

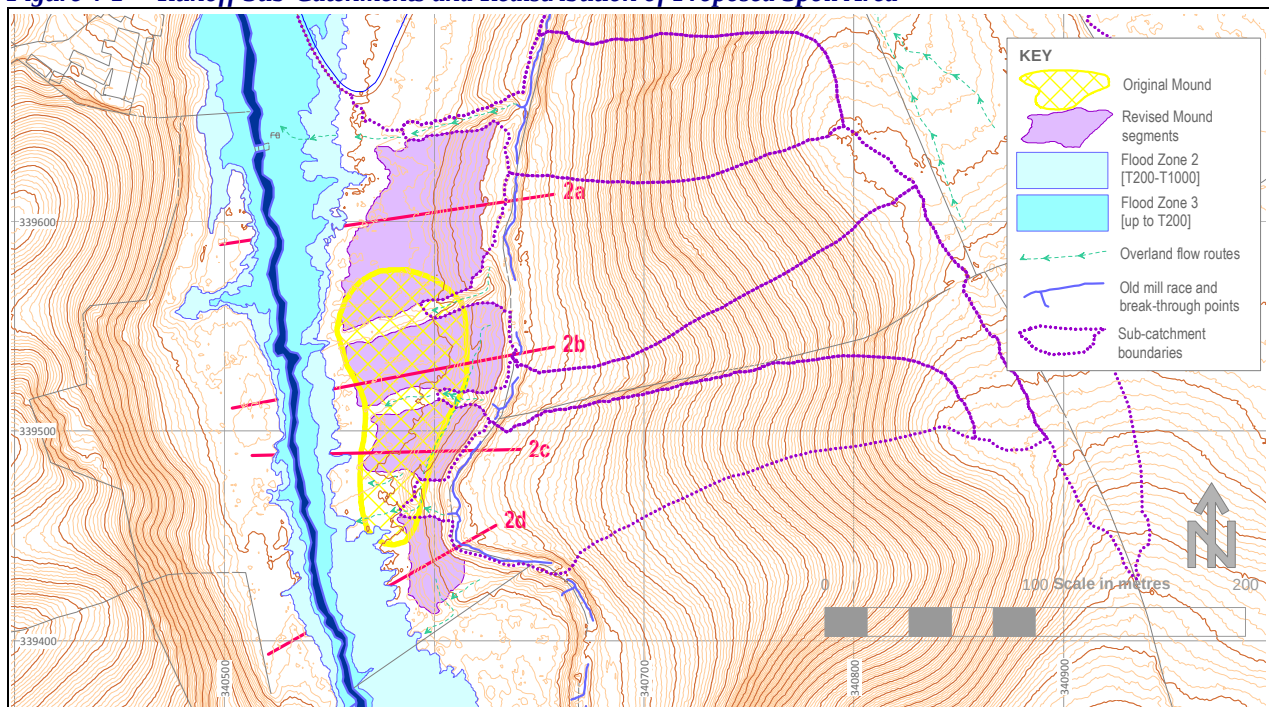
## 4 Consideration of Proposed Mound

### 4-1 Flood Extent

The southern tip of the proposed mound impinges on the T1000 flood extent, so the area of spoil needs redesigning slightly and shifting away from the lower-lying ground at that point.

The proposed mound also does not take into consideration the existing terrain or routes of overland flow which have been mapped in [Figure 4-1](#). There are a number of break-through points along the old mill stream, where overland flow runs off the hillside, collects in the remains of the bunded ditch and then continues across the floodplain.

**Figure 4-1** Runoff Sub-Catchments and Redistribution of Proposed Spoil Area



### 4-2 Spoil Volume

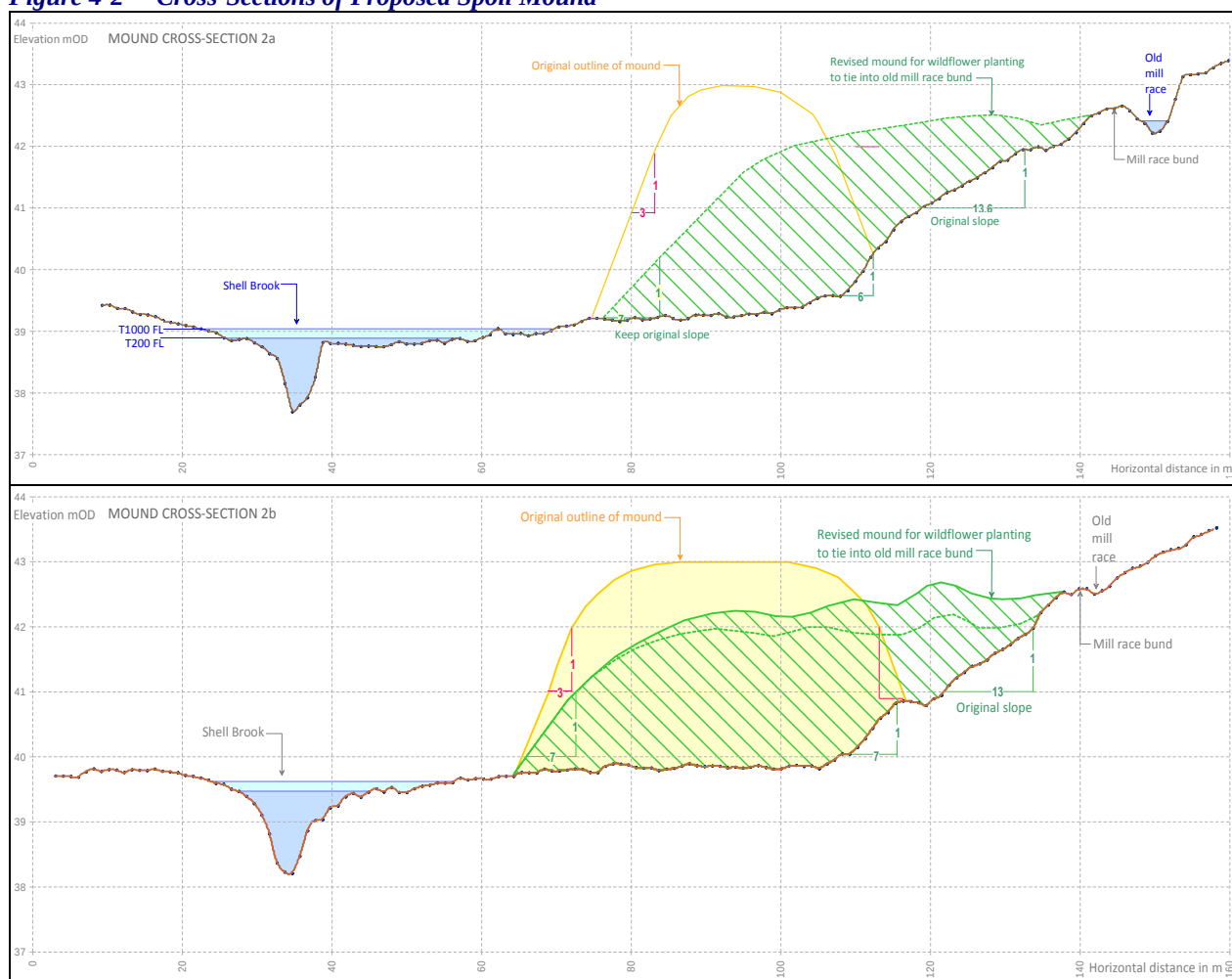
It was also found that the proposed spoil heap would have an average thickness of 3 m based on the volume of arisings from the lake excavation and footprint of 5402 m<sup>2</sup> shown in the CBA drawings. The lake storage data in [Table 3-1](#) have been used to re-assess the spoil volume, which will be of the order of 16274 m<sup>3</sup>. Assuming that slopes would not exceed 1:3, the central height would be excessive to achieve the calculated spoil volume. The proposed mound should therefore be reduced in elevation and broken up to maintain the four main overland flow routes.

Taking drainage into consideration, it is recommended that the mound be divided into at least three segments and moulded into the side of the existing slope up to the millrace bund, maintaining existing gradient of 1:7 to 1:13, down-hill from the old millrace. This is shown in [Figure 4-2](#).

Additional cross-sections are included in [Appendix B-5](#) and volumes are summarised in [Table 4-1](#).

**Table 4-1** Summary of Spoil Volumes and Areas

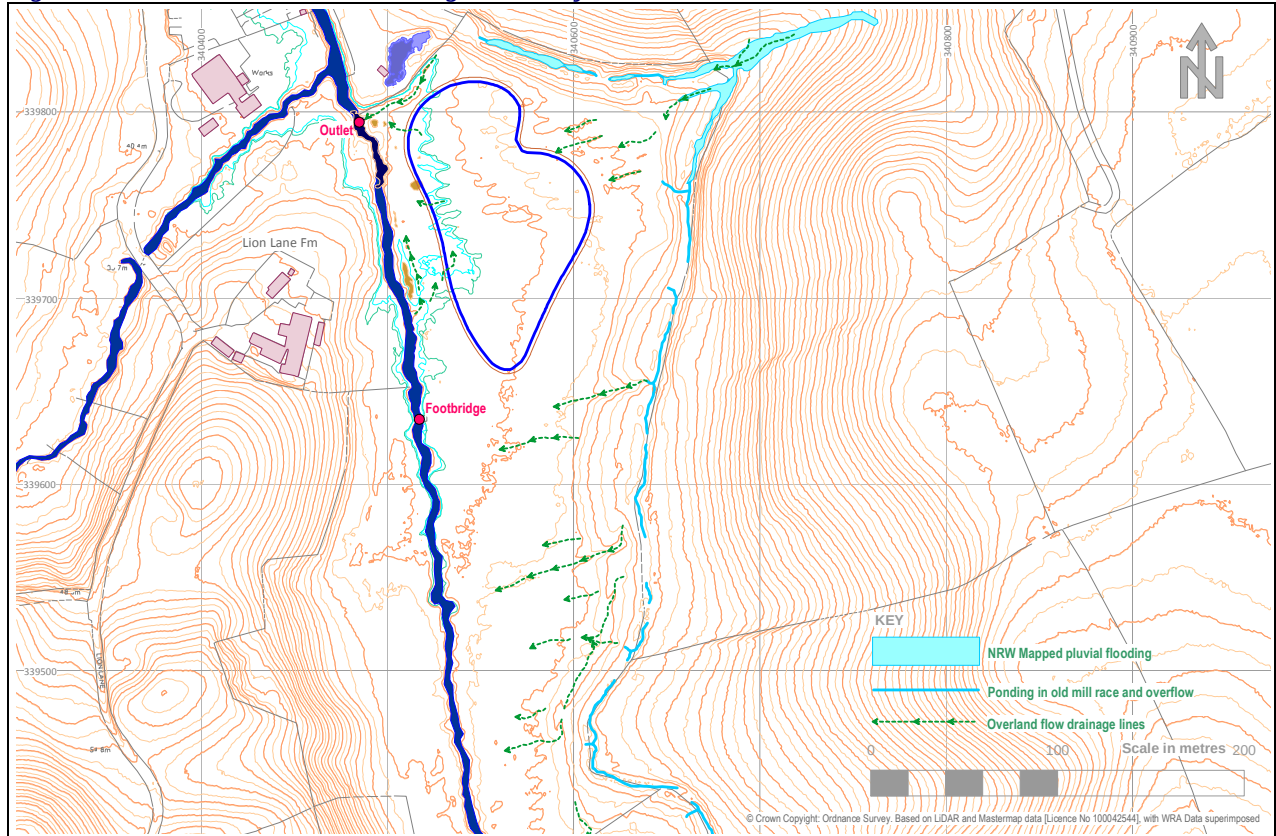
| Segment      | Unit           | Original CBA mound | Revised Spoil Mounds to provide extra volume |       |       |
|--------------|----------------|--------------------|----------------------------------------------|-------|-------|
|              |                |                    | v1                                           | v2    | v3    |
| mound-2a     | m <sup>2</sup> | -                  | 2562                                         | 3831  | 4617  |
| mound-2b     | m <sup>2</sup> | -                  | 205                                          | 2131  | 2444  |
| mound-2c     | m <sup>2</sup> | -                  | 854                                          | 1319  | 1406  |
| mound-2d     | m <sup>2</sup> | -                  | 1371                                         | 799   | 866   |
| Total area   | m <sup>2</sup> | 5402               | 4991                                         | 8080  | 9333  |
| Thickness    | m              | 3.01               | 3.00                                         | 2.02  | 1.82  |
| Total volume | m <sup>3</sup> | 16274              | 14974                                        | 16322 | 17006 |

**Figure 4-2** Cross-Sections of Proposed Spoil Mound

## 5 Pluvial Flooding

The risk of pluvial flooding is shown on NRW mapping as indicative, and this information has been reviewed in the light of field reconnaissance and topographic data. The complete picture regarding overland flow and ponding during intense rainfall is shown in [Figure 5-1](#).

**Figure 5-1 Indicative Pluvial Flooding in the Project Area**



Reference: <https://naturalresources.wales/flood-risk-map/?lang=en>

As has been highlighted elsewhere in the report, sheet flow running off the steep hillsides adjacent to the area of proposed lake and spoil mound, will mainly accumulate in the old mill race, which has no outlet. However, erosion over decades and reduction in the level of the containment bund will allow breakthrough of the ponding and overflow on to the adjacent floodplain, following fairly well-defined lineaments across the field into marshy grassland areas.

The main process of note will be runoff from the mangel wurzel fields in the prominent eastern valley, which will both enter the old mill race and overflow into the proposed lake. Other runoff is not mapped by NRW, but it is likely that the old mill race further south will also trap overland flow, where the infiltration capacity of the sandy soils is exceeded, and overflow along the drainage lines shown in [Figure 5-1](#).

There is no pluvial flooding as such shown in the proposed lake and mound areas, but there are patches of ponding and marshy vegetation, which was confirmed during reconnaissance.

## 6 Conclusions

- 6-1 The Emral Brook catchment area of 15.37 km<sup>2</sup> at the Lion Lane confluence, has T200 and T1000 flood peaks of 8.6 and 12.5 m<sup>3</sup>/s, and flood levels of 38.4, 38.6 m OD at the northern end of the lake.
- 6-2 Floodwater will partially overlap the proposed lake, and overflow at the northwest corner, with convergence and increase in flow velocity. There will be an estimated gain in T1000 floodplain storage of 5900 m<sup>3</sup>, thereby reducing downstream flooding.
- 6-3 Abandoned since 1954, the mill race bund and ditch will intercept, divert and focus hillside runoff. The bund has drainage breakthroughs which feed areas of marshy grassland, following lineaments to the south of the proposed lake across the area of proposed wildflower meadows.
- 6-4 Glacio-fluvial deposits exposed on the hillside eastwards, and underlying valley alluvium will potentially feed the base of the proposed lake, confirmed by borehole and springs.
- 6-5 The southern tip of the CBA mound impinges on the T1000 flood extent, so it has been redesigned, moving it away from the lower-lying ground, reducing elevation and dividing into segments to maintain overland flow routes and achieve the correct volume.
- 6-6 The mound segments would be moulded into the side of the existing slope up to the millrace bund, maintaining existing gradients of 1:7 to 1:13, down-hill from the old millrace.
- 6-7 The proposed access track should be relocated to follow the edge of the floodplain, thereby avoiding the area at the NW corner of the lake where flood velocities will be higher and avoiding the need to bridge or culvert the spring which appears in the old overflow ditch.

## 7 References

- 7-1 Duncan Reed, et al, 1999: FEH Flood Estimation Handbook [Centre for Ecology & Hydrology, ISBN: 9781906698003]
- 7-2 Kjeldsen et al 2008, 2014: FEH statistical method, implemented through WINFAP5. [Centre for Ecology & Hydrology].
- 7-3 FEH Supplementary Report and development of ReFH2 and its associated publication to estimate design flood hydrographs for rural and urbanised ungauged catchments across the UK [Centre for Ecology & Hydrology].
- 7-4 Kjeldsen et al 2013: Revitalisation of the FSR/FEH rainfall-runoff method 2001-2005: developed by [Centre for Ecology & Hydrology].
- 7-5 Planning Policy Wales, Jul 2004: Technical Advice Note 15, development and flood risk [Welsh Assembly Government].
- 7-6 Natural Resources Wales, Dec 2017: Flood estimation technical guidance note [Flood Risk Management Board, GN008].
- 7-7 Chris Burnett Associates, Sep 2020: Penley Mill tree survey, arboricultural method statement.
- 7-8 Penny Anderson Associates Ltd, Dec 2020: Penley Mill preliminary ecological appraisal report.
- 7-9 Chris Burnett Associates, Dec 2020: Proposed 1m Contours and Lake [Drawing No PNLW20.05, rev03, 16-12-20].
- 7-10 Chris Burnett Associates, Jan 2021: Penley Mill Lake, design and access statement, [21 01 21]
- 7-11 Chris Burnett Associates, Jun 2021: Landscaping proposals [Drawing No PNLW20.07, rev03, 08-06-21].
- 7-12 Chris Burnett Associates, Jun 2021: New Lake Cross-sections [Drawing No PMLW20.08, rev03, 08-06-21].
- 7-13 Wildbanks Conservation, Oct 2021: Great crested newts, reasonable avoidance measures method statement [R001, draft v1, 22-10-2021].



## Appendix A NRW Response

Extract from the NRW letter dated 03/09/2021

PROPOSAL: PENLEY MILL, LION LANE, PENLEY, WREXHAM

LOCATION: CONSTRUCTION OF NEW LAKE, WETLAND AND WILDFLOWER MEADOW

We continue to have concerns with the application as submitted because inadequate information has been provided in support of the proposal. To overcome these concerns, you should seek further information from the applicant regarding flood risk and protected species. If this information is not provided, we would object to this planning application. Further details are provided below.

### Flood Risk

As stated in our previous response letter dated 10/03/2021 (our ref: CAS-139579-T4N), the site lies partially within Zone C2 of the Development Advice Map (DAM) contained in Technical Advice Note (TAN) 15: Development and Flood Risk.

The proposal involves the construction of a new lake with associated wetland and meadow. Given the site's partial location within Zone C2, a planning application for these proposals should be supported by a Flood Consequences Assessment (FCA). In the absence of an FCA we still raise concerns with the application.

We have reviewed the following information shared with us on 24/08/2021:

- PMLW20.05-05 OS Proposed 1m Contours & Lake 1,000@A1P (08-06-21)
- PMLW20.08-03 Lake Sections 750@A1L (08-06-21)
- PMLW20.07-03 Landscaping Proposals 1,000@A1P (08-06-21)

It appears that the primary issue relating to a proposed bund adjacent to the watercourse has been resolved in the latest plan submissions by removing that bund and as a result addressing the majority of the concerns raised in our previous response.

The contour and section plans indicate that there will be no ground raising between the watercourse and lake therefore any potential throttling of out-of-bank flows is not an issue.

However, an FCA is required to demonstrate the risks and consequences of flooding can be managed to an acceptable level. The FCA should clarify the matters raised above, including confirmation that the proposed access track would also not inadvertently raise land within the floodplain.

The criteria for the FCA, which should normally be undertaken by a suitably qualified person carrying an appropriate professional indemnity, are given under Section 7 and Appendix 1 of TAN15. The FCA should be proportionate to the development proposed. To help prepare an FCA, we have developed guidance, which contains technical advice and recommendations.

### Groundwater and Land Contamination

As stated in our previous response letter dated 10/03/2021 (our ref: CAS-139579-T4N), it is noted that there is no information relating to any previous ground investigations at the site. However, with the land use at the site comprising 'farmland used for grazing', it is considered unlikely that there is significant contamination present. We note the application site is within the catchment of the River Dee and Bala Lake Special Area of Conservation (SAC) (the river Dee is located ca. 3.8km to the west of the site) and that the bedrock beneath the site (Wilmslow Sandstone Formation) is a Principal Aquifer; the overlying superficial deposits of Alluvium are classified as a Secondary A Aquifer. This site is not located within a groundwater Source Protection Zone.

It is understood that the lake is to be constructed by excavating to a maximum depth of 3m below the current ground level and sealed using natural clay of the Alluvium. There is no reference to whether groundwater is likely to be encountered during this development. However, based on the current use of the site, significant groundwater contamination is unlikely to be encountered.



## Appendix B Hydrological Analysis

### B-1 FEH Hydrological Characteristics

**Table B1-1 FEH Catchment Descriptors**

|           |    |        |        |                |
|-----------|----|--------|--------|----------------|
| CATCHMENT | GB | 340500 | 339750 | SJ 40500 39750 |
| CENTROID  | GB | 341989 | 337080 | SJ 41989 37080 |

|             |          |         |                                                                                                                                                                                                                                                            |
|-------------|----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AREA        | 15.3725  | BFIHOST | Base Flow Index derived using the UK Hydrology of Soil Types [HOST] classification; it is a measure of catchment responsiveness.                                                                                                                           |
| ALTBAR      | 86       |         |                                                                                                                                                                                                                                                            |
| ASPBAR      | 359      |         |                                                                                                                                                                                                                                                            |
| ASPVAR      | 0.26     | DPSBAR  | This landform descriptor (mean Drainage Path Slope) provides an index of overall catchment steepness. Values range from >300 in mountainous terrain to <25 in the flattest parts of the country.                                                           |
| BFIHOST     | 0.473    |         |                                                                                                                                                                                                                                                            |
| BFIHOST19   | 0.498    |         |                                                                                                                                                                                                                                                            |
| DPLBAR      | 5.03     | FARL    | Flood Attenuation by Reservoirs and Lakes Index: provides a guide to the degree of flood attenuation attributable to reservoirs and lakes in the catchment. Values close to unity indicate the absence of attenuation due to lakes and reservoirs.         |
| DPSBAR      | 62.4     |         |                                                                                                                                                                                                                                                            |
| FARL        | 0.995    |         |                                                                                                                                                                                                                                                            |
| FPEXT       | 0.0761   | LDP     | Longest Drainage Path: the greatest distance from a catchment node to the defined outlet.                                                                                                                                                                  |
| FPDBAR      | 0.598    |         |                                                                                                                                                                                                                                                            |
| FPLOC       | 1.084    |         |                                                                                                                                                                                                                                                            |
| LDP         | 8.86     | PROPWET | Catchment wetness index (PROPortion of time soils are WET); a measure of the proportion of time that catchment soils are defined as wet. PROPWET values range from over 80% in the wettest catchments to less than 20% in the driest parts of the country. |
| PROPWET     | 0.35     |         |                                                                                                                                                                                                                                                            |
| RMED-1H     | 9.3      |         |                                                                                                                                                                                                                                                            |
| RMED-1D     | 30.3     |         |                                                                                                                                                                                                                                                            |
| RMED-2D     | 38.3     | SAAR    | Average annual rainfall in the standard period (1961-1990).                                                                                                                                                                                                |
| SAAR        | 694      |         |                                                                                                                                                                                                                                                            |
| SAAR4170    | 743      |         |                                                                                                                                                                                                                                                            |
| SPRHOST     | 36.15    | SMDBAR  | Mean Soil Moisture Deficit for the period 1960-1990 calculated from MORECS month-end values.                                                                                                                                                               |
| URBCONC1990 | -999999  |         |                                                                                                                                                                                                                                                            |
| URBEXT1990  | 0.0026   |         |                                                                                                                                                                                                                                                            |
| URBLOC1990  | -999999  | SPR     | Standard percentage runoff using the UK Hydrology of Soil Types [HOST] classification.                                                                                                                                                                     |
| URBCONC2000 | -999999  |         |                                                                                                                                                                                                                                                            |
| URBEXT2000  | 0.0046   |         |                                                                                                                                                                                                                                                            |
| URBLOC2000  | -999999  | D1      | Catchment rainfall parameter D1 from the Depth-Duration-Frequency [DDF] model.                                                                                                                                                                             |
| C           | -0.02429 |         |                                                                                                                                                                                                                                                            |
| D1          | 0.34335  |         |                                                                                                                                                                                                                                                            |
| D2          | 0.40734  |         |                                                                                                                                                                                                                                                            |
| D3          | 0.28247  |         |                                                                                                                                                                                                                                                            |
| E           | 0.28444  |         |                                                                                                                                                                                                                                                            |
| F           | 2.36612  |         |                                                                                                                                                                                                                                                            |
| C(1 km)     | -0.024   |         |                                                                                                                                                                                                                                                            |
| D1(1 km)    | 0.33     |         |                                                                                                                                                                                                                                                            |
| D2(1 km)    | 0.432    |         |                                                                                                                                                                                                                                                            |
| D3(1 km)    | 0.272    |         |                                                                                                                                                                                                                                                            |
| E(1 km)     | 0.282    |         |                                                                                                                                                                                                                                                            |
| F(1 km)     | 2.377    |         |                                                                                                                                                                                                                                                            |

## B-2 FEH Flood Characteristics

### Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Date of creation 14-11-2021 11:48:26  
 Software WINFAP Version: 5.0.7947 (29986)  
 Peak Flow dataset Peak Flow Dataset 10.0.0

#### Site details

Site number 400104114  
 Site name FEH\_Catchment\_Descriptors\_340500\_339750  
 Site location SJ 40500 39750  
 Easting 340500  
 Northing 339750  
 Catchment area 15.37 km<sup>2</sup>  
 SAAR 694 mm  
 BFIHOST19 0.498  
 FPEXT 0.076  
 FARL 0.995  
 URBEXT2000 0.0046

#### Analysis settings

| Urbanisation settings |                      | Growth curve settings              |                 | QMED settings |                  |
|-----------------------|----------------------|------------------------------------|-----------------|---------------|------------------|
| User defined          | No                   | Distance Measure Method            | Small catchment | Method        | Donor Station(s) |
| Urban area            | 0.11 km <sup>2</sup> | Pooling group URBEXT2000 Threshold | 0.030           |               |                  |
| PRimp                 | 70.00%               | Deurbanise Pooling Group L-moments | Yes             |               |                  |
| Impervious Factor     | 0.300                |                                    |                 |               |                  |
| UAF                   | 1.00533              |                                    |                 |               |                  |

#### Growth curve data and results

| Pooling Group                              |          |               |         |               |                  |                 |                    |             |
|--------------------------------------------|----------|---------------|---------|---------------|------------------|-----------------|--------------------|-------------|
| Station                                    | Distance | Years of data | QMED AM | L-CV Observed | L-CV Deurbanised | L-SKEW Observed | L-SKEW Deurbanised | Discordancy |
| 26016 (Gypsy Race @ Kirby Grindalythe)     | 0.250    | 23            | 0.101   | 0.312         | <b>0.312</b>     | 0.258           | <b>0.258</b>       | 0.103       |
| 25019 (Leven @ Easby)                      | 0.513    | 42            | 5.384   | 0.338         | <b>0.339</b>     | 0.386           | <b>0.385</b>       | 0.517       |
| 27073 (Brompton Beck @ Snainton Ings)      | 0.522    | 40            | 0.816   | 0.214         | <b>0.215</b>     | 0.020           | <b>0.019</b>       | 0.763       |
| 26014 (Water Forlornes @ Driffield)        | 0.600    | 22            | 0.431   | 0.298         | <b>0.299</b>     | 0.120           | <b>0.119</b>       | 0.761       |
| 36010 (Bumpstead Brook @ Broad Green)      | 0.663    | 53            | 7.500   | 0.377         | <b>0.379</b>     | 0.173           | <b>0.172</b>       | 1.535       |
| 27051 (Crimple @ Burn Bridge)              | 0.779    | 48            | 4.544   | 0.219         | <b>0.220</b>     | 0.146           | <b>0.145</b>       | 0.235       |
| 7011 (Black Burn @ Pluscarden Abbey)       | 0.809    | 7             | 5.205   | 0.544         | <b>0.544</b>     | 0.571           | <b>0.571</b>       | 2.722       |
| 39033 (Winterbourne Stream @ Bagnor)       | 0.860    | 58            | 0.401   | 0.342         | <b>0.342</b>     | 0.383           | <b>0.382</b>       | 1.181       |
| 33054 (Babingley @ Castle Rising)          | 0.910    | 44            | 1.132   | 0.204         | <b>0.205</b>     | 0.069           | <b>0.068</b>       | 0.642       |
| 24007 (Browney @ Lanchester)               | 0.932    | 15            | 10.981  | 0.222         | <b>0.222</b>     | 0.212           | <b>0.211</b>       | 0.915       |
| 41020 (Bevern Stream @ Clappers Bridge)    | 0.963    | 51            | 13.660  | 0.204         | <b>0.205</b>     | 0.174           | <b>0.171</b>       | 0.762       |
| 26013 (Driffield Trout Stream @ Driffield) | 0.984    | 10            | 2.685   | 0.292         | <b>0.293</b>     | 0.281           | <b>0.280</b>       | 2.354       |
| 53017 (Boyd @ Bitton)                      | 0.993    | 47            | 13.870  | 0.243         | <b>0.245</b>     | 0.083           | <b>0.080</b>       | 0.403       |
| 27010 (Hodge Beck @ Bransdale Weir)        | 1.022    | 41            | 9.420   | 0.224         | <b>0.224</b>     | 0.293           | <b>0.293</b>       | 1.109       |
| <b>Total</b>                               |          | <b>501</b>    |         |               |                  |                 |                    |             |

| Growth curve L-moments |       | Goodness of fit |           |                                                                                                                                 |
|------------------------|-------|-----------------|-----------|---------------------------------------------------------------------------------------------------------------------------------|
| Rural L-CV             | 0.284 | GL              | 0.9595 *  | * Distribution gives an acceptable fit (absolute Z value < 1.645)<br><b>Heterogeneity</b><br>Standardised test value H2: 3.4383 |
| Rural L-Skewness       | 0.208 | GEV             | -0.8811 * |                                                                                                                                 |
| Urban L-CV             | 0.284 | P3              | -2.2502   |                                                                                                                                 |
| Urban L-Skewness       | 0.209 | GP              | -5.1009   |                                                                                                                                 |
|                        |       | KAP3            | 0.3015 *  |                                                                                                                                 |

|              | Rural fitted parameters |       |        |        |        | Urban fitted parameters |       |        |        |        |
|--------------|-------------------------|-------|--------|--------|--------|-------------------------|-------|--------|--------|--------|
| Distribution | Location                | Scale | Shape  | H      | Bound  | Location                | Scale | Shape  | H      | Bound  |
| GL           | 1.000                   | 0.292 | -0.208 |        | -0.406 | 1.000                   | 0.292 | -0.209 |        | -0.397 |
| GEV          | 0.840                   | 0.433 | -0.058 |        | -6.576 | 0.840                   | 0.431 | -0.060 |        | -6.397 |
| KAP3         | 0.919                   | 0.354 | -0.140 | -0.400 | -1.604 | 0.919                   | 0.353 | -0.141 | -0.400 | -1.577 |

The pooling group is heterogeneous and a review of the pooling group is desirable.

### Standardised growth curves

| Return period | Rural |       |       | Urban |       |       |
|---------------|-------|-------|-------|-------|-------|-------|
|               | GL    | GEV   | KAP3  | GL    | GEV   | KAP3  |
| 2             | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 5             | 1.470 | 1.518 | 1.491 | 1.469 | 1.516 | 1.489 |
| 10            | 1.815 | 1.880 | 1.846 | 1.813 | 1.878 | 1.844 |
| 20            | 2.188 | 2.243 | 2.218 | 2.186 | 2.240 | 2.216 |
| 25            | 2.317 | 2.361 | 2.344 | 2.315 | 2.359 | 2.342 |
| 30            | 2.427 | 2.458 | 2.449 | 2.424 | 2.456 | 2.447 |
| 50            | 2.753 | 2.735 | 2.756 | 2.751 | 2.733 | 2.754 |
| 75            | 3.036 | 2.960 | 3.014 | 3.034 | 2.958 | 3.012 |
| 100           | 3.251 | 3.122 | 3.206 | 3.248 | 3.121 | 3.204 |
| 200           | 3.822 | 3.524 | 3.700 | 3.820 | 3.523 | 3.699 |
| 500           | 4.713 | 4.080 | 4.429 | 4.713 | 4.080 | 4.430 |
| 1000          | 5.508 | 4.520 | 5.046 | 5.509 | 4.522 | 5.049 |

### QMED data and results

#### Donor selection criteria

|                              |        |
|------------------------------|--------|
| Only sites suitable for QMED | Yes    |
| URBEXT2000                   | <0.030 |
| Donor adjusted FSE           | 1.392  |
| No. of donors                | 1      |

#### Donor stations

| Station                | 1    | 2     | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10  | 11    | 12    | 13 | 14  | 15    |
|------------------------|------|-------|--------|--------|--------|--------|--------|--------|--------|-----|-------|-------|----|-----|-------|
| FEH project catchment  |      | 0.005 |        |        |        |        | 341989 | 337080 | 15.37  | 694 | 0.498 | 0.995 |    |     |       |
| 54020 (Perry @ Yeaton) | 9.41 | 0.014 | 10.590 | 10.371 | 15.348 | 15.348 | 337383 | 328872 | 188.08 | 739 | 0.610 | 0.954 | 57 | Yes | 0.387 |

## Unused Donor stations using QMED obs deurbanised

| Station                           | 1     | 2     | 3       | 4              | 5       | 6       | 7      | 8      | 9       | 10   | 11    | 12    | 13 | 14  | 15    |
|-----------------------------------|-------|-------|---------|----------------|---------|---------|--------|--------|---------|------|-------|-------|----|-----|-------|
| 54016 (Roden @ Rodington)         | 12.79 | 0.013 | 10.858  | <b>10.658</b>  | 20.609  | 20.609  | 351700 | 328761 | 261.94  | 693  | 0.587 | 0.981 | 51 | Yes | 0.357 |
| 68005 (Weaver @ Audlem)           | 19.27 | 0.007 | 14.041  | <b>13.919</b>  | 21.035  | 21.035  | 359816 | 344403 | 201.38  | 719  | 0.511 | 0.950 | 51 | No  | 0.313 |
| 67005 (Ceiriog @ Brynkinalt Weir) | 24.51 | 0.001 | 28.990  | <b>28.953</b>  | 58.390  | 58.390  | 317500 | 336107 | 111.72  | 1198 | 0.403 | 1.000 | 23 | No  | 0.282 |
| 54012 (Tern @ Walcot)             | 24.61 | 0.029 | 35.427  | <b>34.062</b>  | 54.616  | 54.616  | 363754 | 325596 | 851.65  | 694  | 0.581 | 0.966 | 61 | Yes | 0.281 |
| 54041 (Tern @ Eaton upon Tern)    | 25.31 | 0.015 | 12.444  | <b>12.174</b>  | 14.981  | 14.981  | 367079 | 333734 | 193.49  | 719  | 0.604 | 0.954 | 42 | Yes | 0.277 |
| 68001 (Weaver @ Ashbrook)         | 26.95 | 0.027 | 46.817  | <b>45.272</b>  | 54.526  | 54.526  | 365240 | 350713 | 622.68  | 732  | 0.533 | 0.955 | 83 | No  | 0.268 |
| 54001 (Severn @ Bewdley)          | 27.71 | 0.020 | 335.078 | <b>327.188</b> | 525.839 | 525.839 | 336744 | 309876 | 4329.89 | 912  | 0.519 | 0.973 | 97 | Yes | 0.264 |
| 68020 (Gowy @ Bridge Trafford)    | 28.75 | 0.017 | 15.374  | <b>15.058</b>  | 17.819  | 17.819  | 351376 | 364257 | 148.66  | 729  | 0.541 | 0.994 | 41 | No  | 0.259 |
| 67008 (Alyn @ Pont-y-Capel)       | 29.04 | 0.029 | 21.680  | <b>20.905</b>  | 42.347  | 42.347  | 323013 | 359066 | 225.65  | 917  | 0.542 | 0.990 | 55 | Yes | 0.257 |

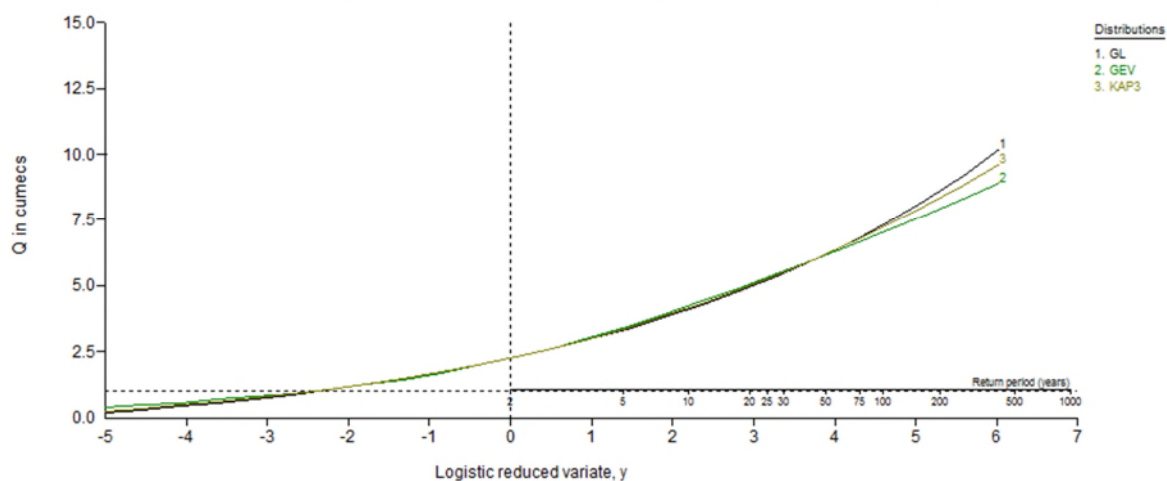
## Key:

|            |                    |              |              |                        |
|------------|--------------------|--------------|--------------|------------------------|
| 1 Distance | 4 QMED deurbanised | 7 Centroid X | 10 SAAR      | 13 Years of data       |
| 2 URBEXT   | 5 QMED CDs urban   | 8 Centroid Y | 11 BFIHOST19 | 14 Pooling suitability |
| 3 QMED obs | 6 QMED CDs rural   | 9 Area       | 12 FARL      | 15 Weight              |

## Flood Frequency Curves

| Return period      | Rural     |            |             | Urban     |            |             |
|--------------------|-----------|------------|-------------|-----------|------------|-------------|
|                    | GL (m³/s) | GEV (m³/s) | KAP3 (m³/s) | GL (m³/s) | GEV (m³/s) | KAP3 (m³/s) |
| Growth curve chart | 1         | 2          | 3           | 1         | 2          | 3           |
| 2 QMED             | 2.249     | 2.249      | 2.249       | 2.261     | 2.261      | 2.261       |
| 5                  | 3.306     | 3.414      | 3.352       | 3.321     | 3.429      | 3.367       |
| 10                 | 4.081     | 4.228      | 4.151       | 4.099     | 4.246      | 4.169       |
| 20                 | 4.921     | 5.044      | 4.989       | 4.942     | 5.065      | 5.010       |
| 25                 | 5.211     | 5.310      | 5.271       | 5.234     | 5.333      | 5.294       |
| 30                 | 5.457     | 5.529      | 5.507       | 5.481     | 5.553      | 5.531       |
| 50                 | 6.192     | 6.151      | 6.198       | 6.219     | 6.179      | 6.226       |
| 75                 | 6.828     | 6.657      | 6.779       | 6.859     | 6.688      | 6.810       |
| 100                | 7.311     | 7.022      | 7.210       | 7.344     | 7.056      | 7.244       |
| 200                | 8.596     | 7.925      | 8.321       | 8.638     | 7.966      | 8.362       |
| 500                | 10.600    | 9.175      | 9.962       | 10.655    | 9.226      | 10.015      |
| 1000               | 12.388    | 10.164     | 11.349      | 12.456    | 10.224     | 11.414      |

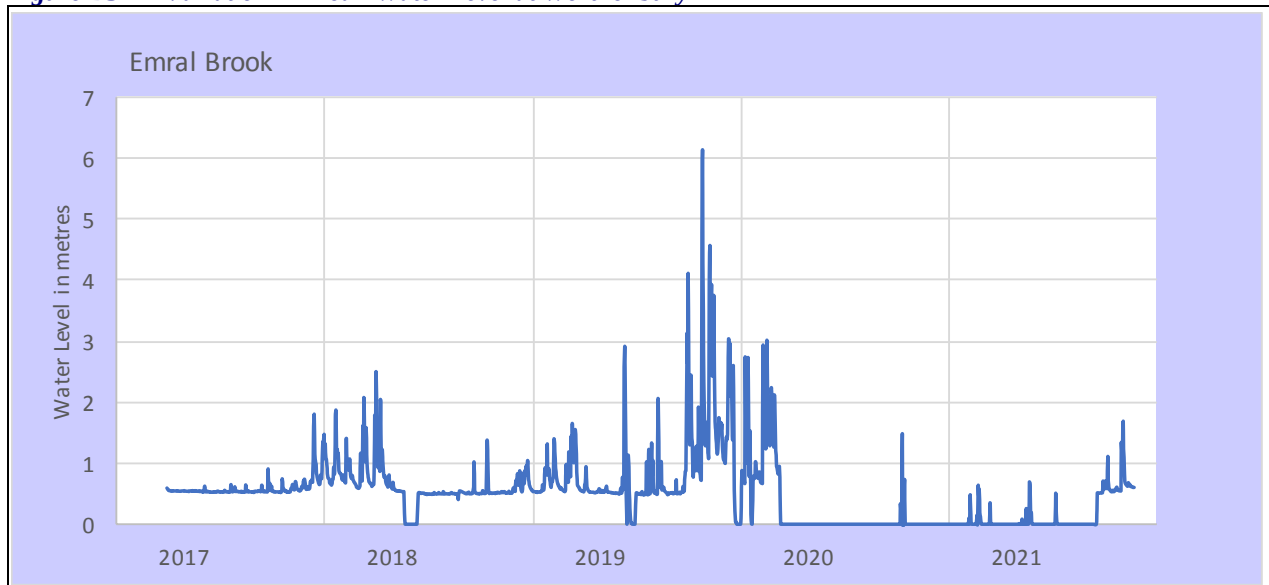
## Pooling-group - SJ 40500 39750 (14-11-2021 11:44) - rural



### B-3 Emral Brook Monitoring

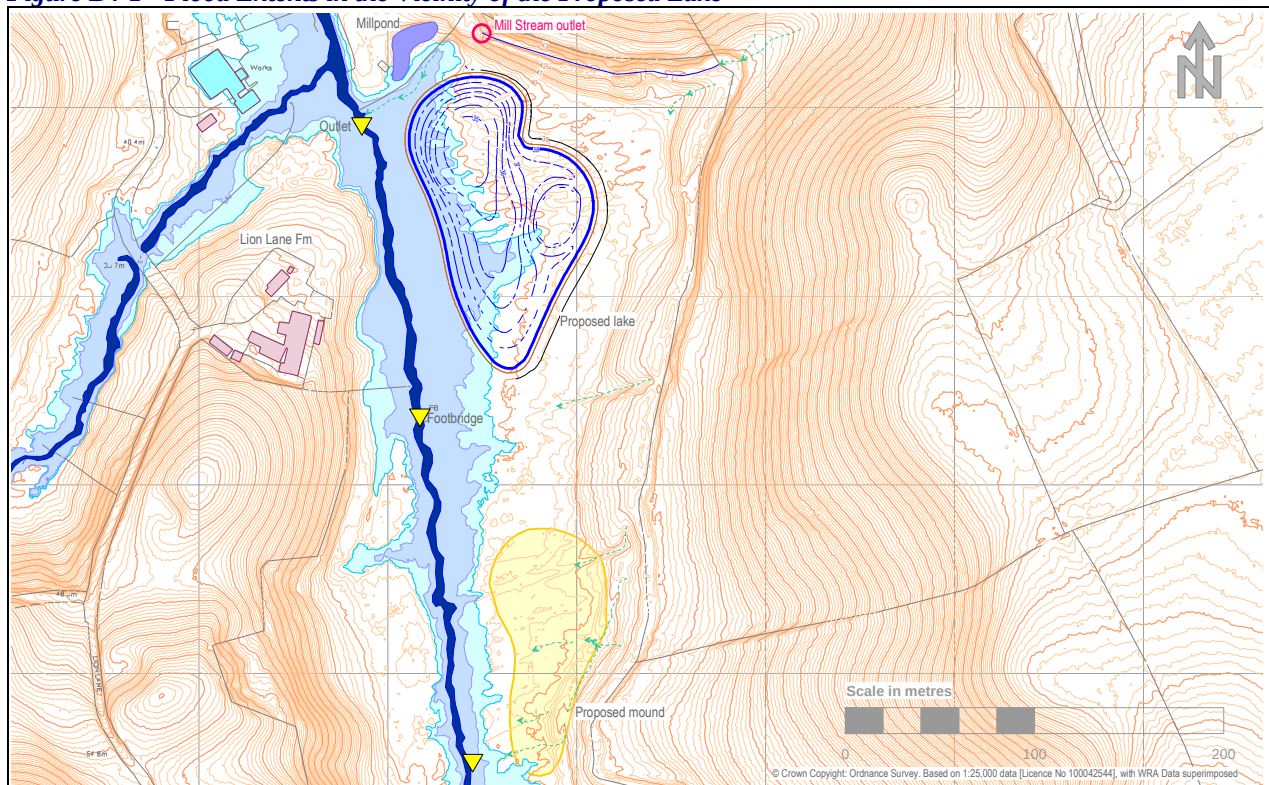
Emral Brook does not appear to have sufficient flow data for use in flood prediction. [Figure B3-1](#) shows an extract of water level data for the gauge at Worthenbury.

**Figure B3-1** Variation in Mean Water Level at Worthenbury



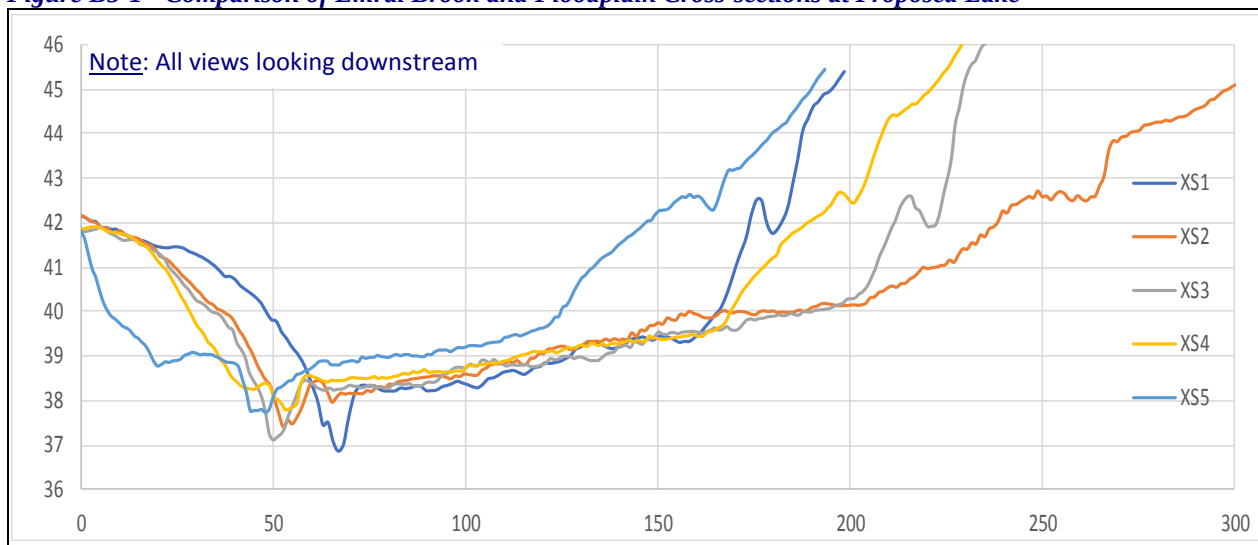
### B-4 Flood Extent Mapping

**Figure B4-1** Flood Extents in the Vicinity of the Proposed Lake

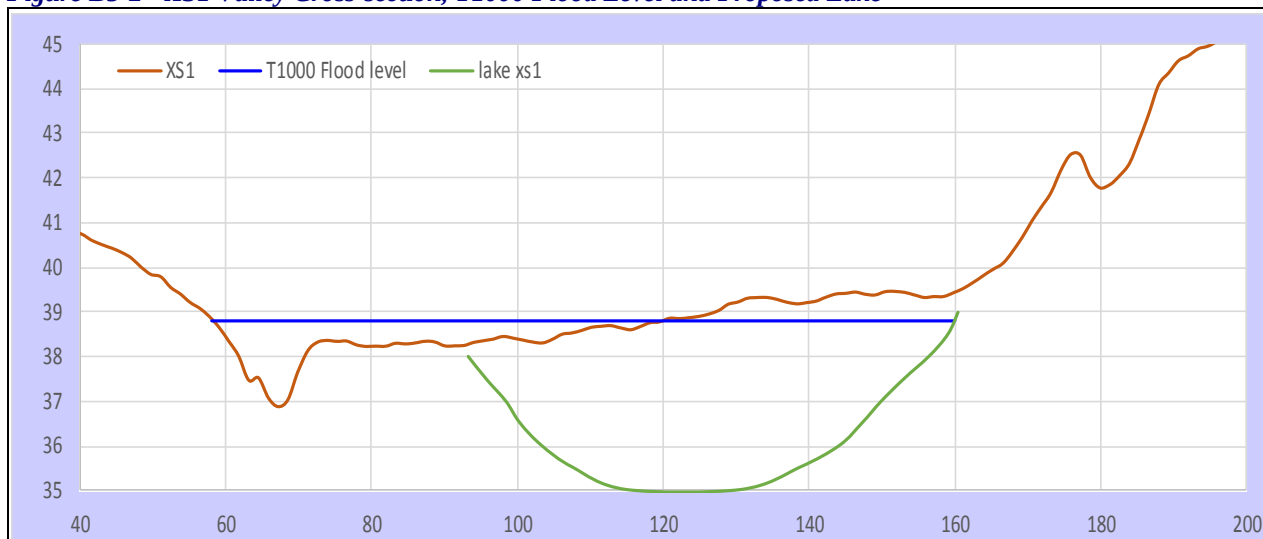


## B-5 Cross-Sections and Storage Characteristics

**Figure B5-1 Comparison of Emral Brook and Floodplain Cross-sections at Proposed Lake**



**Figure B5-2 XS1 Valley Cross-section, T1000 Flood Level and Proposed Lake**



**Figure B5-3 XS2 Valley Cross-section, T1000 Flood Level and Proposed Lake**

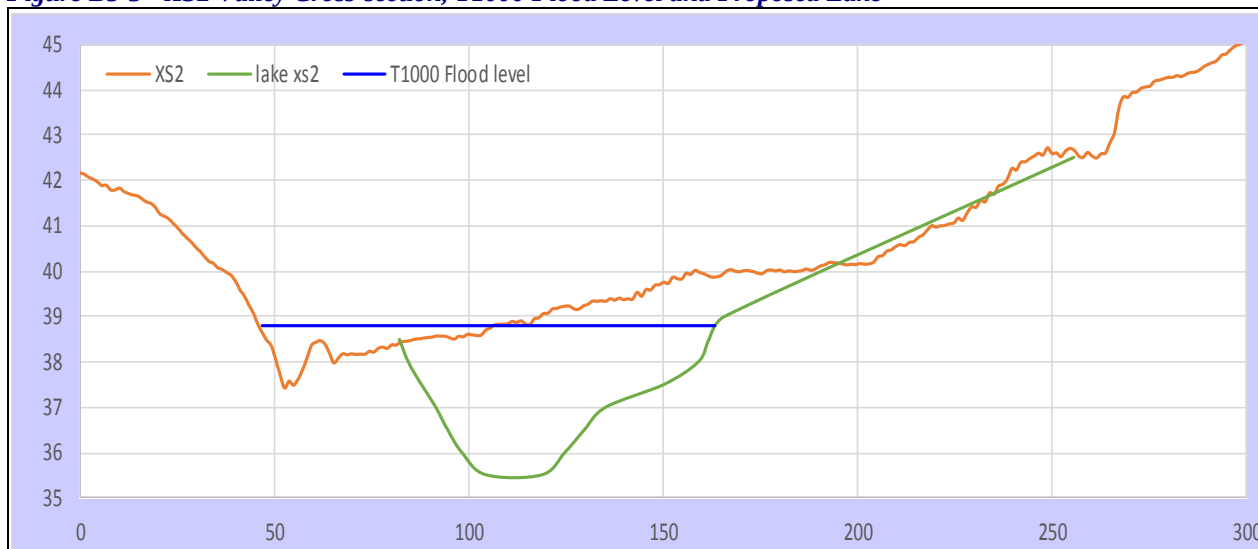


Figure B5-4 XS3 Valley Cross-section, T1000 Flood Level and Proposed Lake

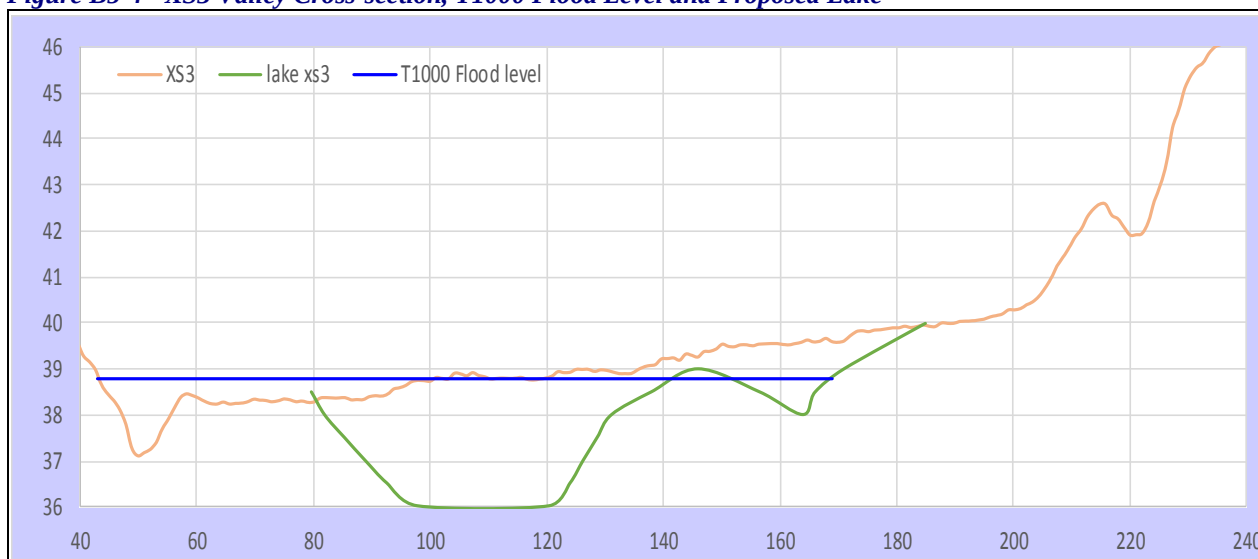


Figure B5-5 XS3 Valley Cross-section, T1000 Flood Level and Proposed Lake

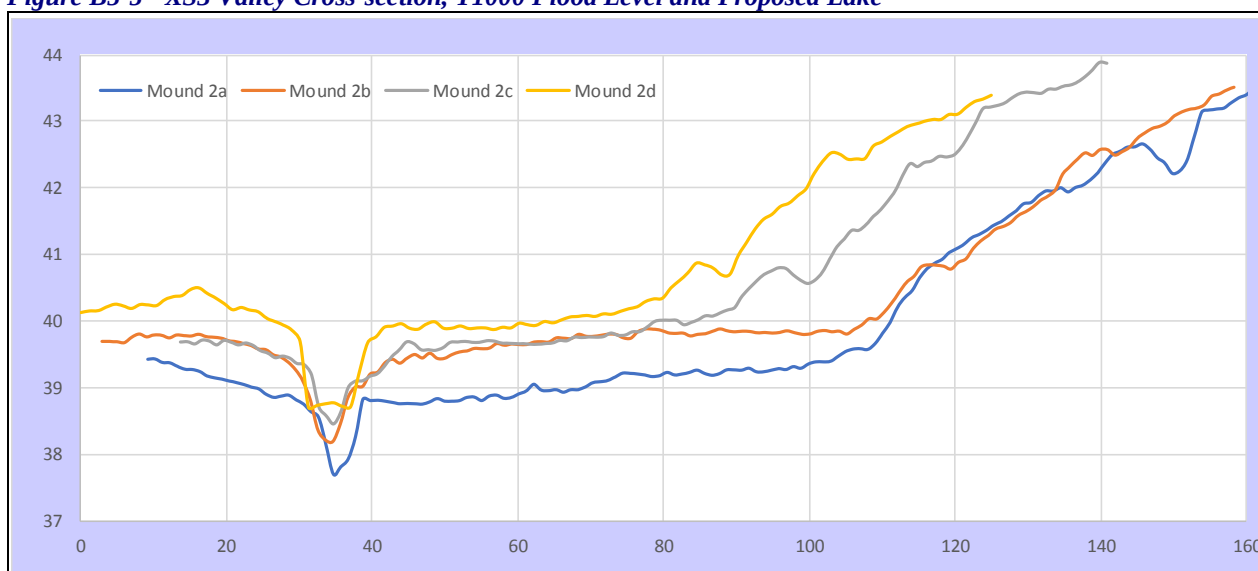
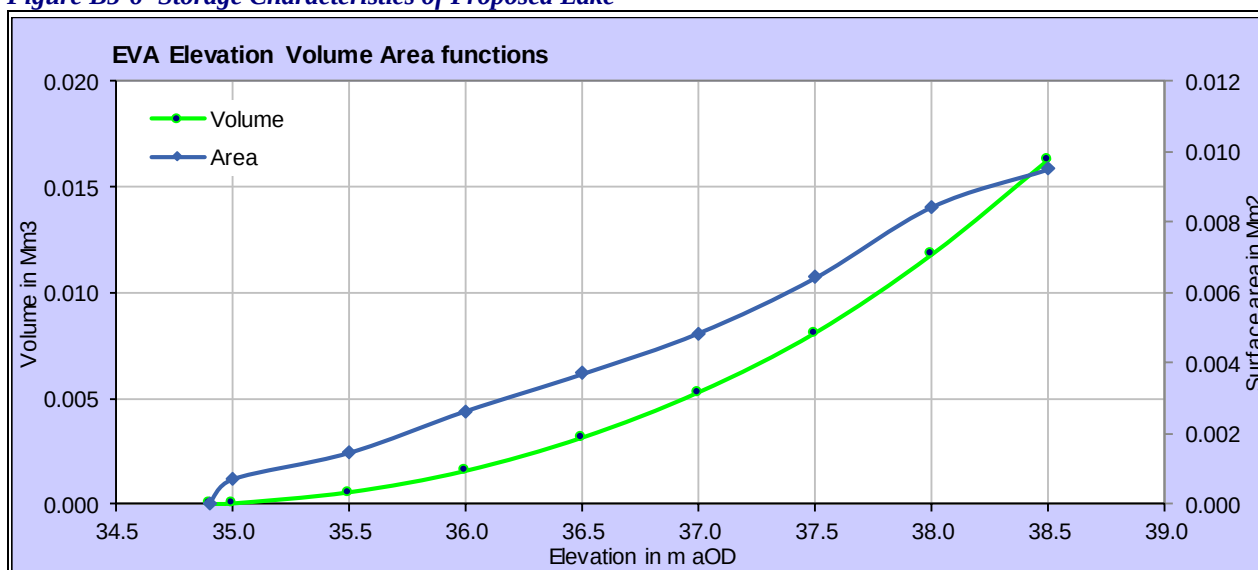
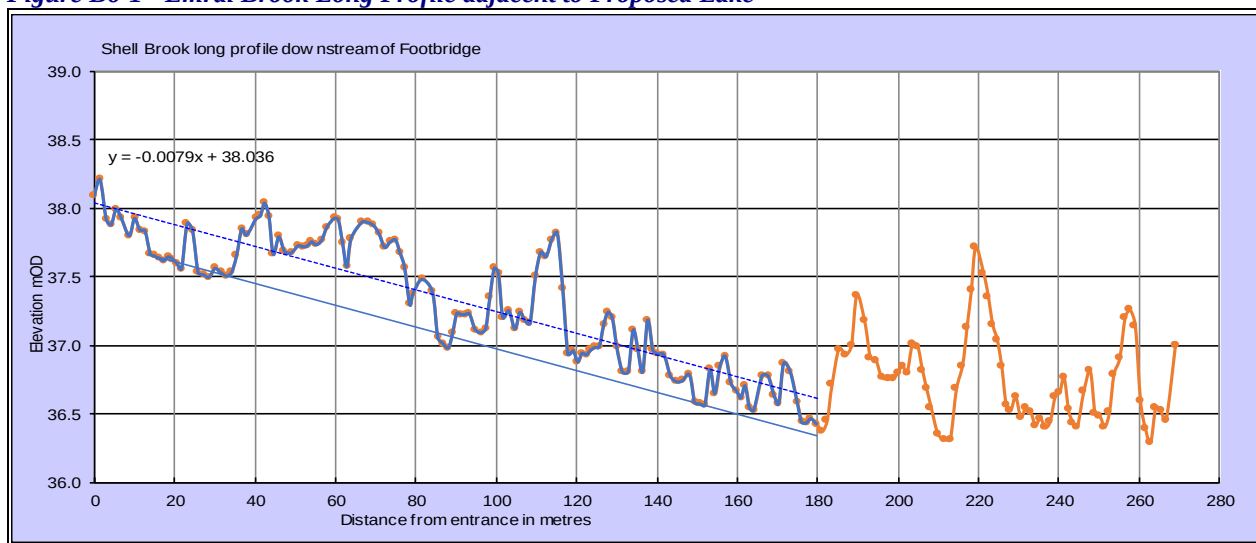


Figure B5-6 Storage Characteristics of Proposed Lake

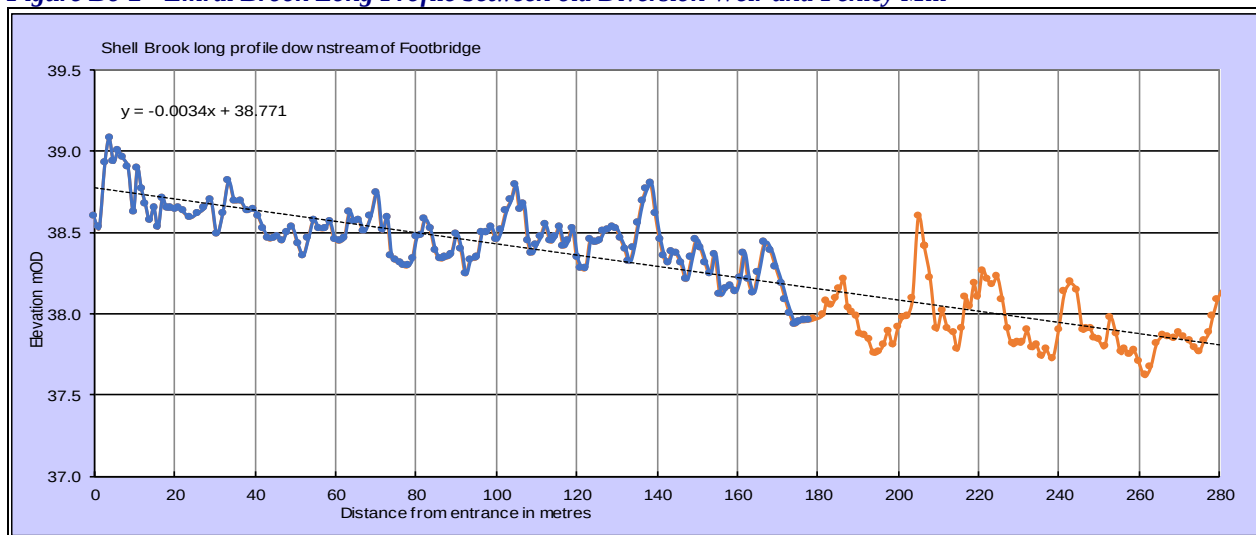


## B-6 Stream and Floodplain Long Profiles from LiDAR

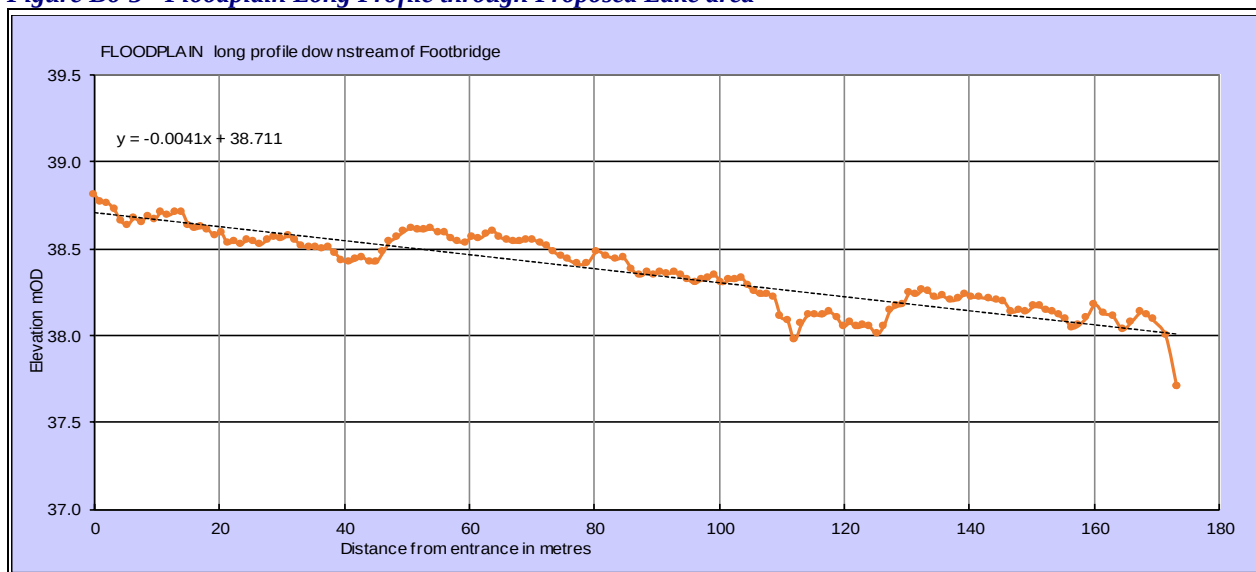
**Figure B6-1 Emral Brook Long Profile adjacent to Proposed Lake**



**Figure B6-2 Emral Brook Long Profile between old Diversion Weir and Penley Mill**

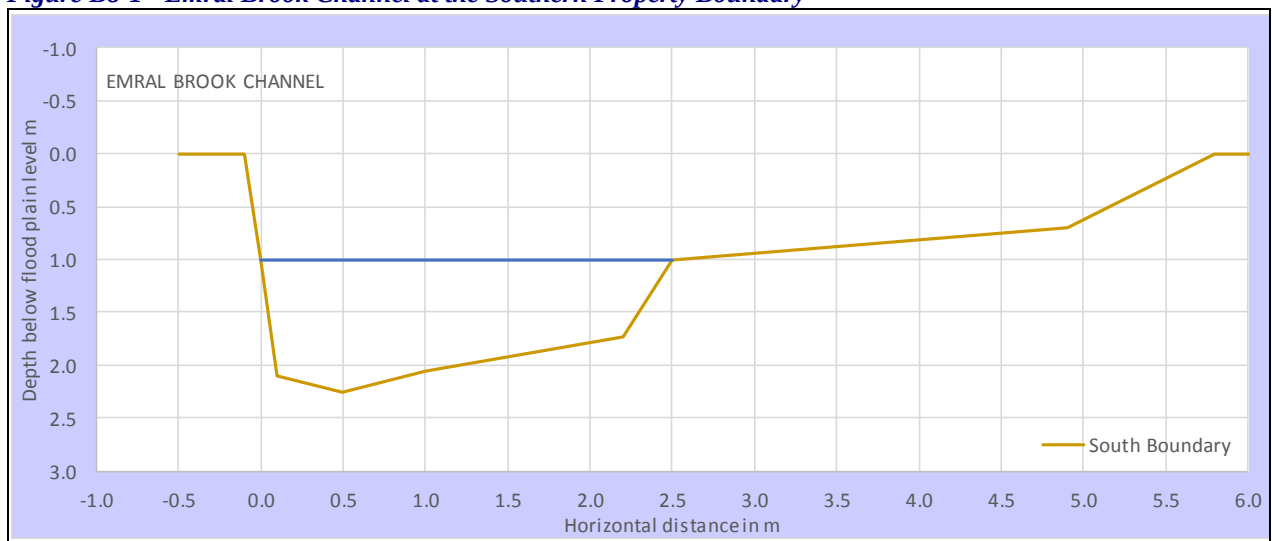


**Figure B6-3 Floodplain Long Profile through Proposed Lake area**

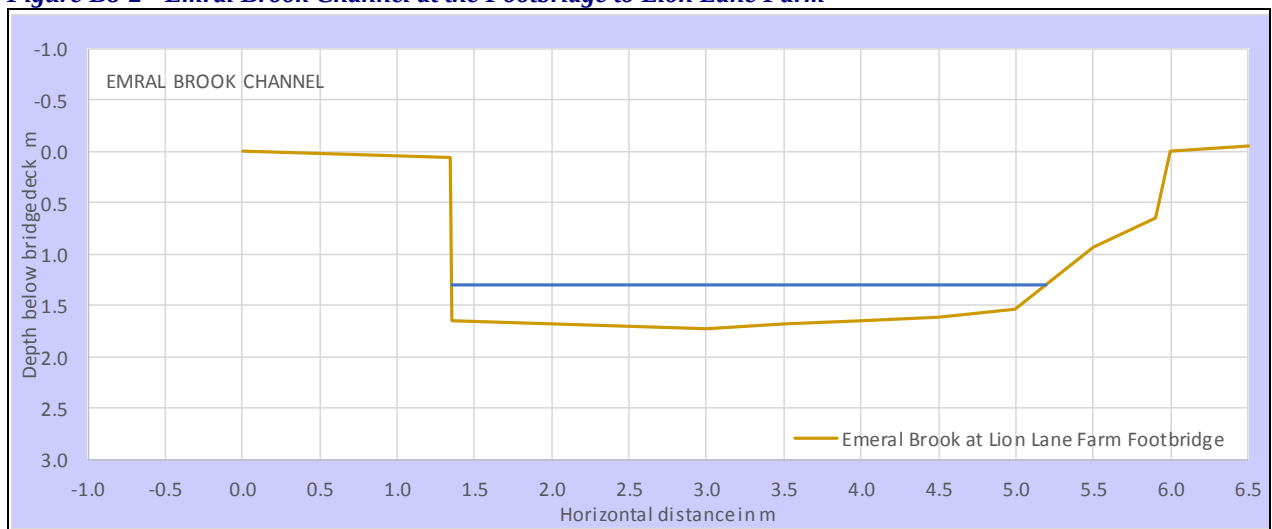


## B-8 Cross-Sections from Field Survey

**Figure B8-1** *Emral Brook Channel at the Southern Property Boundary*



**Figure B8-2** *Emral Brook Channel at the Footbridge to Lion Lane Farm*



Note: All views looking downstream