic Classification Factors for Upper Cannop Pond**

Parameter	Value	Classification Factor
Capacity	27,972m <sup>3</sup>	0
Height	4.0m	0
Evacuation Requirements	1000 - 100	4
Potential Damage	Moderate	8
<b>TOTAL</b>		<b>12</b>

Table G3 of the application note then produces a Dam Category of II for Upper Cannop Pond, from which Table N4 of the application note prescribes a Safety Evaluation Earthquake (SEE) of 1 in 3,000 years. This is much less than the 1 in 10,000 probability values given in Figure N1 and while comparisons are imprecise, some indication of the likely relationship between the two is given in Tables N1 and N2 of the application note. These would indicate a likely SEE for Upper Cannop Pond of approx. 0.1g.

Finally, Table N5 of the application note indicates that for a Category II embankment less than 15m high, evaluation type Eb would be appropriate. This recommends looking “*for features particularly vulnerable to earthquake damage and undertaking seismic analyses only if such features are found*”.

The embankment dam is a low structure, and there are no features associated with the dam that could be considered as being particularly susceptible to damage by earthquake. From the inspection made and the conditions observed, it is considered that the dam stability would be satisfactory under these conditions. Any loss of freeboard that might arise from earthquake induced settlement is also likely to be small.

Taking the above points into account it is considered that the situation is satisfactory and no further action is needed on this matter.

**5.5**

[Redacted text block]

**5.6 Adequacy of Access Provisions**

The access arrangements are described in Section 3.9 and I consider these to be adequate.

## 6 SUPERVISION PROVIDED BY THE UNDERTAKER

### 6.1 Correctness of the particulars in the Reservoir Record

There is currently no Prescribed Form of Record for the reservoir. **I recommend that a Prescribed Form of Record is prepared for the reservoir in the high-risk format to the satisfaction of the Supervising Engineer.**

The currently available bathymetric survey is only of the south section of Upper Cannop Pond. As the north part of the pond is also part of the reservoir, as there is a direction connection between the two parts, **I recommend that an estimate of the water and silt volume, and surface area, of the north section of Upper Cannop Pond be carried made in order to establish the entire volume and surface area of the reservoir. Once established, the values are to be recorded in the Prescribed Form of Record.**

### 6.2 Method of Recording Water Levels

Water levels in the reservoir are not currently being recorded. There is currently no means of accurately recording the water level in the reservoir.

**I recommend that a water level gauge board is installed at the site to allow accurate water level readings, to the satisfaction of the Supervising Engineer.**

**I recommend that reservoir water levels are taken at least on a monthly basis and recorded in Part 1 of the PFR, together with any unusually high or low reservoir levels.**

### 6.3 Instrumentation

There is no internal or external instrumentation installed at the dam, which I consider satisfactory.

### 6.4 Frequency of surveillance by Undertaker

The Supervising Engineer visits once a year. Maintenance staff visit the site on a weekly basis to ensure there are no obvious problems at the reservoir. The reservoir is also visited at times of heavy rainfall when there is a risk of flooding. **I recommend that surveillance visits of the reservoir continue to be undertaken at least monthly and that a simple record sheet is used by the Undertaker to formally record these visits, using a format to be agreed with the Supervising Engineer.**

In the event of heavy rainfall, high winds, or exceptional storm conditions, then the frequency of walkovers should be increased to daily to check the conditions in the aftermath of the storm. **I recommend that surveillance visits of the reservoir are undertaken daily during heavy rainfall, high winds, or exceptional storm conditions.**

If there are any significant changes in the conditions observed, or any developments which are of concern, then the Supervising Engineer should be informed. Regular communication and liaison between the Undertaker and the Supervising Engineer is an important part of ongoing supervision and surveillance.

### 6.5

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



## 7 RECOMMENDATIONS OF THE ENGINEER

### 7.1 Statement in relation to previous Measures to be taken in the Interests of Safety

This is the first statutory inspection of the reservoir and therefore there are no previous recommendations made in the interests of safety.

### 7.2 Recommendations as to Measures to be taken in the Interests of Safety under Section 10(3)(c) (mandatory)

I recommend that:

- a) [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

- [REDACTED]
- [REDACTED]

### **7.3 Other Measures Recommended to be taken but not requiring Supervision by a Qualified Civil Engineer**

I recommend that:

- a) the trees and shrubs on the upstream embankment face be removed and cut stumps be treated with a suitable herbicide to prevent regrowth.
- b) wild boar activity be monitored at the reservoir and appropriate action be taken if damage to the embankment is occurring.

### **7.4 Matters of Maintenance under Section 10(3)(b) (mandatory)**

I recommend that:

- a) the drainage ditches downstream of the embankment are cleared within 6 months and maintained when required to assist the drainage of the area and take water away from the embankment.
- b) the drainage ditch from the pipe that passes under the B4234 downstream of the right abutment is cleared within 6 months and maintained when required to assist the drainage of the area and take water away from the embankment.

### **7.5 Other Matters of Maintenance and Safety of Personnel / Public**

I recommend that:

- a) grass growth be encouraged on the downstream face of the embankment through regular cutting and that it be maintained at a length of between 50mm and 200mm to allow adequate inspection.
- b) all tree logs be removed from at least 5m out from the toe of the embankment and grass growth be encouraged through regular cutting and that it be maintained at a length of between 50mm and 200mm to allow adequate inspection.

### **7.6 Matters to be watched by the Supervising Engineer in accordance with Section 10(4)**

In addition to surveillance in accordance with good practice such as 'An Engineering Guide to Safety of Embankment dams in the UK' (BRE, 1999, 2<sup>nd</sup> Edition) the following specific matters are identified for the guidance of the Supervising Engineer.

I recommend that the Supervising Engineer visits the site at least once a year and pays attention to any leakage, seepage, instability and / or settlement and in particular ensures that:

- a) the PFR is kept up to date.
- b) the water levels are measured at least monthly and recorded in the PFR.

- c) a simple record sheet is used by the Undertaker to formally record monthly visits, using a format to be agreed with the Supervising Engineer.
- d) once established, the embankment downstream face grass cover is maintained between 50mm and 200mm in length to facilitate inspection and surveillance.
- e) a careful watch be made for damp or wet areas on the embankment downstream face and toe.
- f) a careful watch be made for any areas of embankment instability.
- g) a careful watch be made for damage to the spillway and stilling basin.
- h) A careful watch be made for signs of damage to the embankment by wild boar.

### 7.7 Directions in respect of Records under Section 11(2) of the Act (mandatory)

I recommend that:

- a) a Prescribed Form of Record is prepared for the reservoir in the high-risk format to the satisfaction of the Supervising Engineer.
- b) an estimate of the water and silt volume, and surface area, of the north section of Upper Cannop Pond be carried made in order to establish the entire volume and surface area of the reservoir. Once established, the values are to be recorded in the Prescribed Form of Record.
- c) a water level gauge board is installed at the site to allow accurate water level readings, to the satisfaction of the Supervising Engineer.
- d) reservoir water levels are taken at least on a monthly basis and recorded in Part 1 of the PFR, together with any unusually high or low reservoir levels.
- [REDACTED]
- f) surveillance visits of the reservoir continue to be undertaken at least monthly and that a simple record sheet is used by the Undertaker to formally record these visits, using a format to be agreed with the Supervising Engineer
- g) daily surveillance visits of the reservoir are undertaken during heavy rainfall, high winds or exceptional storm conditions.

### 7.8 Date of the next inspection under Section 10

The next inspection by an Inspecting Engineer under Section 10(2) of the Act should be undertaken within 10 years of the date of this inspection, i.e. before 24<sup>th</sup> May 2032.

Signe

[REDACTED]

Date: 29<sup>th</sup> November 2022

Member of Panel AR, as constituted under the Reservoirs Act 1975  
(Current appointment to AR Panel expires 19<sup>th</sup> July 2026)

## Appendix A - Photographs



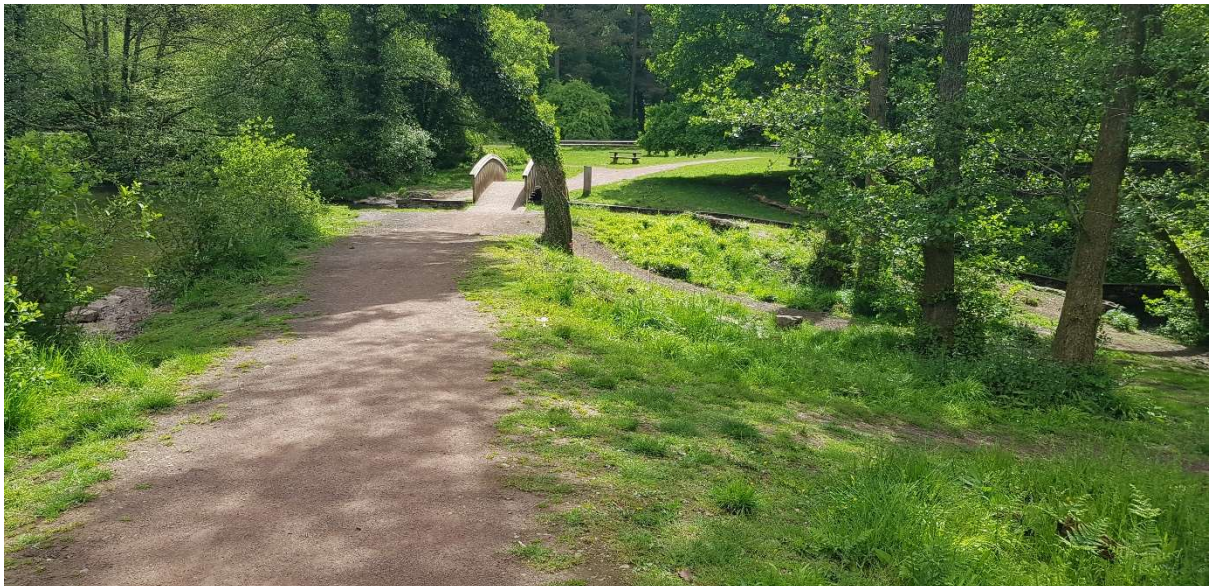
***Photograph 1: General view of embankment***



***Photograph 2: Embankment upstream face with stone block protection and vegetation growth***



***Photograph 3: Embankment crest***



***Photograph 4: Embankment crest looking towards spillway on left abutment***



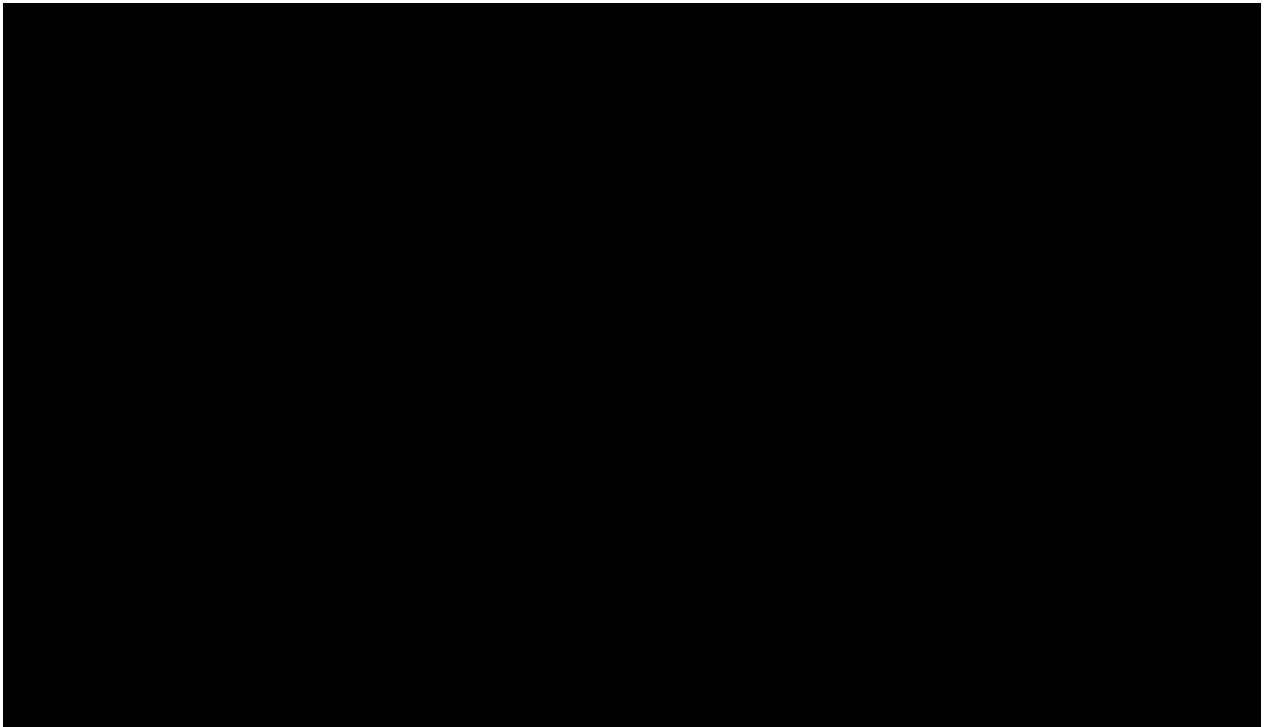
***Photograph 5: Embankment downstream face with significant vegetation growth***



***Photograph 6: Embankment downstream toe with significant vegetation growth and cut tree logs***



***Photograph 7: Wet area downstream of embankment toe***





***Photograph 9: Exit to culvert passing under B4234 and discharging to area downstream of embankment right mitre***

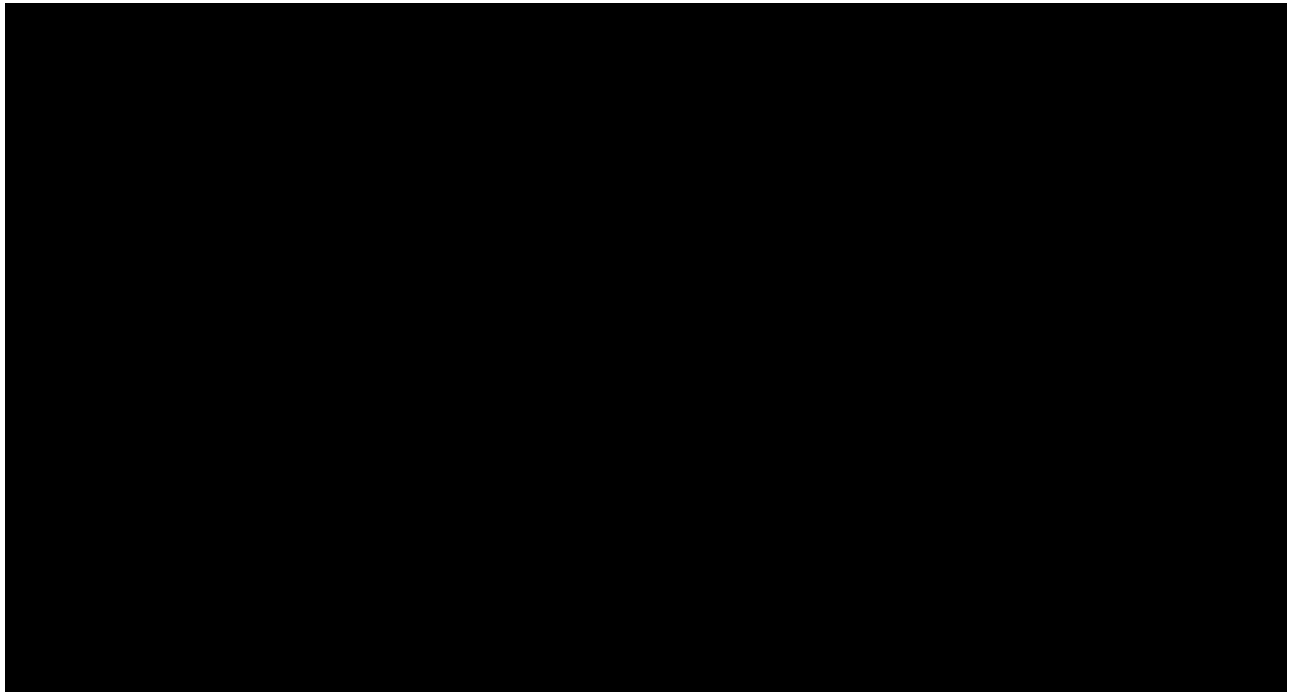


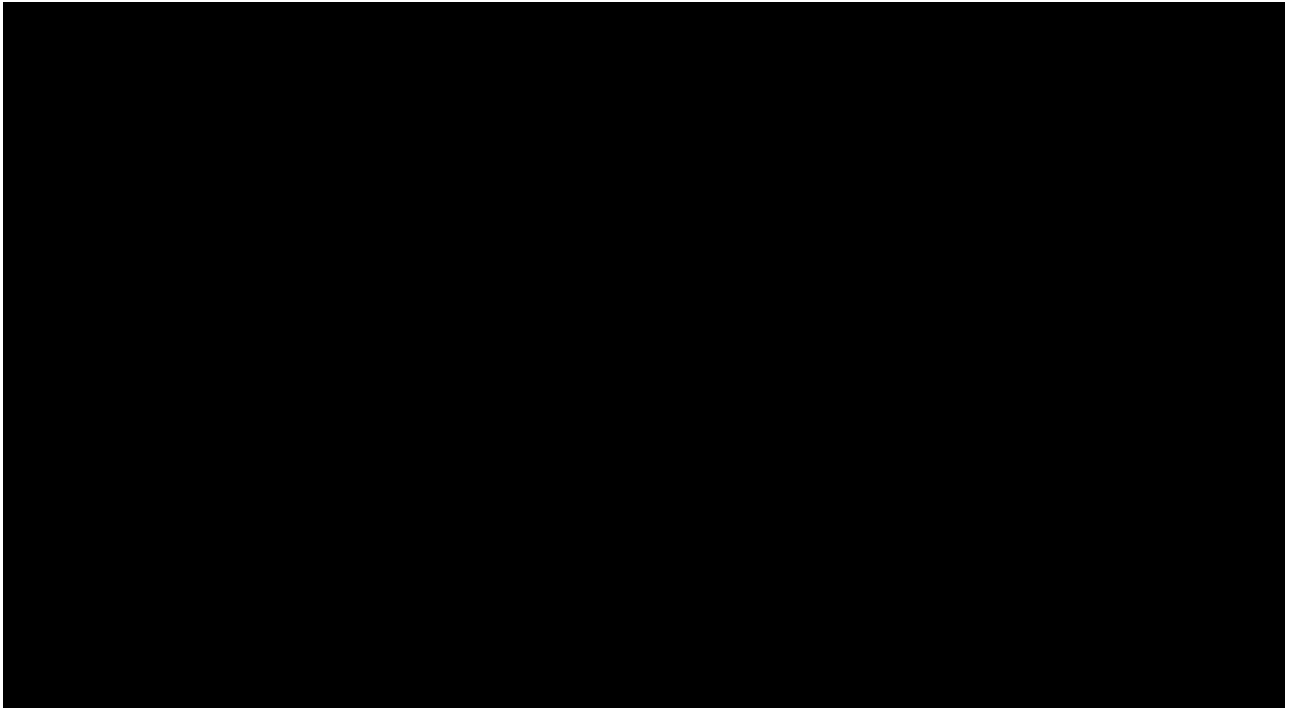
***Photograph 10: Spillway weir***





**Photograph 11: Spillway chute**

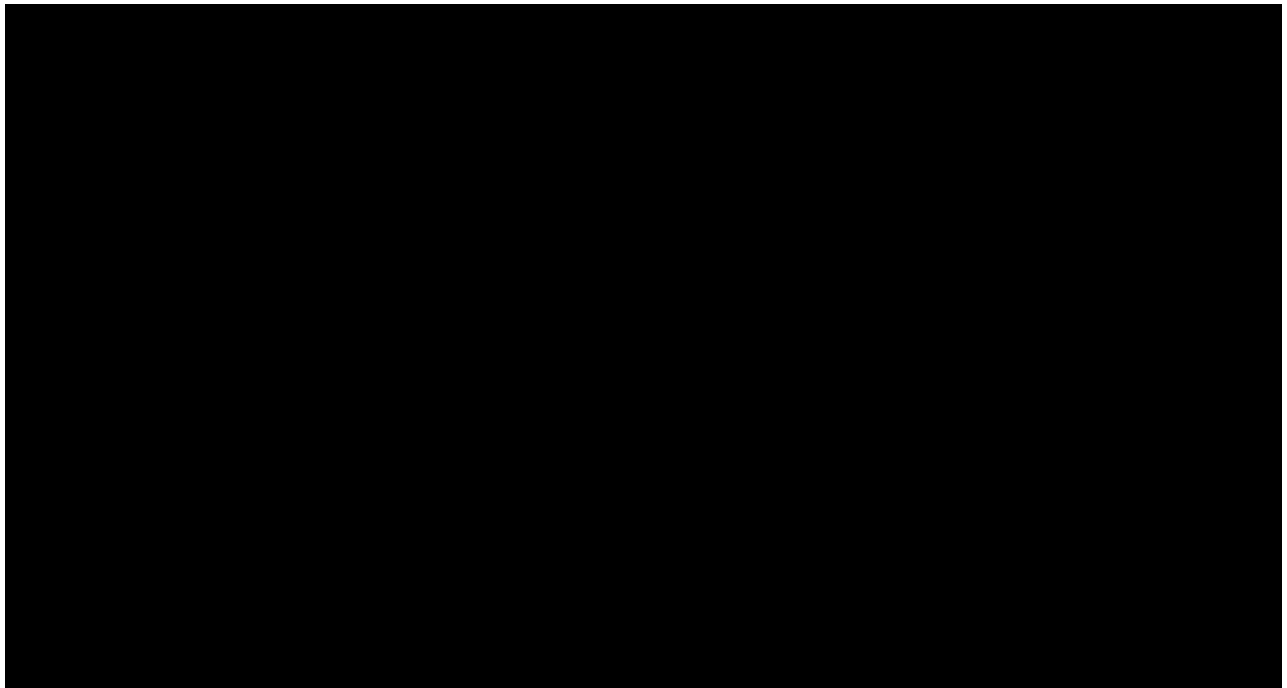




***Photograph 14: Spillway stilling basin***



***Photograph 15: Spillway stilling basin weir and downstream channel***





***Photograph 17: Culverts under road embankment near to left abutment bringing flows from eastern catchment into reservoir during high rainfall***



***Photograph 18: Causeway embankment dividing the north and south sides of the pond***



***Photograph 19: Channel through causeway embankment joining the north and south sides of the pond***

## **Appendix B - Section 26(2) Annex**

**Forestry England**  
**Upper Cannop Pond**  
**Lydney, Gloucestershire**

**Annex under Section 26(2) of the**  
**Reservoirs Act 1975**

**December 2022**

Client:	Forestry England
Project:	Upper Cannop Pond
Document Title:	Annex under Section 26(2) of the Reservoirs Act 1975
Project No:	P2380

ORIGINAL	Originator	Checked by	Reviewed by
Signature:			
Issue Date:	7 <sup>th</sup> December 2022		
Document Status	Final		

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In producing this report, Stillwater Associates has relied upon information provided by others. The completeness or accuracy of this information is not guaranteed by Stillwater Associates.



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## 1 GENERAL

### 1.1 Scope of Report

This is annex under Section 26(2) to a Section 10 of the Reservoirs Act 1975.

### 1.2 Name and Situation of Reservoir

Upper Cannop Pond is located in the Forest of Dean approximately 8km north of Lydney, Gloucestershire.

National Grid Reference SO 609 109 lies within the reservoir.

### 1.3 Name and Address of Engineer Making the Report

[REDACTED]  
Stillwater Associates Limited  
Chapter House  
33 London Road  
Reigate  
Surrey  
RH2 9HZ

Office:

Home:

Mobile:

Email:

### 1.4 Panel of which the Engineer is a Member

The Engineer is a member of the All Reservoirs Panel [REDACTED] appointment to this panel is valid until 19<sup>th</sup> July 2026.

### 1.5 Name and Address of the Undertaker

Forestry England  
Bristol Business Park  
Coldharbour Lane  
Bristol  
BS16 1EJ

Contact:

Mobile:

Email:

## 1.6 Name and Address of the Enforcement Authority

Reservoir Safety - Technical Manager  
The Environment Agency  
Manley House  
Kestrel Way  
Sowton Industrial Estate  
EXETER  
EX2 7LQ

Phone: 03708 506506  
Fax: 01392 444238

## 1.7 Date of Inspection

The Section 10 inspection associated with this annex was carried out on 24<sup>th</sup> May 2022 and was attended by the following:

- [REDACTED] Forestry England
- [REDACTED] Stillwater Associates

## 1.8 Name and Address of the Supervising Engineer

[REDACTED]  
Stillwater Associates Limited  
Chapter House  
33 London Road  
Reigate  
Surrey  
RH2 9HZ

Tel: [REDACTED]  
Mobile: [REDACTED]  
Email: [REDACTED]

As the reservoir was only registered in 2022 [REDACTED] is the first Supervising Engineer.

[REDACTED] combined the S10 Inspection and annual Supervising Engineer's visit on the 24<sup>th</sup> May 2022.

## 2 DESCRIPTION OF THE RESERVOIR

### 2.1 General

#### 2.1.1 Information on the Reservoir

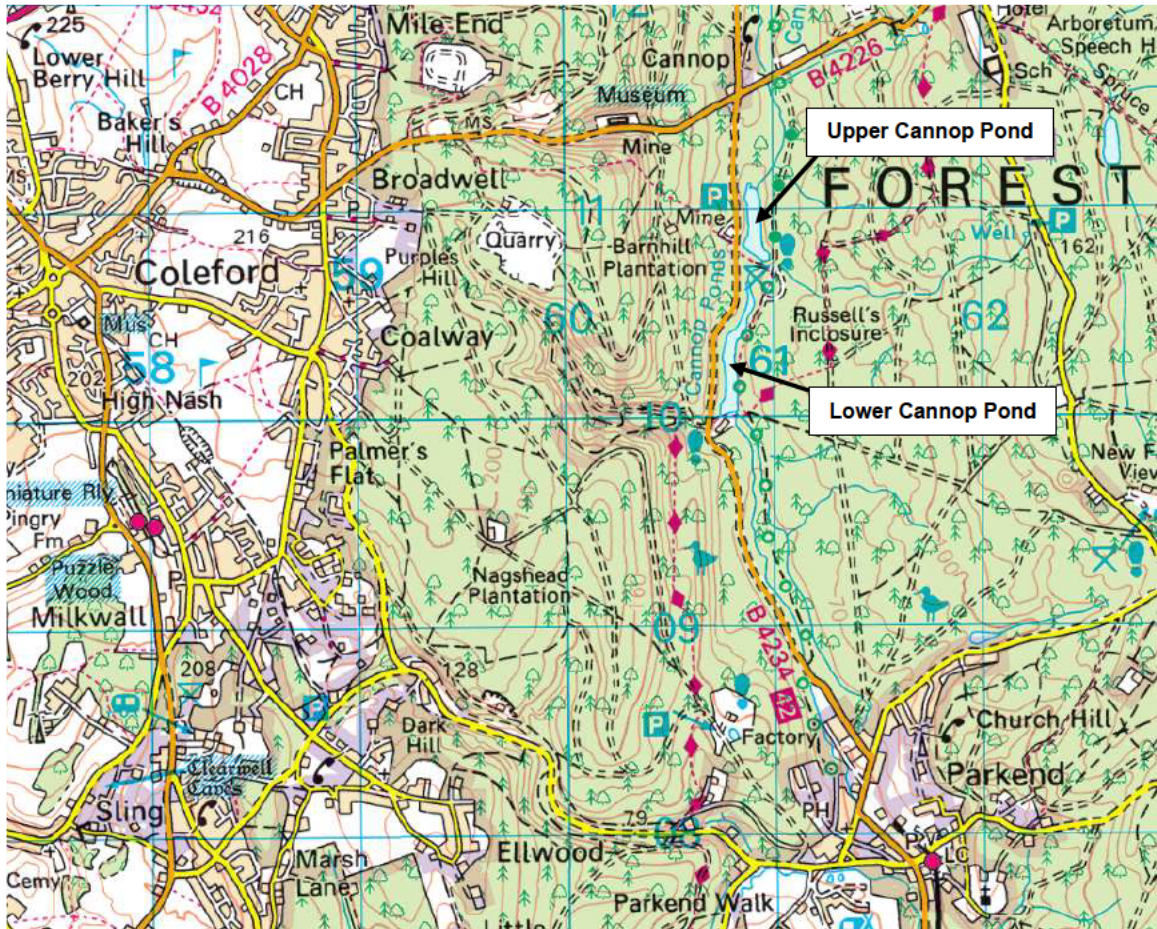
Upper Cannop Pond is a conventional impounding reservoir that is located in the forest of Dean, about 8km north of Lydney, Gloucestershire, as shown in Figure 2.1.

The reservoir was constructed in 1829 to support the increasing power demands associated with the expansion and modernisation of the Parkend Ironworks south of the reservoir. It followed the construction of Lower Cannop in 1825, which fed water, via a leet, to the ironworks to power a waterwheel. The reservoirs have since also served the needs of the stone cutting, wood distillation, and railways industries.

Upper Cannop Pond is the uppermost reservoir in a series of two reservoirs in cascade on the Cannop Brook. Lower Cannop Pond, a registered large raised reservoir, is located about 150m downstream of Upper Cannop Pond dam. The distance between the Upper and Lower Cannop Pond embankment dams is approximately 750m.

The reservoir is broadly rectangular in shape and is aligned roughly north south. The spillway is located on the east side of the embankment dam (left abutment) and outflows pass into Lower Cannop Pond via a small brook. The reservoir is divided into two connected ponds by an embankment 'causeway' that was constructed around 1984 to create a 'silt settling lagoon' to the north of the causeway. A 2.5m wide opening in the causeway joins the two ponds. The opening consists of a deep masonry walled channel structure spanned by a timber footbridge. The pond to the north of the causeway is part of the Cannop Marsh Nature Reserve.

According to the bathymetric survey carried out in 2021 by H R Surveying (in Appendix A), the capacity of the reservoir is 27,972m<sup>3</sup> when it is full to a Top Water Level (TWL) of 69.04m AOD (Above Ordnance Datum), however this volume is only that of the section of the reservoir south of the causeway. The volume includes soft silt. At this level the total surface water area of the south section of the reservoir is 18,053m<sup>2</sup>.



**Figure 2.1: Location map of Upper Cannop Pond**

Key levels are given in Table 2.1. Available photographs taken during this Inspection are included in Appendix A.

**Table 2.1: Key dimensions and levels relating to Upper Cannop Pool**

Feature	Units	Value	Source/comment
<b>Dimensions</b>			
Reservoir capacity	m <sup>3</sup>	27,972	2021 bathymetric survey
Reservoir area at TWL	m <sup>2</sup>	18,053	2021 topographic survey
Catchment area	km <sup>2</sup>	12.64	FEH Website
Embankment crest length	m	170	2021 topographic survey
Spillway weir width	m	8.7	2021 topographic survey
<b>Levels</b>			
Embankment crest level (minimum)	m AOD	69.54	2021 topographic survey
Spillway weir level (TWL)	m AOD	69.04	2021 topographic survey
Minimum Freeboard (relative to TWL)	m	0.5	

### 2.1.2 Details of Modifications, Remedial Works and History

The following modifications / repairs are known to have been undertaken at Upper Cannop Pond:

Date	Modification / Repair works
1829	An earth embankment dam was constructed upstream across Cannop Brook to form <b>Upper Cannop Pond</b> . The pond was used by Cannop Colliery with water pumped into the stream which feeds the pond.
1907	Following reports of [REDACTED] the dams were in a poor state or repair. Significant repair works and modifications were undertaken to make the dams safe and raise the water level by approximately 4ft, enabling additional use by the Bixlade Stone Works (now the Forest of Dean Stone Firms Ltd).
1958	Towards the end of use of the reservoirs for industrial purposes (Wood Distillery demolished in 1966), Upper Cannop reservoir appears to have been largely drained with only a minimal area of water remaining. Lower Cannop remained at its raised level.
1965	Reports of [REDACTED] and costly remedial measures required.
1968	Cannop Colliery closes. Reports of significant siltation of the pond [REDACTED] [REDACTED] Reports of angling club involvement with the lake.
1973	Repair works to Upper and Lower Cannop dam recorded. [REDACTED] [REDACTED] It is likely this was also when Upper Cannop reservoir was returned to its current water level.
1984	An embankment 'causeway' that was constructed to provide a silt settling lagoon to the north of the causeway. This divided the pond into two water bodies that are joined via a 2.5m wide opening in the causeway. The opening consists of a masonry walled structure spanned by a timber footbridge.
2019	Embankment upstream slope protection works including placement of randomly placed stone revetment.
2020	Tree removal works and vegetation management at the downstream toe of embankment.

### 2.1.3 Current Use

The reservoir is maintained as an amenity lake and accommodates an active angling club. The northern part of the reservoir forms part of the Cannop Bridge Marsh nature reserve, which is managed by the Gloucestershire Wildlife Trust.

## 2.2 Geology

According to the British Geological Survey maps, the reservoir is underlain by sedimentary rock of the Cinderford Member including mudstone, siltstone and sandstone formed between during the Carboniferous period. The formation is mainly grey mudstone and siltstone, with some reddening, coal and sandstone. The lower part of the succession is dominantly argillaceous and included relatively thick coals, including the Brazilly and Crow coals. The middle part of the member includes the Serridge Sandstone, which passes from exclusively sandstone in the north to interbedded sandstone and shale to the south. The upper argillaceous part of the member includes further coal seams (Woodgreen Coals).

The Cinderford Member is overlain by alluvium consisting of clay, silt, sand and gravel formed during the Quaternary period.

There are two geological faults running north to south either side of Upper Cannop Pond. The fault to the west of the reservoir is the closest and runs approximately 20m west of the embankment right abutment.

As part of the preparation of this Section 10 report a 'Coal Mining Report' was requested through Landmark (Envirocheck) and provided by The Coal Authority. According to the official mining information records held by the Coal Authority at the time of preparation of this report there is evidence of, or the potential for, coal mining related features near to Upper Cannop Pond. A summary of the findings of the report is provided below in relation to the area around the Upper Cannop Pond embankment dam:

- The property is in a surface area that could be affected by underground mining in 1 seam of coal at 210m to 260m depth, and last worked in 1954. Any movement in the ground due to coal mining activity associated with these workings should have stopped by now.
- The property is not within a surface area that could be affected by present underground mining.
- The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods.
- The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.
- The property is not in an area likely to be affected from any planned future underground coal mining. However, reserves of coal exist in the local area which could be worked at some time in the future.
- No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.
- There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.
- The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.
- The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since the 31<sup>st</sup> October 1994.

## **2.3 Embankment**

The dam comprises a 170m long earthfill embankment with a maximum height of around 4m. The embankment is located at the south-west side of the reservoir, and in plan, has a linear alignment with an approximate south-east (left) to north-west (right) direction.

There are no details available to show the construction details or the internal arrangement of the dam. However, given its age it is likely that it is a simple, homogeneous structure that was built from locally won silty clay material.

### **2.3.1 Upstream face**

The upstream face slope is not known as this is generally submerged beneath the water and the margin between the dam crest and the waterline is partially hidden beneath reeds and vegetation. The upstream face includes sandstone blocks that form a sub-vertical wall at the reservoir TWL. The voids between the blocks are filled with 50mm diameter stone. The vegetation on the upstream face is managed but significant regrowth of some trees is evident.

### 2.3.2 Crest

The embankment crest width varies from around 2m up to around 5m in places. An earth / stone footpath is present along the embankment crest and the verges either side of the path are grassed.

### 2.3.3 Downstream face

The slope of the downstream face varies across the length of the embankment with various undulations however the steepest slope is around 2H:1V. The downstream face is clear of trees but covered in a variety of thick low growing vegetation. There are a lot of old tree stumps on the downstream face.

Several large cut tree logs are located just off the toe of the embankment.

## 2.4 Spillway

The spillway is located on the left abutment and consists of a 8.7m wide broad crested masonry weir and spillway chute that tapers slightly as it passes over the embankment crest and then drops away into a stilling basin at the toe of the embankment. The spillway chute is around 8m wide at its narrowest and has a slope of around 20H:1V as it passes over the crest then steepens to around 8H:1V as it drops away to the toe of the stilling basin at the toe of the chute. The spillway chute walls are around 0.9m high.

The stilling basin is formed by a smaller weir on the brook approximately 20m downstream of the toe of the spillway chute. Flow from the spillway is turned through around 50 degrees at the stilling basin and is directed towards the centre of the embankment via an unlined, meandering, channel. The channel eventually joins the original brook alignment around 50m downstream of the toe of the embankment.

## 2.5 Outlets

There are no known operational outlets at the reservoir. [REDACTED]

[REDACTED]

## 2.6 Inlets

There are no formal inlet structures at the headwaters of the reservoir that are designed to control inflows into Upper Cannop Pond.

There are several pipes that could restrict flows from the catchment to the east of the reservoir behind a small embankment that forms the access road to the left abutment, formally a railway embankment. The arrangement consists of two 450mm diameter and one 300mm diameter HDPE twinwall pipes. It is understood that there was once a direct hydraulic connection between this area to the east of the access road and the reservoir, as indicated in the old map from 1878 in Figure 2.3. It is to be noted that the 1959 OS map shows a much reduced reservoir footprint to that shown in Figure 2.3, however this was subsequently reinstated to the current footprint which is similar to that in Figure 2.3.






**Figure 2.2: 1878 map of Upper Cannop Pond**

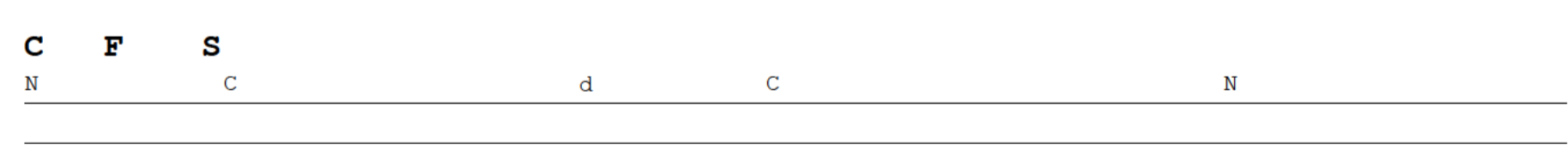
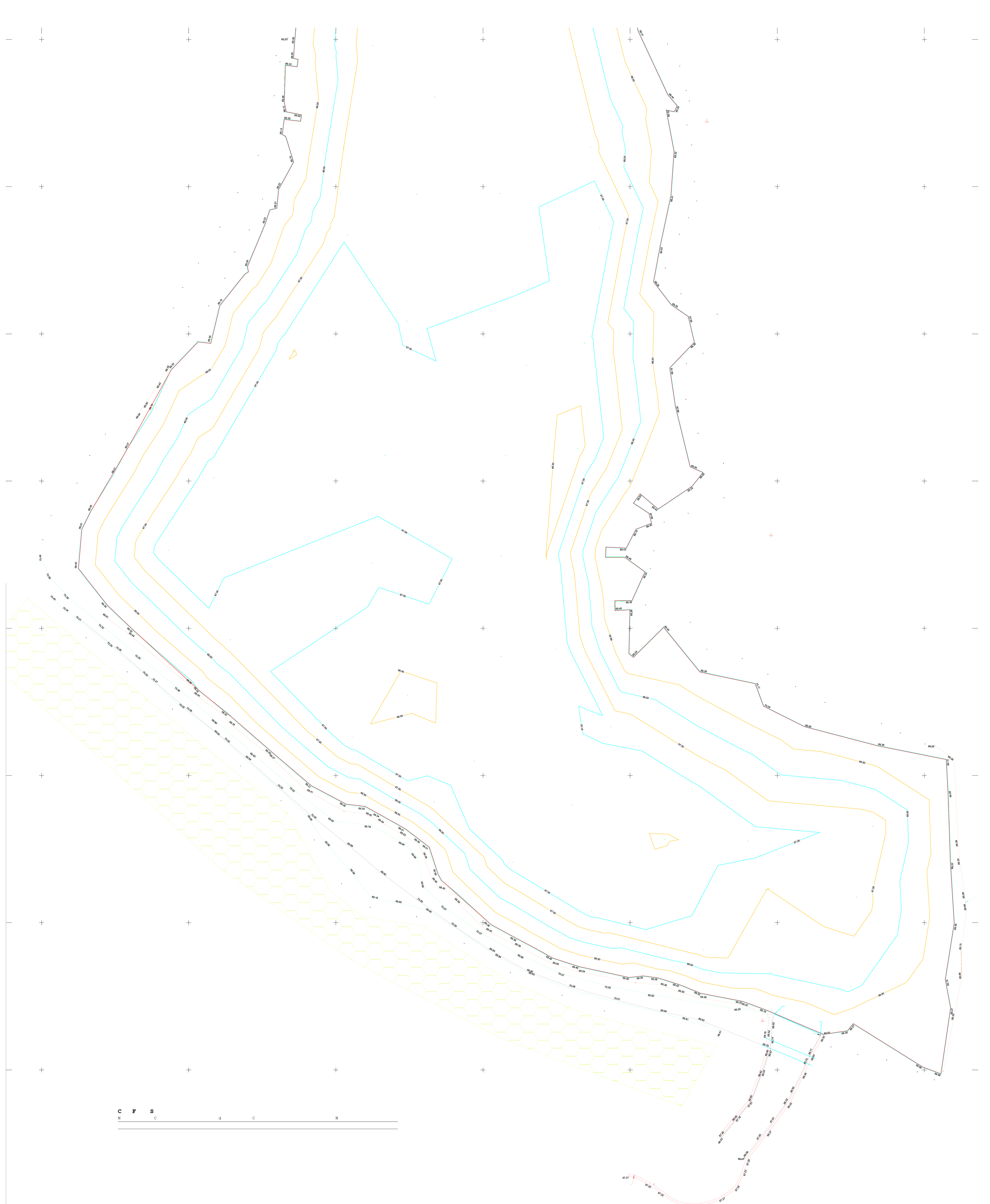
## **2.7 Instrumentation**

There is no internal or external instrumentation installed at the dam.

Signed  Date: 7<sup>th</sup> December 2022

Member of Panel AR, as constituted under the Reservoirs Act 1975  
(Current appointment to AR Panel expires 19<sup>th</sup> July 2026)

## **Appendix A - Topographic and Bathymetric (H D Surveying, Nov. 2021)**



STANDARD REFERENCE & ABBREVIATIONS

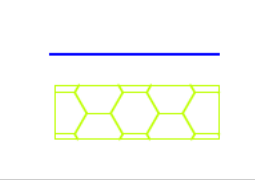
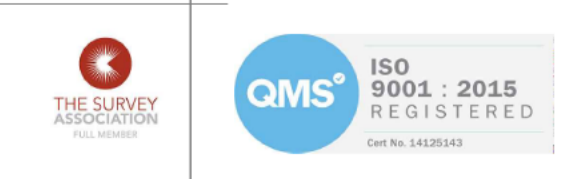


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STANDARD REFERENCE & ABBREVIATIONS

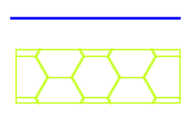


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## **Appendix C - Flood Study (Binnies, Jan. 2022)**