

They will support mixed arable farming and grassland, and occur in the project area from the glacio-fluvial outlier at Lion Lane Farm and upstream in the Emral Brook catchment.

Soilscape 6 will allow infiltration and recharge of groundwater, which may then feed the base of the proposed lake. If there is arable farming, this may result in the presence of nitrate in groundwater, with siltation and nutrient enrichment occurring in streams from soil erosion on certain of these soils.

3-3 Lake Storage

The proposed lake will be formed by excavation of alluvial deposits down to a maximum depth of 3 m bgl, that is 35 m OD. The soil arising from the excavation will be deposited as a low segmented mound with micro-relief and surface area of 8,400 m² at the southern end of the floodplain, outside the maximum flood extents of Emral Brook. The floodplain field where work will be carried out [project site] covers an area of 53,224 m² of which the lake will occupy 8,439 m² with a volume of 0.012 Mm³ at top water level of 38 m OD. The area of the proposed lake would therefore cover 15.9% of the designated area of existing floodplain.

The storage-elevation characteristics are shown in [Figure 3-2](#), and summarised in [Table 3-1](#).

Figure 3-2 Storage Characteristics of the Proposed Lake

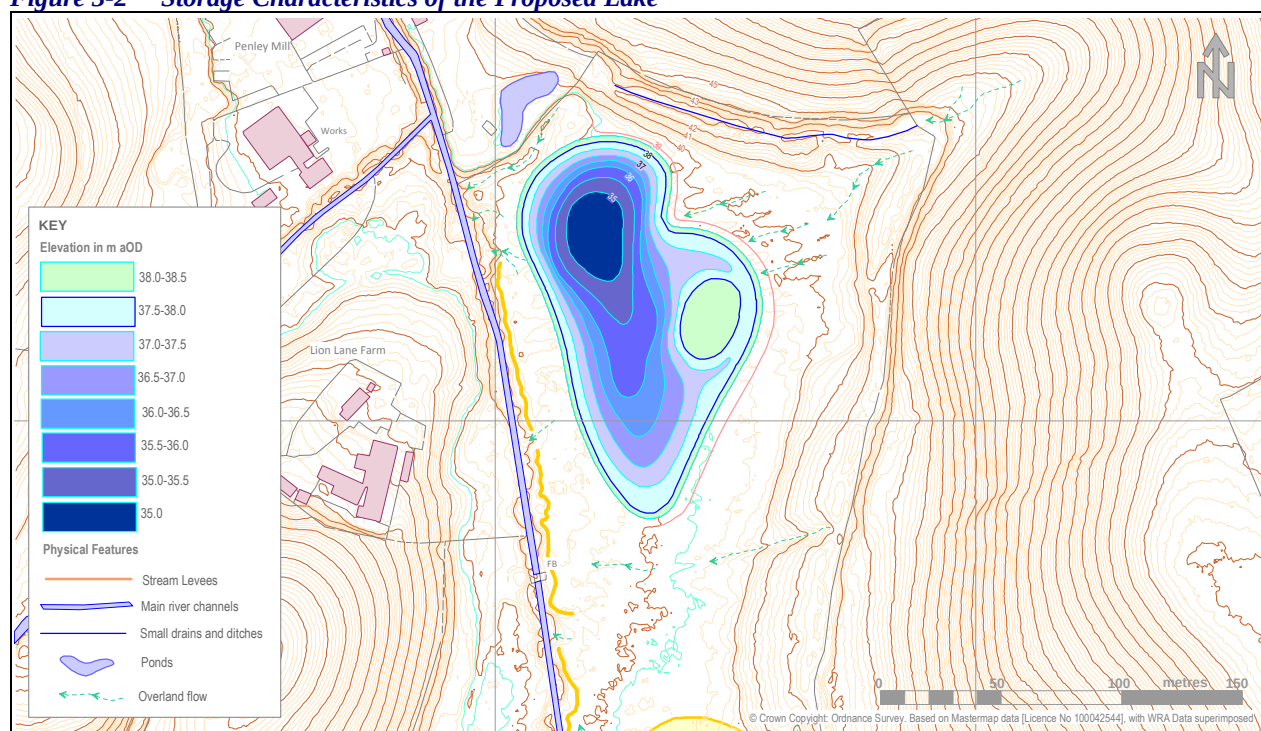


Table 3-1 Storage Characteristics of the Proposed Lake

Elevation	m	35.0	35.5	36.0	36.5	37.0	37.5	38.0	38.5
Volume	Mm ³	0.000024	0.000555	0.001566	0.003143	0.005274	0.008086	0.011791	0.016274
Area	Mm ²	0.000709	0.001461	0.002640	0.003697	0.004855	0.006428	0.008439	0.009505

3-4 Impact of Geology on Lake Performance

In excavating the lake to a depth of 3 m, the construction is likely to intercept the underlying glacio-fluvial sand and gravel which will contain groundwater, in addition to minor seepages in silty sand lenses in the clay alluvium. The distribution of alluvial deposits and glacio-fluvial sands is shown in [Figure 3-3](#), based on 1:10,560 BGS mapping [Sheet SJ43NW] and revised using field mapping: it can be seen that the permeable sand and gravel extends under the clay-dominant alluvium and is exposed on the hillside to the east of the proposed lake area.

A number of boreholes were drilled in the vicinity of Penley for BGS Industrial Minerals Assessment Unit, including one in the alluvial deposits at Penley Mill [Borehole SJ43NW10]. This borehole was drilled to a depth of 16.5 m, and encountered 3.4 m of alluvium overlying glacial sand and gravel, as summarized in

Table 3-2. Ground level at the borehole is recorded as 40.0 m OD, and groundwater was struck at a depth of 4.4 m bgl [35.6 in OD] in the glacio-fluvial sand and gravel. The borehole record is dated April 1980.

Figure 3-3 *Geology of the Lake Area and Cross-Section Location*

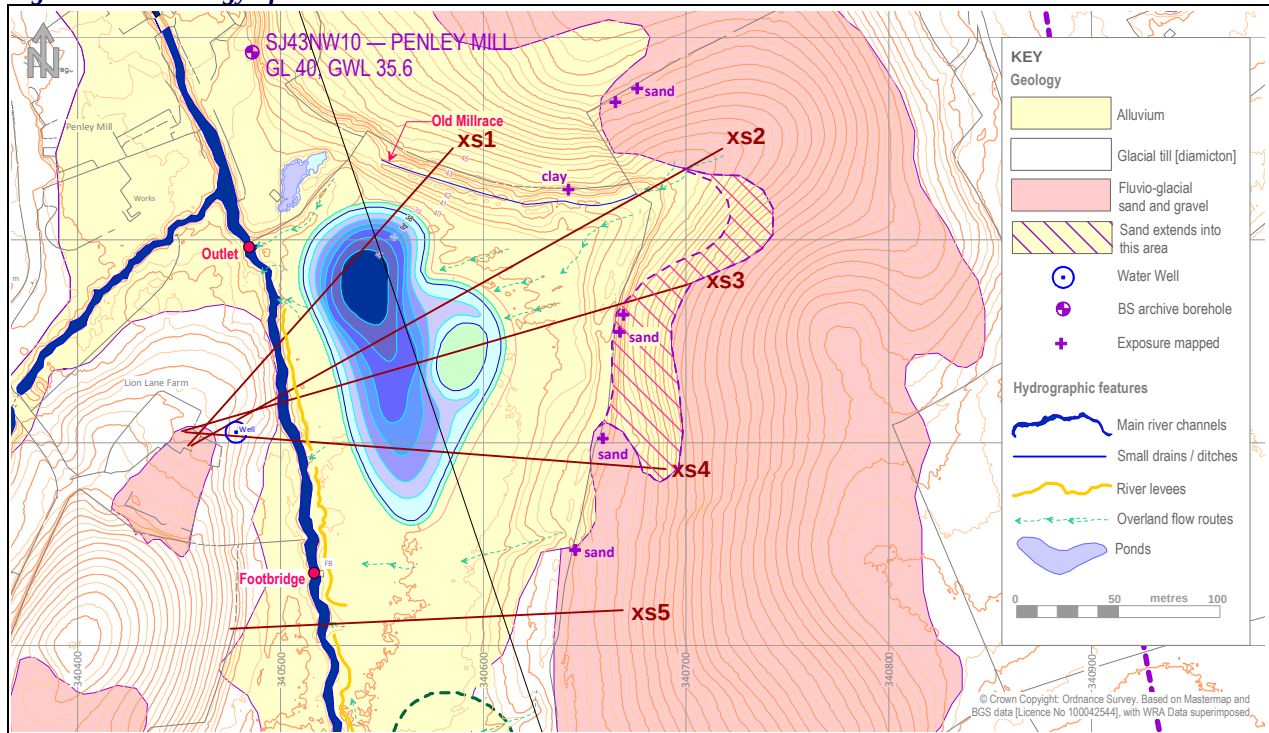


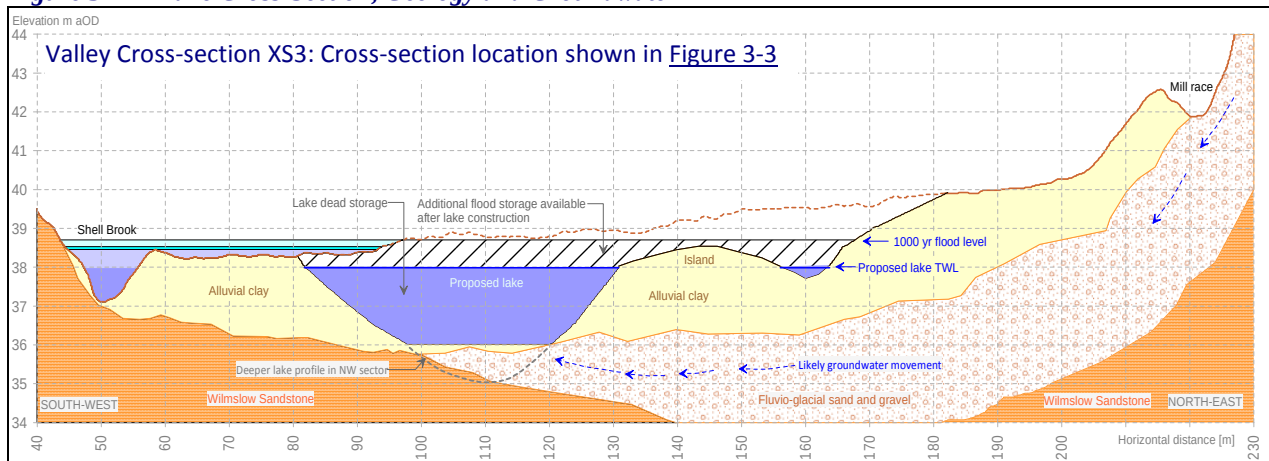
Table 3-2 *Lithology and Particle Size Distribution for Borehole SJ43NW10*

Formation	Lithology	Fines	Sand			Gravel			Thickness m	Depth m bgl
			Fine	Medium	Coarse	Fine	Coarse	Cobble		
Alluvium	Clay	Sandy, soft with a few pebbles							3.4	3.4
Glacio-fluvial sand and gravel	Pebbly sand	8	16	51	3	8	8	6	1.0	4.4
	sand	3	35	62	0	0	0	0	3.0	7.4
	sand	3	35	59	2	1	0	0	9.1	16.5

Although most of the lake excavation will occur in alluvial clays, it is likely that groundwater will be encountered in the bottom 0.5 m or so of the deeper part of the lake, which will require dewatering during construction.

The potential interaction with the proposed lake is best understood by looking at the lake in cross-section, as shown in Figure 3-4. Additional cross-sections are provided in Appendix B-5.

Figure 3-4 *Lake Cross-Section, Geology and Groundwater*



The cross-section shows that rainwater and runoff infiltrating on the slopes to the east, will feed groundwater circulation under the lake, and if a connection is made by excavation into the glacio-fluvial sand, this will help maintain water in the lake and keep the water sweet.

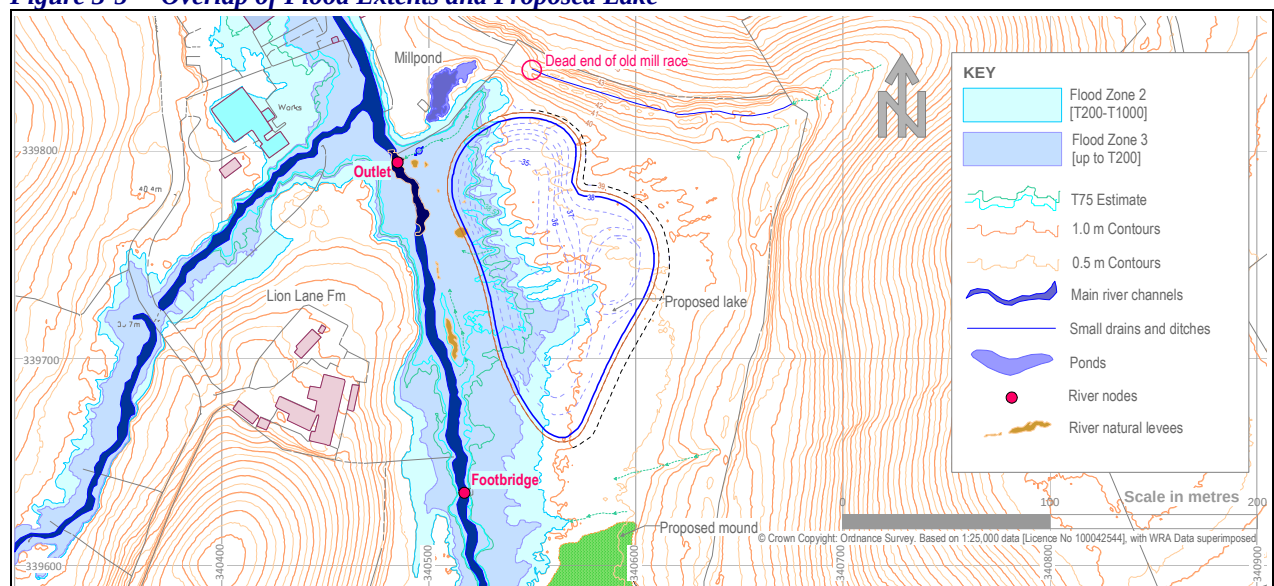
It may be decided to limit excavation to 2.5 m bgl, or to stop when groundwater is struck, rather than dig deeper and dewater, which will require desilting before discharge to the Emral Brook, along with a temporary discharge permit.

There are three dug-wells in the locality excavated in or near the edge of the alluvial deposits at Lion Lane Farm, Llanerch Panna and Ellesmere Lane. These wells were investigated in an attempt to determine groundwater level in formations underlying the alluvium. The well at Lion Lane Farm remains open and protected by a flagstone and cover. However, earth has fallen into the hole partially filling it and making it impractical for observing water level. The well at Llanerch Panna is marked but a flagstone placed over to facilitate ploughing the field for mangel wurzel, so access was not feasible. Photographs are included in [Appendix C](#).

3-5 Impact of Lake on Floodwater Movement

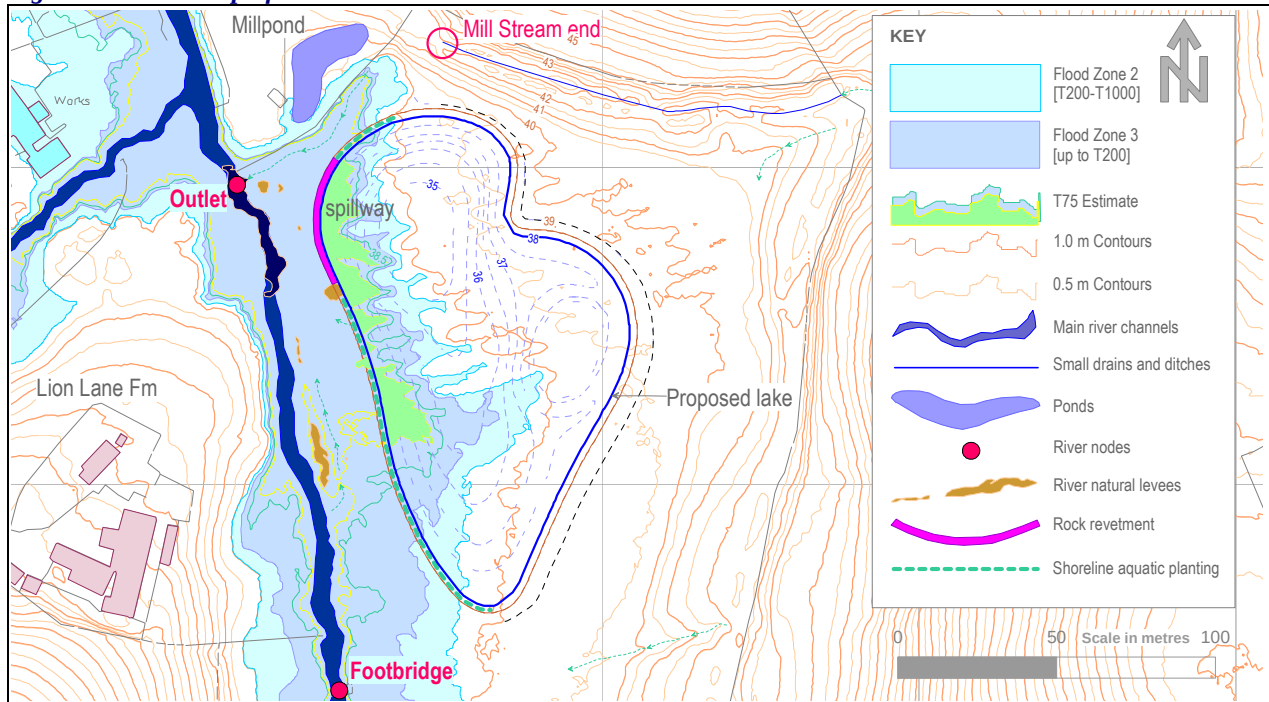
When existing bank-full conditions are exceeded, floodwater will leave the Emral Brook channel and flow parallel to the channel in the nearest section of floodplain separated from the main channel by natural levees. This strip will expand as the flood becomes larger and partially overlap the proposed lake. The flood extents, levees and lake outline are shown in [Figure 3-5](#).

Figure 3-5 *Overlap of Flood Extents and Proposed Lake*



The lake section in [Figure 3-4](#) shows that there will be a significant gain in floodplain storage, as maximum predicted T1000 flood extents only overlap the western 25 m width of the lake, which will be generally of the order of 54 to 83 m wide. An estimate of this gain in floodplain storage at T1000 flood level is 5900 m³ [Flood lift × lake area less island: 0.7 m × 8439 m²]. This will result in lower predicted flood levels downstream, as new storage in the lake attenuates discharge passing along the floodplain corridor.

Floodwater will move into the proposed lake from the south-west, and overflow at the north-west corner, as a result of the hydraulic gradient of the flood and general floodplain gradient of 0.0041 from south to north. The floodplain halves in width just downstream of the lake outlet so water will converge and flow velocity will accelerate at that point. For that reason, the lake outlet should be provided with protection along a 40 m length of the lake margin, in the form of placed-stone revetment. This will ensure the integrity of the lake and prevent long-term erosion, and is shown in outline in [Figure 3-6](#).

Figure 3-6 *Overlap of Flood Extents and Shoreline Protection at NW Corner*

3-6 Proposed Access Track

The landscape plan shows a proposed access track for maintenance, to be located between the stream and lake, which would cross through ground which is currently very boggy. This would also lie in the active floodplain and pass across the NW lake outlet where flow velocities during flood will be higher.

The route of the proposed track would also have to pass over the old overflow ditch which is some 2 m deep and has a groundwater spring issuing just upstream of the proposed track. It would be better to locate the route around the periphery of the floodplain, as shown in [Figure 3-7](#).

Figure 3-7 *Improved Position of the Access Track*