Abbey Consols Site Remediation	**Grid reference:** SN 74381 66157			**Water body ID No.** GB110062043540			**Name of water body and River Basin District**: Teifi - headwaters to confluence with Meurig; Western Wales	
Project Design	**Hydro-morphological designation**	**Current Overall Status**	**Status Objectives**	**Biological elements**	**Chemical elements**	**Hydro-morphological elements**	**Mitigation**	**Assessment**
The former mine and mine processing site was identified as the main source of zinc (and cadmium) pollution of the Afon Teifi. The remediation targets the two main sources of pollution, i.e. mine water discharge and mine waste on site. Detailed studies show that the mine waste on site needs to be isolated from water contact as much as practical. This will be achieved via consolidation of the waste materials in smaller areas and capping of the materials to stop rainfall percolation through the waste. This will also stop the erosion of waste tips towards the Teifi. In addition, groundwater levels need to be controlled with drains to avoid contact between groundwater and waste materials. Earthworks in or adjacent to the river are not required for that. A plan of the schemes outline design is available within Figure 4. Mine water currently discharges via a buried adit towards the waste tips with most of the mine water flowing in a ditch directly towards the Teifi. A formal mine water capture structure at the adit entrance followed by a closed channel to minimise contact with the ground are proposed. The water will be taken to a treatment area which is proposed to be developed within the current waste tip area. Treatment processes are currently designed aiming to remove as much heavy metal loading as reasonably practical. Treatment is expected to occur in lagoons with some basic chemical dosing to optimise the pH conditions to precipitate metal carbonates (no harmful chemicals are proposed). Rainfall run-off from the capped waste tips will be collected and together with the treated mine water and captured groundwater be taken to a new outfall to the Afon Teifi. Two outfall options are considered at detailed design and both options form part of this assessment. Option A (see Figure 1 & 2) avoids direct discharge to the river, using a soakaway system slightly upgradient of the floodplain. Option B (see Figure 3) is based on a direct discharge structure at the river bank. The attached figures indicate locations and concept designs for the two outfall options. Both options aim to minimise works adjacent to the river.	Not designated as artificial or heavily modified.	Moderate	**Overall Objective:** Good by 2021 **Chemical Objective**: Good by 2015 **Ecological objective:** Good by 2021	**Current Ecological status:** Moderate **Fish** Good **Inverts:** Good **Macrophytes:** Good **Diatoms:** Good	**Ph:** moderate **Dissolved Oxygen:** high **Biological Oxygen Demand (BOD):** high **NH_3:** high **Temp:** high **Phosphate**: good **Arsenic:** high **Copper:** high **Dimethoate:** high **Iron:** high **Zinc:** moderate **Manganese:** high **Cadmium:** high **Clorvinfos:** high **Diazinon** high **Lead:** high **Nickel:** high	The baseline hydromorphological condition would be assessed through a geomorphological walkover survey and detailed desk study.	**Construction Mitigation** Ensure impacts on river bed are avoided by designing outfall outside the river. Avoid mobilisation of sediments during construction and operation via good practice silt/sediment management and appropriate drainage design (surface water management system). Avoidance of earthworks during very wet site conditions. Work in close proximity to the river will need to be undertaken outside the spawning period of sensitive migratory species during the months July, August and September. **Operational Mitigation** <u>Outfall Option A</u> None required. <u>Outfall Option B</u> Outfall option B would require robust embedded mitigation in order to neutralise the anticipated potential impacts of the structure on WFD hydromorphology quality elements. The specific mitigation measures would be determined by understanding the baseline morphology of the reach. However, standard embedded mitigation could be incorporated into the design of the outfall, including (but not limited to): careful consideration of scour and erosion control and, where practicable, use of green or grey engineering solutions; appropriate placement of the outfall, i.e. avoiding areas of active erosion or naturally high shear stress; ensuring the correct angle of the outfall and avoiding protrusion of the structure. Geomorphological field survey	**Effect on WFD Objectives to achieve Good Ecological Status** The remediation scheme is driven by the objective to improve the WFD status of the Afon Teifi by minimising the heavy metal loading discharging from the site into the Teifi. **Temporary impacts during construction** No construction activities are planned within the river and construction of minor structures (headwall) or pipeworks in close proximity to the river will be minor and only for a short period. The main earthworks related to the waste tips will be undertaken at substantial distance (>50m) from the river and mobilisation of sediments can be managed by good practice measures (Environmental Action Plan to specify requirements). A surface water management plan will be implemented by the contractor(s) to ensure that the surface water runoff can be adequately contained and treated to limit the risk of polluting discharges entering the watercourse. Surface water quality discharges will be monitored before during and after construction of the scheme. It can therefore be concluded that the construction activities associated with the proposed remediation scheme would not prevent the water body from reaching Good Ecological Status. **Permanent effect during operation** The proposed remediation scheme aims to mitigate the currently uncontrolled release of heavy metals to the Afon Teifi. The remediation measures including the surface and groundwater management and mine water treatment measures will alter the site drainage but with negligible impacts on the Teifi flows. **<u>Physicochemical</u>** It is not anticipated that the scheme will lead to a deterioration in the WFD chemical elements for the watercourse. The scheme is designed to improve water quality by reducing the levels of zinc, lead and cadmium released from the site into the water environment. **<u>Biological</u>** It is not anticipated that the scheme will lead to a deterioration in the WFD biological elements for the watercourse. The scheme is designed to improve water quality and this in turn will help the waterbody achieve its objectives. **<u>Hydromorphological</u>** <u>Outfall Option A</u> Outfall option A is not anticipated to have an adverse impact on the hydromorphological quality elements of the Afon Teifi, therefore no further assessment would be required. <u>Outfall Option B</u> Outfall option B has the potential to adversely impact a number of WFD hydromorphology quality elements, however, due to its small-scale and proposed mitigation measures, it will not prevent the water body from achieving Good Ecological Status. Therefore, no further WFD assessment is

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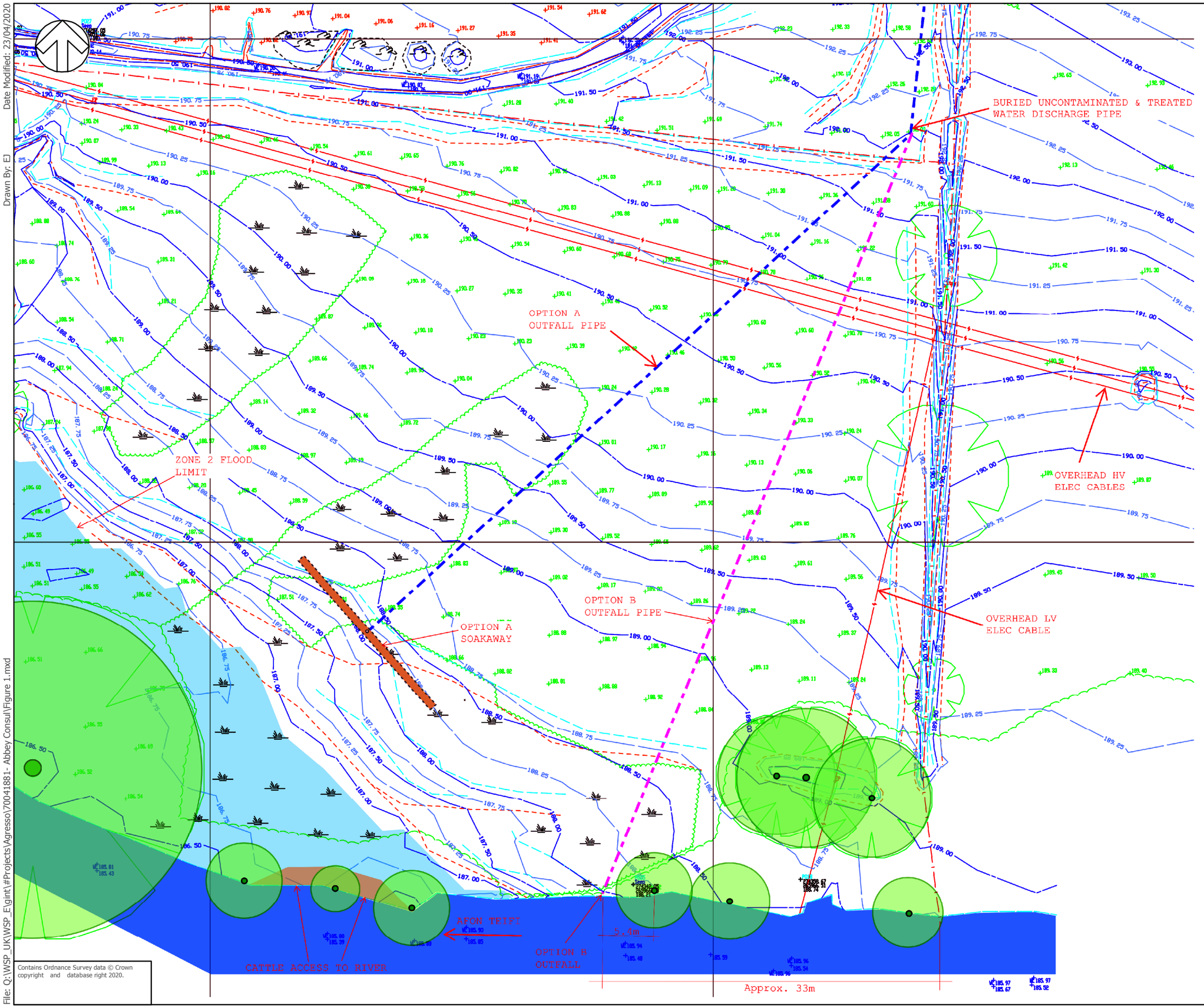
Project Design	**Hydro-morphological designation**	**Current Overall Status**	**Status Objectives**	**Biological elements**	**Chemical elements**	**Hydro-morphological elements**	**Mitigation**	**Assessment**
							would inform the most appropriate mitigation options; however mitigation could include: riparian planting; green scour/erosion control; and habitat creation. Consultation with Natural Resources Wales would be sought in order to define the level of mitigation required.	required. The nature of the proposed outfall (i.e. bank-side structure above the mean water level) is identified as a potentially high impact option (SEPA, 2019: Engineering in the Water Environment, Good Practice Guide, Intakes and outfalls) and thus must be designed and mitigated appropriately, particularly as the Afon Teifi is designated as a SSSI and SAC. Note: lower impact options are not viable for this site due to insufficient water depth. A high-level assessment of each hydromorphological quality element and suggested mitigation is presented below: 1. **Quantity and Dynamics of Flow**: Bank erosion and bed scour triggered by the proposed outfall could instigate geomorphic adjustment that leads to an alteration in flow dynamics. Appropriate bank erosion and bed scour protection would eliminate this risk; however, it would have to be done sympathetically in order to avoid deterioration of other quality elements and avoid additional damage. 2. **Connection to Groundwater Bodies:** no anticipated impacts. 3. **River Continuity:** The proposed outfall may impact upon lateral and longitudinal connectivity, particularly if the structure triggers bank erosion and associated geomorphic adjustment. Appropriate and sufficiently well-designed embedded mitigation would eliminate these impacts. 4. **Structure and Substrate of the Riverbed:** the proposed outfall may have an adverse impact on the local riverbed through bed scour and redistribution of bed material downstream. Appropriate and sufficiently well-designed embedded mitigation would eliminate these impacts. 5. **Structure of the Riparian Zone.** The proposed outfall would lead to a direct loss of riparian habitat and thus would require appropriate mitigation to offset this loss. In addition, it is likely that the proposed outfall would require erosion protection which could increase the zone of influence of the structure. Green engineering techniques would be the preferable method of protection; however, this would still need to be offset through mitigation to neutralise its impacts. Moreover, if green engineering solutions are not viable, the mitigation measures required to neutralise its impacts would need to be more robust than those required to offset green engineering impacts.

Date Modified: 23/04/2020

Drawn By: EJ



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A		EJ 23/04/20	TE 23/04/20	TE 23/04/20

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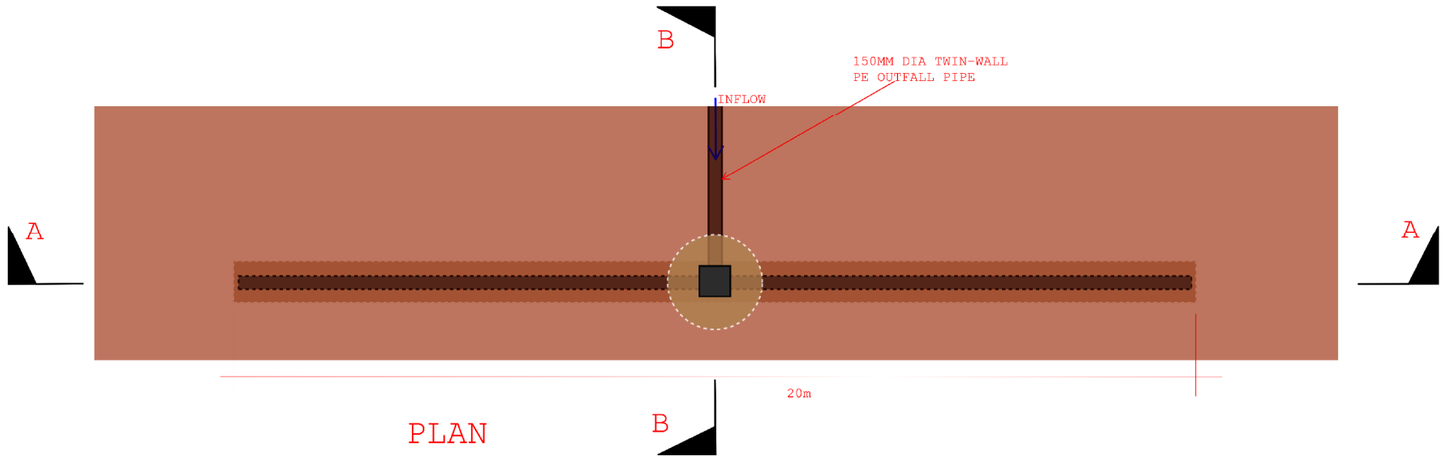
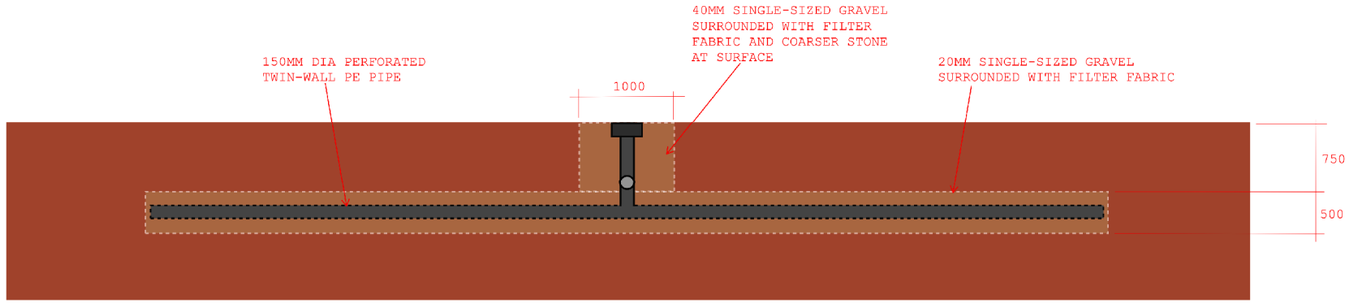
Metal Mine Remediation Project

Figure 1
Outfall Options Routes

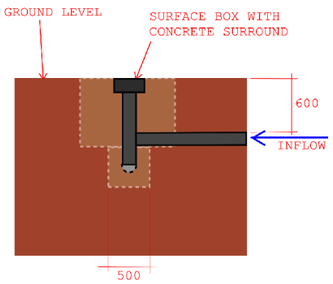


PLAN

NOTES:
1. Dimensions are in mm unless otherwise stated



SECTION A-A



SECTION B-B

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A		EJ 23/04/20	TE 23/04/20	TE 23/04/20

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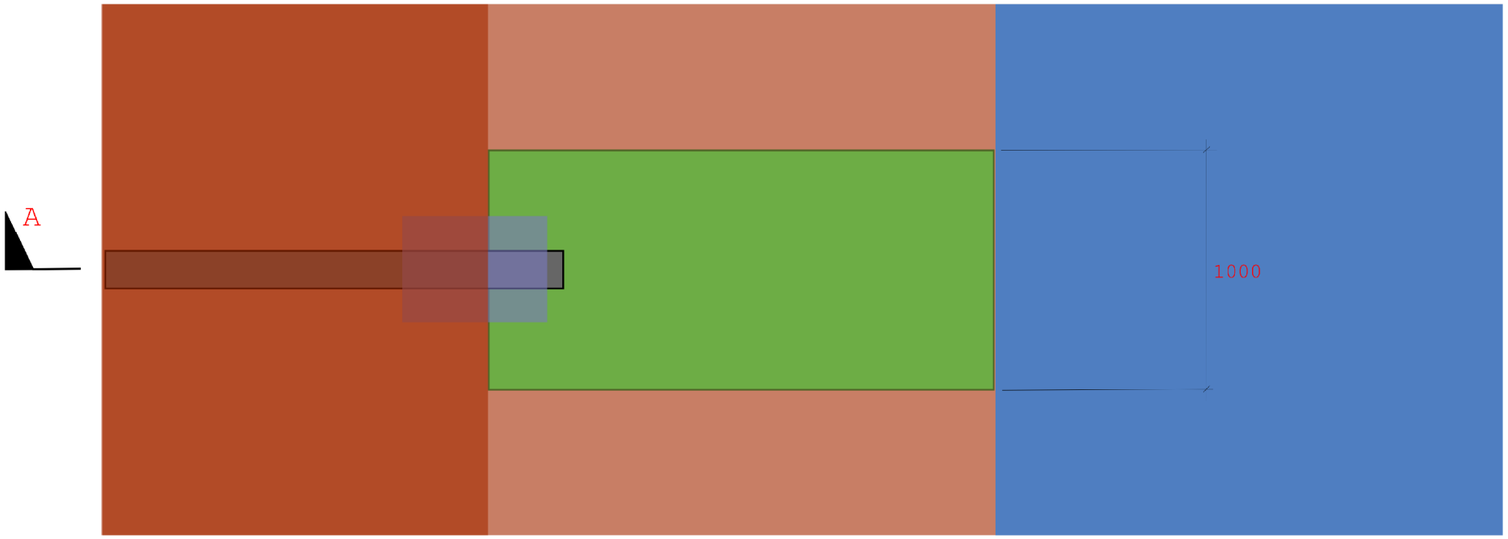
Figure 2
Outfall Option A Soakaway

Drawn By: EJ Date Modified: 23/04/2020



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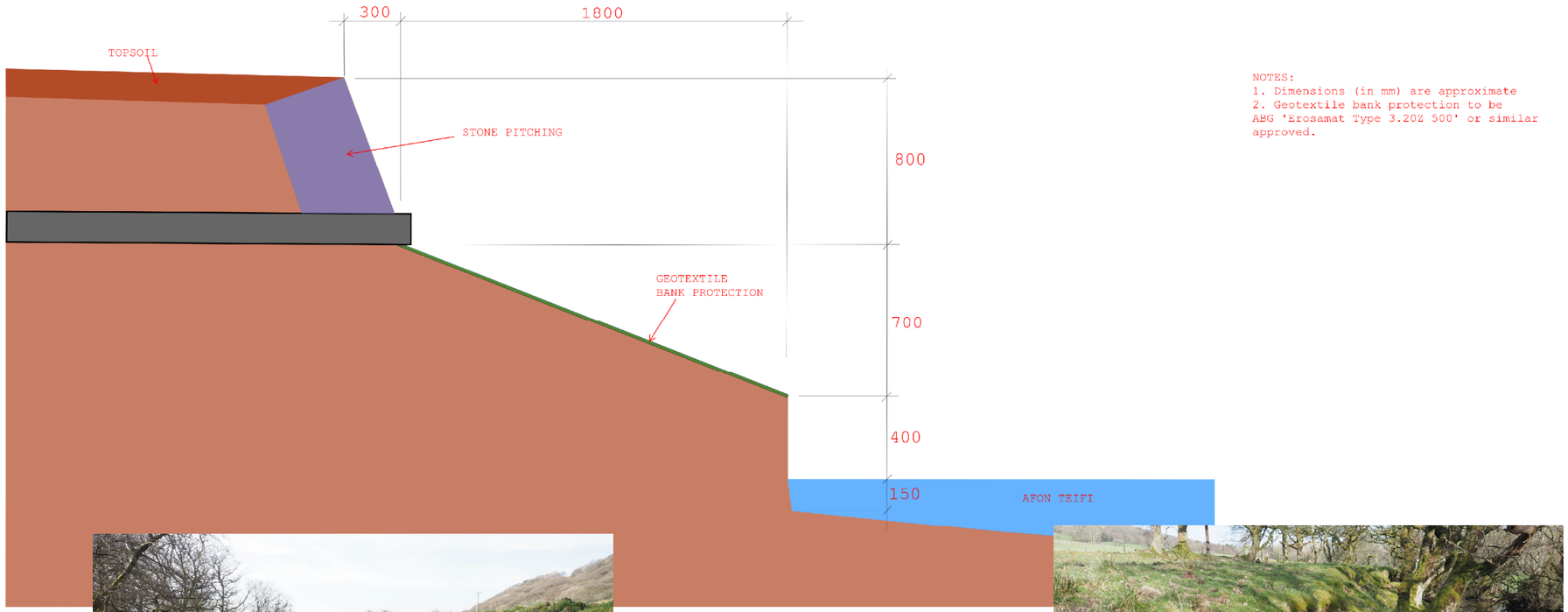
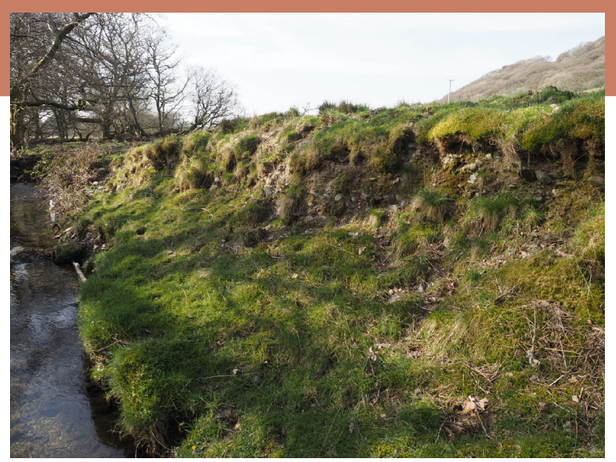


SECTION A-A



NOTES:
1. Dimensions (in mm) are approximate
2. Geotextile bank protection to be ABG 'Erosamat Type 3.20Z 500' or similar approved.

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Figure 3
Outfall Option B
(Direct Discharge to River)

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Adit portal will be excavated, backfilled to current levels, with water being captured inside the adit and then carried to treatment area.Manhole will be installed for access.

Adit discharge (contaminated)

Filter drain to remove surface water from base of capping

Existing drains to be retained (clean)

Shallow clay wall (1.5m) to avoid the seepage from the marshy area to the west travelling back into tips

Existing marsh area to be retained

New culverted section below existing road

Gated entrance

New culverted section below existing road

Open channel to convey adit discharge to treatment area. Channel to include capping underlay.

Piped groundwater from north of road and groundwater drainage along eastern boundary

Limestone Lagoon

Filter drain to remove surface water from base of cap

High groundwater drain

Limestone Bed

Vertical Flow Reactor

Treated mine water feeding into uncontaminated water discharge route

Clean water discharge route from site

Area for positioning discharge outlet to river

Afon Teifi

0 5 10 20 30 40 50 Metres

KEY

- Existing Drain
- Adit
- Adit Water Drain
- Groundwater Collector Drain
- Surface Water Drain
- Clay Wall
- Archaeological features that could be indicated with future topography
- Capped surface major contour
- Capped surfaces minor contour
- Capped area
- Area to be regraded
- Access road
- Footpath
- Treatement Ponds
- Chemical dosing kiosk and storage area

Ver	Amendments	Originated by and date	Checked by and date	Approved by and date
A		DH 25/07/2019	TH 25/07/2019	TE 25/07/2019

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Client : Cyfoeth Naturiol Cymru Natural Resources Wales

Project : Abbey Consols Metal Mine Remediation Project

Drawing Title : General arrangement plan

Drawing No : Figure 04

Scale @ A3 : 1:850

Purpose : Information

Path: \\uk.wspgroup.com\Central Data\Projects\700418xx\70041881 - Abbey Consols mine water FS\02 SW Data\00 GIS Work\01 GIS\01 MXD\10 Outline design planning figures\Figure 04 General arrangement plan.mxd