CHAPTER 11 – THE WATER ENVIRONMENT

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List of Acronyms

BAT	Best Available Technology
BGS	British Geological Survey
CEMP	Construction Environmental Management Plan
CEH	Centre for Ecology & Hydrology
CEMP	Construction Environmental Management Plan
Development	All activities within the red line planning boundary (see Drawing ECL-BQ-000 in Technical Appendix TA1-1)
Development Site	The physical site on which the Development is to be located as defined by the red line planning boundary (see Drawing ECL-BQ-000 in Technical Appendix TA1-1)
DEMP	Demolition Environmental Management Plan
DRO	diesel range organics
DWS	Drinking Water Standard
ERF	Energy Recovery Facility
EPH	extractable petroleum hydrocarbons
EQS	Environmental Quality Standard
EQS	Environmental Quality Standard Directive
FCA	Flood Consequences Assessment
FEH	Flood Estimation Handbook
NGR	National Grid Reference
NRFA	National River Flow Archive
NRW	Natural Resources Wales
PAH	Polyaromatic hydrocarbons
PCC	Powys County Council
SAAR	standard annual average rainfall
SWMP	Surface Water Management Plan
SuDS	Sustainable Drainage Systems
TAN	Technical Advisory Note
WFD	Water Framework Directive

11. WATER ENVIRONMENT

11.1. Introduction

11.1.1. This chapter considers the current baseline hydrogeological and hydrological environments within and surrounding the Development Site with regards to water quality and water flow regimes. The potential impacts of the Development on the baseline water environment and the proposed mitigation and management measures are subsequently presented. Any potential residual effects on the water environment, throughout the life of the Development, are identified.

11.1.2. A formal request for Scoping Direction was submitted to the Planning Inspectorate Wales in August 2018, with their response received October 2018. In their response, the Planning Inspectorate comments as follows:
'The statutory SuDS regime comes into force in Wales on 7 January 2019. While this is a separate legislative regime from the planning regime, there may be practical considerations for the design of the scheme that should be reflected in the ES.'
'As the site is located entirely within Flood Zone A, there is no requirement for a Flood Consequences Assessment.'
'NRW have provided detailed feedback on this section of the SR, and the applicant is advised to continue to liaise with NRW on this section of the ES as work progresses. NRW advise that no enough information has been provided to screen out the requirement for a Water Framework Directive Assessment at this stage.'
The scope and content of this assessment of the water environment has been guided by these documents.

11.1.3. Natural Resources Wales ("NRW") has been consulted for information regarding local baseline surface water quality, groundwater quality, groundwater level and rainfall data and responded on 10th October 2018[i].

11.1.4. Powys County Council ("PCC") has been consulted for details of Private Water Supplies within the vicinity of the application site and responded on 9th August 2018[ii].

11.1.5. A site meeting was held with Simon Crowther, Powys County Council Land Drainage Engineer and Rachel Probert, Powys County Council Ecologist, on 18th March 2020 to discuss the surface water management proposals for the Development. The Powys County Council representatives were fully supportive of the outline surface water management plan presented within the 2019 pre-application advice request for SuDS Approving Body Approval. This surface water management scheme has therefore been incorporated within the ES.

11.2. Relevant Legislation and Planning Policy

11.2.1. The assessment of the Water Environment has been undertaken with due consideration of the following relevant legislation:

- **Water Framework Directive (Directive 2000/60/EC)** – implemented via the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. A legislative framework for the protection of surface waters and groundwater.

- **The Planning Inspectorate, Advice Note 18: The Water Framework Directive** – summarises the legal context and obligations of the Water Framework Directive and presents a staged approach to Water Framework Directive assessments.
- **Directive on Environmental Quality Standards (Directive 2008/105/EC)** – presents Environmental Quality Standards (EQSs) for priority substances and other pollutants, with the aim of achieving good chemical water quality status in accordance with the provisions of the Water Framework Directive.
- **Environmental Permitting (England and Wales) Regulations 2016** – regulation of potentially polluting activities and flood risk activities.
- **Land Drainage Act 1991** – includes duties on landowners to drain land and protect land from flooding.
- **Flood and Water Management Act 2010** – Schedule 3 provides a framework for the approval and adoption of surface water drainage systems serving new developments. Schedule 3 came into effect in Wales on 7th January 2019 and requires all new developments of more than 1 dwelling house or construction area of 100m^2 or more, to include sustainable drainage systems (SuDS) which must comply with the national statutory SuDS standards[iii].
- **Planning Policy Wales** (Edition 10, December 2018) and supplementary Technical Advice Note 15: Development and Flood Risk (TAN15) - provides guidance on reducing flood risk to development.
- **Powys Local Development Plan 2011-2026 (Adopted April 2018)** – Policy DM5 – Development and Flood Risk, and Policy DM6 – Flood Prevention Measures and Land Drainage provide local planning policy requirements and guidance regarding flood risk and surface water management.

11.2.2. Other relevant technical guidance documents are referenced throughout the chapter.

11.3. The Existing Environment

11.3.1. This section of the chapter details the Development Site's current baseline Water Environment and is based on a thorough desk study exercise, consultation with Powys County Council and Natural Resources Wales, and a site walkover undertaken by an experienced hydrologist/hydrogeologist on 25th September 2018.

11.3.2. The baseline is as defined in Chapter 2 – The Approach to the EIA.

Environmental Assessment Boundary

11.3.3. The study area for the water environment extends to a 1km radius from the boundary of the Development Site. However, the assessment includes water bodies and abstractions extending outside of this area based on professional judgement of their value and connectivity to the Development Site.

Base Line Conditions - Geology

11.3.4. The Development Site currently comprises Buttington Quarry void and associated access road and adjacent land used for stockpiling to the south-west of the void. Buttington Quarry is an opencast mudstone and clay pit which supplied the former neighbouring brickworks and has been operational since the late 19th Century. Following closure of the brickworks, the quarry has operated on a small scale to produce general aggregate from an area south-west of the main quarry void.

11.3.5. Extracts of the British Geological Survey ("BGS") on-line mapping, presenting the superficial geology and underlying bedrock geology, are included as Drawings 11/1 and 11/2 respectively[iv] which may be found in Technical Appendix 11-1.

11.3.6. Table 11-1 presents a summary of the local geology within the Development Site, as illustrated on Drawings 11/1 and 11/2, Technical Appendix 11-1. The geological details summarised in Table 11-1 are based on BGS published mapping and descriptions, supplemented through a geotechnical site investigation undertaken in October/November 2018[v].

Table 11-1: Buttington Quarry – Local Geology

Geological Unit (& Age)	Distribution (outcrop) within the Development	Approximate Vertical Thickness	BGS Published Geological Description
Superficial Deposits			
Head (Quaternary)	NE site boundary	Site investigation confirms typical thickness of 1m, where present	Clayey and silty gravel
Glaciofluvial Fan Deposits (Quaternary, Late Devensian)	SE site boundary		Gravel, sand and silt
Till (Quaternary, Late Devensian)	Southern and NW site boundaries		Gravelly clay
Bedrock Geology			
Trewern Brook Mudstone Formation (Silurian, Wenlock)	Outcrops along the south-eastern margin of the site and extends to the SE, as a NE to SW trending outcrop.	Up to 400m	Mudstone, silty, formed in a marine environment
Tarannon Mudstone Formation (Silurian, Llandovery)	Outcrops within the quarry footprint as a NE to SW trending outcrop.	150m	Mudstone, formed in a marine environment
Cefn Formation (Silurian, Llandovery)	Outcrops along the north-western margin of the site as a NE to SW trending outcrop.	200m	Grey mudstone with thin sandstone beds, formed in a marine environment
Stone House Shale Formation (Ordovician, Caradoc)	Limited outcrop along the NW margin of the site. Extends NW towards the River Severn (beneath superficial deposits)	650m +	Mudstone, formed in a marine environment

11.3.7. The published geological maps indicate that superficial deposits are largely absent from the Site and limited to peripheral areas only, as outlined in Table 11-1. This was confirmed by the site geotechnical investigation. Any superficial deposits within the main void of Buttington Quarry have been removed during historic quarrying activities. More extensive superficial deposits are present immediately surrounding the Site, including Glaciofluvial Fan Deposits to the south-east, Glaciolacustrine Deposits to the north-east and Alluvium to the north-west associated with the River Severn.

11.3.8. The geological map indicates areas of Made Ground around the northern, eastern and southern margins of Buttington Quarry void, forming the quarry rim. The definition of Made Ground includes mine and quarry waste and these areas are considered to represent predominantly clay overburden and other quarry waste.

11.3.9. With regards to the bedrock geology, the Development Site lies on the north-western limit of the Long Mountain Syncline with the strata dipping steeply towards the south-east. Successively younger rock strata outcrop in a south-easterly direction.

11.3.10. The bedrock geology within the Development SIte comprises Silurian shales and mudstones, which are detailed within the Chapter 15 - Geotechnical and Materials Management and summarised here.

11.3.11. The Silurian bedrock are bedded and dip very steeply (75°–85°) towards the south-east and the three lithologies encountered within the Development Site are the Cefn Formation, Tarannon Mudstone Formation and Trewern Brook Mudstone Formation. These strata were described within the 2018 site investigation as follows.

11.3.12. The Tarannon Mudstone Formation was found as weak dark reddish brown locally light greenish grey mudstone with closely spaced fractures stained orangish brown. Bedding fractures were recorded as orientated 75°- 85° with primarily planar smooth to polished surfaces. Other fractures were found to be variable in orientation and reported as clean and generally tight to open.

11.3.13. The Cefn Formation was found to be completed weathered to soil to around 1m depth. This graded into extremely weak dark grey mudstone with bands of non-intact laminated mudstone and siltstone. Bedding fractures were identified by their 80°- 85° orientation. Fracture planes were also present, with varying orientations and fractures were generally clean.

11.3.14. The Trewern Brook Mudstone Formation was found weathered to very gravelly clay soil in some areas to 1.0m depth. In general, it is formed of weak grey to dark grey mudstone beds, initially non-intact or very weak in areas and becoming medium strong to strong at depth. Bedding fractures followed a 75°- 85° orientation. Other fractures and joints were prevalent, and most fractures were clean. Mineralisation of some fractures was noted, but these were typically no wider than 1mm.

11.3.15. The north-eastern end of Buttington Quarry void is designated as a geological Site of Special Scientific Interest (“SSSI”). The SSSI extends to 0.7 hectares and displays a continuous sequence of rocks from Llandovery to Wenlock age. It includes the type section of the Buttington Shale Formation, a sequence of shales with a diverse microflora and microfauna from the upper part of the Llandovery Series. The site also includes a section

across the Llandovery-Wenlock boundary, showing the contact between the upper part of the Buttington Formation (Tarannon Mudstone Formation) and the blue-grey Trewern Brook Mudstone Formation[vi].

Base Line Conditions - Aquifer Characteristics

11.3.16. The 1977, 1:625,000 scale Hydrogeological Map of England and Wales[vii] identifies the Site and wider geological area of Silurian and Ordovician bedrock as a "*region underlain by impermeable rocks, generally without groundwater except at shallow depth.*" The bedrock is described as rocks which have been deformed tectonically and are highly indurated (hardened). "*In general, they have little or no groundwater except in areas where deep weathering has produced a sub-surface permeable zone in which perched water tables may occur.*"

11.3.17. The British Geological Survey has published an updated 1:625,000 scale hydrogeological map of the UK to provide a regional guide to aquifer potential. This current, regional map[iv] describes the Silurian (Wenlock and Llandovery) strata as a "*low productivity aquifer – highly indurated, largely argillaceous rocks with limited groundwater".* The Ordovician (Caradoc) strata are described as "*low productivity aquifer – mudstone, siltstone and sandstone with limited yields.*"

11.3.18. More recent studies[viii] confirm that while the Ordovician and Silurian rocks of Wales have traditionally been considered to have low groundwater resource potential, groundwater present in the mudstones and overlying superficial deposits may form an important local resource and/or provide an important contribution to streams and rivers. Primary porosity is generally very low (commonly less than 2%[ix]) with groundwater flow predominantly via the near-surface weathered horizon and discontinuities including bedding plane fractures and faulting which can be at a deeper level.

11.3.19. The local bedrock strata are all classified as Secondary B aquifers[iv] which are defined as: *predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers*.

11.3.20. In terms of groundwater vulnerability, the bedrock geology is classified as medium or high vulnerability[x]. Groundwater vulnerability to pollution is inferred from broad datasets for recharge, soil leaching, superficial cover (thickness and permeability) and the unsaturated zone. Medium vulnerability defines areas that offer some groundwater protection. High vulnerability areas are able to easily transmit pollution to groundwater and are characterised by high leaching soils and the absence of low permeability superficial deposits. The published groundwater vulnerability mapping is at a coarse scale (1km grid) and due to the general absence of superficial deposits within the application site it is inferred that any underlying groundwater would be classified as having high vulnerability.

11.3.21. Superficial deposits are present to a limited extent within peripheral areas of the Site. These deposits are also classified as Secondary aquifers,[iv] as outlined below in Table 11-2. The Alluvium of the River Severn valley to the west of the site and the localised Glaciofluvial Fan Deposits are classified as Secondary A aquifers which are defined as: *permeable layers*

capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

11.3.22. The aquifer characteristics of the local geology are summarised on Drawing 11/3 in Technical Appendix 11-1 and in Table 2 below.

Table 11-2 : Hydrogeological Characteristics

Geological Unit (Description)	Aquifer Designation (1:50,000 BGS Map) and Characteristics
Superficial Deposits	
Head (clayey and silty gravel)	Classified as Secondary Aquifer (undifferentiated). Limited aquifer potential due to predominantly low permeability and very limited lateral extent.
Glaciofluvial Fan Deposits (gravel, sand and silt)	Classified as Secondary A Aquifer. Variable porosity and permeability but limited aquifer potential due to restricted lateral extent and (probable) limited thickness of deposits.
Till (gravelly clay)	Classified as Secondary Aquifer (undifferentiated). Limited aquifer potential due to low permeability (clay) and restricted lateral extent.
Bedrock Geology	
Trewern Brook Mudstone Formation (silty mudstone)	Classified as Secondary B Aquifers. High groundwater vulnerability beneath the Development Site due to absence of Superficial Deposits and negligible unsaturated zone. Very low primary porosity and permeability. Groundwater flow associated with secondary porosity and permeability within the near-surface weathered horizon and discontinuities (including fractures, bedding planes and fissures).
Tarannon Mudstone Formation (mudstone)	
Cefn Formation (mudstone with thin sandstone beds)	
Stone House Shale Formation (mudstone)	

Base Line Conditions - Groundwater Levels and Flow

11.3.23. As outlined above, groundwater flow within the mudstones beneath the Site predominantly occurs within the near-surface weathered horizon and within discontinuities. Groundwater forms a perched groundwater table within the near-surface, higher permeability bedrock, with the direction of groundwater flow predominantly influenced by topography, connectivity of discontinuities and the direction of geological dip (i.e. the orientation of discontinuities).

11.3.24. Ten boreholes were installed within the floor and walls of Buttington Quarry in October and November 2018 as part of the geotechnical site investigation. Borehole logs and a borehole location plan are included within Technical Appendix 13-1, Annex C and Drawings section respectively. Seven of the boreholes were completed with slotted screen for long-term monitoring, with 1.0m of solid casing below ground surface. Groundwater levels have

been monitored within these boreholes on three occasions between November 2018 and March 2020; details are presented in Tables 11-3 and 11-4 below.

Table 11-3: Buttington Quarry Site Monitoring Boreholes

Borehole Reference, Location and Ground Level (GL) (mAOD)	Geology & Borehole Depth (m)
BH1 – Quarry floor, **GL: 88.71**	Tarannon Mudstone; Borehole Depth: 13.85m
BH2 – SE quarry bench, **GL: 111.92**	Trewern Brook Mudstone; Borehole Depth: 43.00m
BH3 – SE quarry rim, **GL: 112.23**	Trewern Brook Mudstone; Borehole Depth: 18.10m
BH4 – SE quarry bench, **GL: 114.35**	Trewern Brook Mudstone; Borehole Depth: 39.45m
BH5 - SE quarry rim, **GL: 118.22**	Trewern Brook Mudstone; Borehole Depth: 17.80m
BH6 – Quarry floor, **GL: 89.17**	Tarannon Mudstone; Borehole Depth: 14.00m
BH7 – NW quarry bench, **GL: 110.52**	Cefn Formation; Borehole Depth: 24.25m
BH8 - SE quarry rim, **GL: 117.23**	Trewern Brook Mudstone; Borehole Depth: 46.45m
BH9 - SE quarry rim, **GL: 115.26**	Trewern Brook Mudstone; Borehole Depth: 14.00m
BH10 – NW quarry rim, **GL: 114.16**	Cefn Formation; Borehole Depth: 11.50m

Table 11-4: Buttington Quarry Groundwater Levels

Borehole Reference, Ground Level (GL) (mAOD)	Groundwater Level					
	21/11/2018		25/03/2019		04/03/2020	
	mAOD	mbgl	mAOD	mbgl	mAOD	mbgl
BH1	88.41	0.30	No access		88.51	0.20
BH2	93.57	18.35	95.8	16.1	98.36	13.56
BH4	101.65	12.69	98.6	15.8	103.40	10.95
BH6	88.90	0.27	88.9	0.3	89.17	0.0
BH7	98.72	11.80	103.1	7.4	No access	
BH8	105.93	11.30	106.1	11.1	114.13	3.10
BH9	105.06	10.20	110.6	4.7	114.76	0.50

Table notes: mbgl = metres below ground level; mAOD = metres above Ordnance Datum

11.3.25. Drawing 11/4 in Technical Appendix 11-1 presents a site plan confirming borehole locations and bedrock geology; the cross-section on Drawing 11/4 includes the range of groundwater levels recorded within the site boreholes over the three monitoring events.

11.3.26. The site investigation boreholes confirm the presence of perched groundwater within the mudstones beneath the site. Groundwater levels within the two boreholes installed within the quarry floor (BH1 and BH6) are consistently shallow, at between 0.0m and 0.3m below ground level (mbgl). This is equivalent to between 88.4mAOD and 89.17mAOD.

11.3.27. Groundwater levels recorded within the peripheral boreholes installed in the quarry walls and rim are more variable, often with significant seasonal variation, and are consistently higher than groundwater levels beneath the floor of the quarry.

11.3.28. Site observations also indicate that the quarry floor approximately coincides with the local groundwater level as evidenced from ponded water and associated vegetation. Site personnel confirmed that the quarry floor dried completely during the prolonged dry summer of 2018. Site personnel confirm there is no evidence of springs or groundwater seepages from the quarry walls, even during or immediately following periods of prolonged rainfall. Any limited groundwater inflows at the base of the quarry are discharged via the local surface water drainage network.

11.3.29. The site-specific groundwater level monitoring data and site observations indicate that incident rainfall readily infiltrates to ground where weathered mudstone is exposed, with groundwater levels responding relatively rapidly to prolonged rainfall events. Beneath the weathered horizon, groundwater flow will preferentially occur via discontinuities including bedding planes and fractures, but the potential for groundwater movement and storage will diminish with depth as the bedrock becomes more competent.

11.3.30. It is noted from the site investigation report[v] that groundwater was not encountered within the majority of the monitoring boreholes during installation. Groundwater gradually flowed into the boreholes from discontinuities intercepted through their length, with the hydraulic connectivity of water bearing horizons likely to be limited.

11.3.31. Review of the schematic regional hydrogeological cross-section on Drawing 11/3 in Technical Appendix 11-1 confirms that the potential for groundwater inflows into Buttington Quarry void is limited due to the elevation of the quarry floor relative to the local topography to the west. Any potential groundwater inflows from higher ground to the east/south-east are limited by the local topography, geology and hydrogeology, with shallow groundwater throughflow emerging as springs on Heldre Hill. Locally, perched groundwater flow is limited to the shallow weathered horizon with movement down-dip or in the direction of topographic fall, to local springs and watercourses.

11.3.32. No significant groundwater flow is anticipated at depth (greater than 30 to 40m)[ix] within the bedrock geology due to the lack of weathering, low primary porosity and permeability. Flow will be limited to fractures and other discontinuities such as bedding planes.

11.3.33. The inferred local direction of groundwater flow within the Development Site is towards the main void and to the south-west, towards the local watercourse, as indicated on Drawing 11/4 in Technical Appendix 11-1. Groundwater flow will be locally influenced by the presence, direction and connectivity of discontinuities.

11.3.34. Natural Resources Wales has not provided any groundwater level data within a 2km radius of the Development Site in their consultation response.

11.3.35. Data from the National River Flow Archive ("NRFA") for the monitoring station at Montford on the River Severn (National Grid Reference: SJ 411 144) provides rainfall data for the catchment of the Severn headwaters, which includes the Development Site. The standard annual average rainfall ("SAAR") for this catchment, between 1961 and 1990 was 1147mm[xi].

11.3.36. The Flood Estimation Handbook ("FEH") catchment descriptors for the surface water catchment that includes the Development Site indicate an annual average rainfall (1961-1990) of 791mm. This is significantly lower than the NRFA regional statistics. Full details of the Development catchment and descriptors are presented below in the review of the hydrological baseline setting.

11.3.37. Due to the steep local topography and aquifer characteristics it is considered likely that the majority of incident rainfall within the Development Site and to the east will form surface water runoff, or shallow groundwater throughflow emerging as springs or baseflow. Infiltration within areas of higher permeability superficial deposits and shallow, weathered bedrock is unlikely to percolate vertically to any significant extent but will preferentially move laterally and emerge as springs and seepages. This is evident from the dense surface water drainage network immediately surrounding the Development Site.

11.3.38. Land to the west of the Development Site comprises the flat-lying floodplain of the River Severn and the majority of incident rainfall will discharge to the river and its tributaries via surface water runoff or shallow percolation through the Alluvium.

Baseline Conditions - Water Framework Directive Groundwater Body Classification

11.3.39. Under the Water Framework Directive ("WFD") the UK is split into River Basin Districts each subdivided into smaller management units known as Water Bodies.

11.3.40. The application site overlies the WFD Severn Uplands - Lower Palaeozoic Groundwater Body (ID: GB40902G205300) of the River Severn River Basin District.

11.3.41. In accordance with the requirements of the WFD, groundwater bodies are classified based on their quantitative and qualitative status. The quantitative status is classified as 'good' or 'poor' based on a large scale assessment of the quantity of water available as baseflow to watercourses and water dependent ecosystems and the quantity available for groundwater abstractions.

11.3.42. The qualitative status of a groundwater body is also classified as 'good' or 'poor' based on the concentrations of a range of key pollutants, the quality of groundwater baseflow to watercourses and contributing to water-dependent ecosystems and the quality of groundwater abstractions.

11.3.43. Information on the status of the Severn Uplands – Lower Palaeozoic Groundwater Body has been obtained from the Environment Agency's Catchment Data Explorer[xii] and is summarised in Table 11-5 for the 2015 (Cycle 2) assessment.

Table 11-5: Severn Uplands WFD Groundwater Body Assessment

Parameter	Severn Uplands Groundwater Body Status 2015
Water Body ID	GB40902G205300
Surface Area	2036.704 km^2
Water Body Type	Groundwater
Protected Area Designations	Nitrates Protected Area, Drinking Water Protected Area
Overall Status	**Poor**
Quantitative Status	**Good**
Quantitative Elements:	
Saline Intrusion	Good
Water Balance	Good
Groundwater Dependent Terrestrial Ecosystems	Good
Groundwater Dependent Surface Water Bodies	Good
Qualitative Status	**Poor**
Qualitative Elements:	
Chemical Saline Intrusion	Good
Chemical Groundwater Dependent Terrestrial Ecosystems	Good
Chemical Dependent Surface Water Bodies	Poor
General Chemical Test	Good
Drinking Water Protected Areas	Good
Reasons for Not Achieving Good Status	**No known technical solution is available (sector under investigation)**

11.3.44. The regional groundwater qualitative status is classified as poor under the WFD Assessment, due to the presence of dependent surface water bodies with poor chemical status.

Baseline Conditions - Groundwater Quality

11.3.45. Natural Resources Wales has not provided any groundwater quality monitoring data within a 2km radius of the Development Site in their consultation response.

11.3.46. Local groundwater forming shallow throughflow and emerging as springs on Heldre Hill is likely to be weakly mineralised and of good quality due to limited residence times. This is evidenced from the number of local private drinking water supplies (detailed below).

11.3.47. As outlined above, the bedrock geology beneath the Development Site comprises low permeability Mudstones, with limited groundwater present within the near-surface weathered horizon and discontinuities. The local groundwater level appears to be at or just below the quarry floor elevation.

11.3.48. Any shallow groundwater beneath the Development Sitecould therefore be locally influenced by suspended solids loading within infiltration through the quarry floor.

11.3.49. Groundwater samples were collected for analysis from seven of the geotechnical site investigation boreholes in November 2018; the laboratory results are included as Annex F in Technical Appendix 13-1 and the principle chemistry parameters are presented in Table 11-6. Boreholes 1 and 6 (highlighted in Table 11-6) are installed within the quarry floor and represent shallow groundwater quality immediately beneath the proposed development platform.

Table 11-6: Buttington Quarry Groundwater Quality

Parameter	UK DWS	Units	Groundwater Quality (02/11/2018 & 21/11/2018)						
			BH1	BH2	BH4	BH6	BH7	BH8	BH9
Aluminium	200	µg/l	220	88	140	58	790	92	140
Arsenic	10	µg/l	0.89	45	26	12	12	0.73	1.2
Boron	1000	µg/l	310	260	180	240	330	150	45
Calcium	-	mg/l	9.0	130	240	7.9	7.7	74	54
Copper	2000	µg/l	1.5	0.4	<0.4	100	7.6	0.4	5.1
Iron	200	µg/l	220	7.5	5.5	1600	660	38	32
Lead	10	µg/l	0.52	0.13	0.10	0.59	14	0.22	0.34
Magnesium	-	mg/l	0.82	39	75	0.87	1.9	27	18
Manganese	50	µg/l	55	97	270	54	34	41	16
Nickel	20	µg/l	0.9	6.9	12	150	2.5	0.7	5.7
Sodium	200	mg/l	180	110	45	200	130	30	24
Zinc	5000	µg/l	37	61	22	340	110	2.1	11
Conductivity	2500	µS/cm	722	1260	1630	939	639	734	551
pH	6.5-9.5	mg/l	8.2	6.6	6.8	8.1	8.3	7.3	7.4
BOD	-	mg/l	26	8.5	19	13	<1.0	5.4	3.2
COD	-	mg/l	11	<10	10	<10	26	<10	34
Hardness	-	mg/l	25.8	487	898	23.3	26.7	296	206
Suspended Solids	-	mg/l	1200	150	880	330	960	62	640
Ammoniacal Nitrogen	0.39	mg/l	0.039	0.41	0.85	0.46	0.23	0.13	0.079
Chloride	250	mg/l	1.5	18	13	1.1	17	13	11
Sulphate	250	mg/l	7.1	330	300	2.1	110	58	50
TPH	-	µg/l	<10	<10	<10	<10	48	<10	<10
EPH	-	µg/l	<10	<10	<10	<10	770	<10	<10
PAH Total	-	µg/l	<0.2	<0.2	<0.2	<0.2	0.20	<0.20	<0.20

Note: all metals analysed as dissolved metal content. UK DWS = UK Drinking Water Standard (where one applies)

11.3.50. Local groundwater quality will be influenced by groundwater residence time, hydraulic connectivity and chemical interaction with the substrate. Review of the site-specific monitoring data indicates that groundwater quality is generally good, with the majority of parameters remaining below the relevant UK Drinking Water Standard ("DWS"). Concentrations of most metals, including aluminium, arsenic, lead, iron and nickel, exceeded the UK DWS within at least one borehole.

11.3.51. Boreholes BH1, BH6 and BH7 located in the quarry floor and northern quarry wall, record relatively low water hardness and correspondingly low concentrations of calcium and magnesium, relative to the remaining boreholes. Boreholes BH1, BH6 and BH7 also record higher (alkaline) pH and typically record higher concentrations of most metals, relative to the remaining boreholes located in the southern quarry wall and rim.

11.3.52. Table 11-3 confirms that BH1 and BH6 were installed within the Tarannon Mudstone Formation and BH7 was installed within the Cefn Formation. All other boreholes were installed within the Trewern Brook Mudstone Formation. Therefore, the variation in groundwater quality observed is likely to reflect the different geological mineralisation of the mudstone formations.

11.3.53. Groundwater within boreholes BH1 and BH6, beneath the quarry floor, record very low chloride concentrations, low hardness and slightly alkaline pH, all indicative of groundwater with a short residence time (i.e. recently infiltrated rainfall).

11.3.54. The suspended solids content of the groundwater samples is often elevated, with a maximum of 1200mg/l in BH1, beneath the quarry floor. This reflects the weathered mudstone geology.

11.3.55. Therefore, the data indicate that groundwater quality beneath the Development Site is generally good but varies in response to the local geology and groundwater residence times.

Baseline Conditions - Groundwater Abstractions and Source Protection Zones

11.3.56. Review of NRW's online Geoportal for Wales confirms that the development site is not within or in the vicinity of a Groundwater Source Protection Zone.

11.3.57. Review of NRW's Public Register of Water Resource Licences[xiii] and a 2017 Groundsure Report has identified one active groundwater abstraction licence within a 2km radius of the Development Site boundary, as detailed in Table 11-7.

Table 11-7: Licensed Groundwater Abstractions (2km Radius)

Licence No.	Licence Holder	Use	Source	Location NGR (distance from site)	Annual Limit (m^3)
MD/054/0001/011	Welshpool Livestock Sales Ltd.	General Washing/ Process Washing	Borehole (Buttington Cross)	324450 308844 (1.96km SW)	45,000

11.3.58. This abstraction is located adjacent to the River Severn and is considered likely to abstract groundwater from the Alluvium, a Secondary A aquifer. Therefore, although the abstraction is potentially down-gradient of the application site it is located beyond the River Severn and therefore hydraulically isolated from the Development Site.

11.3.59. Powys County Council Environmental Health Department has confirmed they hold records of 11 private water supplies within a 2km radius of the application boundary[xiv]. The details of these private water supplies are presented within Table 11-8 and their locations are included on Drawing 11/3 in Technical Appendix 11-1. All of the private water supplies listed have a daily water use of less than $10m^3$/day. It should be noted that each grid reference location refers to the property and the Council has no record of the source of each supply which could be located some distance from the property.

11.3.60. The majority of the private water supplies are located on the northern slopes of Heldre Hill / Long Mountain, to the east of the Development Site, with water sourced from natural springs or wells. No private water supplies are located within 2km down-gradient (west or south-west) of the Development Site.

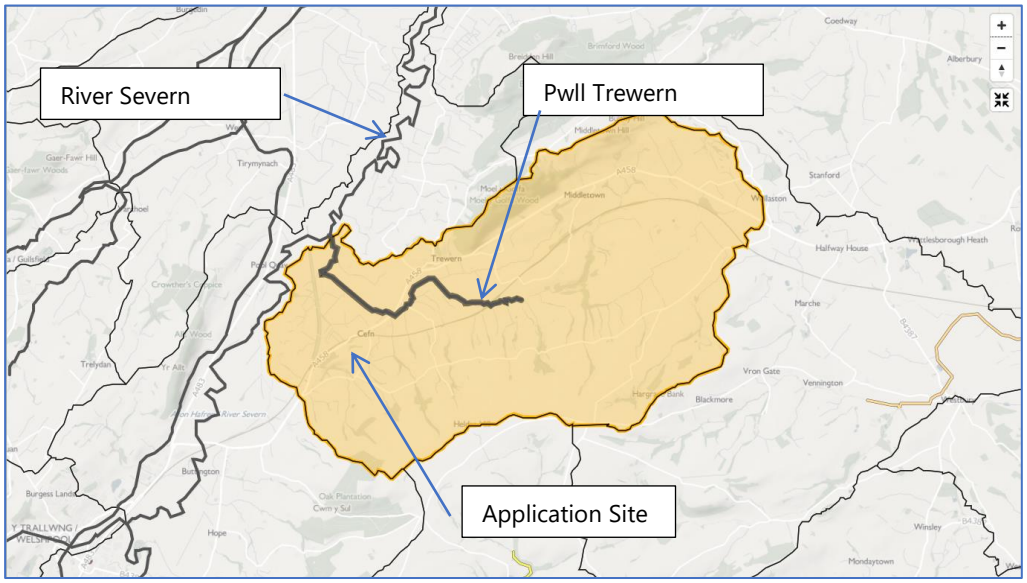
Table 11-8: Private Water Supplies (2km Radius)

Property Name	Post Code	Grid Reference (distance from site boundary)	Source	Supply Classification
1. Cletterwood Farm	SY21 8HB	326281 308588 (1km south)	Spring	Regulation 10 (Single Supply)
2. Diamond Cottage	SY21 8TF	328256 309728 (1.3km east)	Spring	
3. Little Heldre	SY21 8TF	328147 309746 (1.1km east)	Spring	
4 .Middle Heldre	SY21 8TE	328031 310181 (0.9km east)	Well	
5. Middle House	SY21 8TF	328442 309554 (1.6km east)	Well	
6. Nantyrbrochan/ Upper Heldre Farm/The Granary	SY21 8TE	327780 309820 (0.9km east)	Spring	Regulation 11 (shared domestic supply)
7. Penybank/ Pobceiniog	SY21 8TF	328503 309756 (1.6km east)	Spring	
8. Southview	SY21 8TF	32836 309581 (1.5km east)	Well	Regulation 10 (Single Supply)
9. Top House	SY21 8TF	328559 309573 (1.5km east)	Borehole	
10. Llwyn Melyn/ Rowan Tree Barn/Rhyd Barn/The Stables/Long Meadow/Oaklands House/The Carthouse	SY21 8EG	328790 311180 (1.8km NE)	Borehole	Regulation 11 (shared domestic supply)
11. Lower Heldre	SY21 8TD	328210 310730 (1.1km NE)	Well	Regulation 10 (Single Supply)

11.3.61. Buttington ERF would be developed within the main void of Buttington Quarry, which has a quarry floor elevation of approximately 90mAOD. The quarry is elongated north-east to south-west, with the sidewalls rising steeply to perimeter ground levels of approximately 120mAOD.

11.3.62. The Environment Agency's Catchment Data Explorer[xv] indicates that the Site lies within the surface water catchment of Pwll Trewern, an ordinary watercourse (not classified as a main river) and a tributary of the River Severn. Pwll Trewern rises as a number of springs / tributary watercourses on Heldre Hill to the east of the site and discharges to the River Severn near Watery Lane, Trewern, approximately 2km north of the application site. The alignment of Pwll Trewern and its catchment area are shown on Figure 11-1.

Figure 11-1: Pwll Trewern Alignment and Catchment Area



Note to Figure: after Environment Agency's online Catchment Data Explorer

11.3.63. Surface water runoff from the Development Site currently discharges directly to a minor, unnamed tributary watercourse of Pwll Trewern, which rises on Heldre Hill and flows north-west before following the southern boundary of the Development Site This minor watercourse then flows towards the south-west, crossing the site access road via a culvert and then turns north-west before passing under the A458 and adjacent railway line. The watercourse then discharges into Main Ditch, which flows towards the north-east and converges with Pwll Trewern near Trewern Hall. Pwll Trewern continues to flow in a northerly direction and discharges into the River Severn near Watery Lane, Trewern, approximately 600m downstream. The local watercourses and hydrological site setting are presented on Drawings 11/5 and 11/6 in Technical Appendix 11-1.

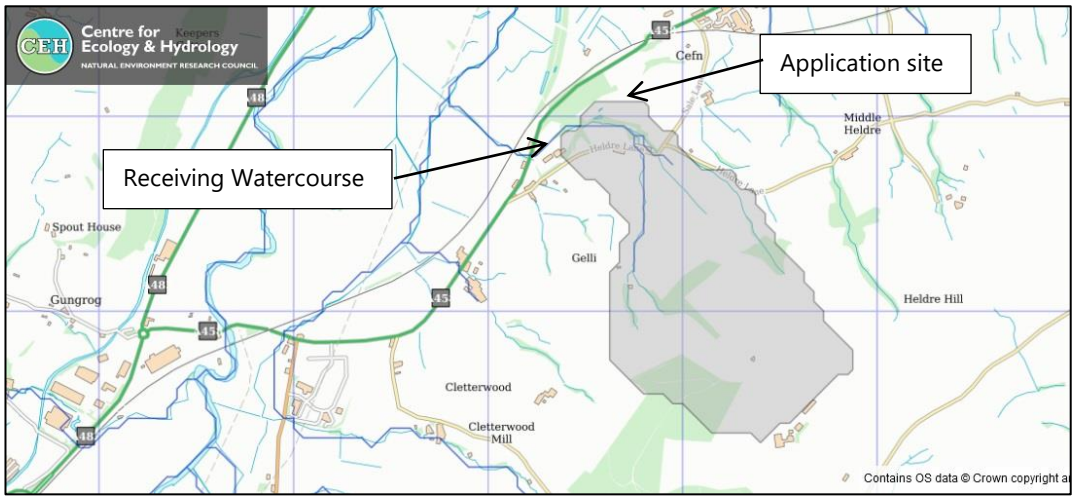
11.3.64. The topography to the west of the Development Site falls steeply to the A458 but is then flat-lying at approximately 65mAOD representing the broad natural floodplain of the River Severn.

11.3.65. The floodplain of the River Severn to the west of the application site is within the boundary of Powys land Internal Drainage District ("IDD"), managed by NRW. Within such drainage districts NRW manages water levels and reduces flood risk through management and maintenance of drainage channels, ordinary watercourses, pumping stations and control structures. The Development Site is shown to be located outside of an IDD area.

11.3.66. The local topography rises steeply away from the Development Site to the south-east towards Heldre Hill. Numerous minor watercourses rise as springs on Heldre Hill, which is a significant local topographic feature, rising to 381mAOD. The density of surface watercourses reflects the steep topography and relatively low permeability geology, with rainfall forming surface water runoff or shallow groundwater throughflow emerging as springs a short distance down gradient.

11.3.67. The surface water catchment of the minor watercourse draining the application site is reproduced below as Figure 11-2, from the Centre for Ecology & Hydrology ("CEH") Flood Estimation Handbook Web Service[xvi]. The catchment illustrated in Figure 2 represents the area of land contributing surface water runoff to the watercourse up-gradient of the point at which site drainage from the existing quarry void discharges into the watercourse. This up-gradient catchment area is calculated to be 1.395km^2.

Figure 11-2: FEH catchment area for the minor watercourse up-gradient of Buttington Quarry discharge.



11.3.68. Review of Figure 11-2 and the local topography confirms that there is no significant up-gradient surface water catchment draining into Buttington Quarry. Runoff from land immediately east and south-east of the quarry (beyond Sale Lane) drains via minor watercourses flowing towards the north-east which discharge to Pwll Trewern near Trewern Bridge, approximately 600m north-east of Buttington Quarry. Similarly, land to the immediate north and north-west drains towards minor tributaries of Pwll Trewern. Therefore, runoff draining from the quarry in a south-westerly direction and discharging into the watercourse identified in Figure 2 is limited to that generated within the quarry floor and immediately surrounding quarry walls.

11.3.69. No published river flow data are available for Pwll Trewern or its tributary watercourses. Due to the steep topography and hydrogeological characteristics of the catchment area surface water flow rates within the tributary watercourse draining the application site will respond rapidly to rainfall events.

11.3.70. The FEH catchment descriptors for the catchment identified in Figure 11-2 have been exported and can be summarised as follows:

- Catchment Area: 1.395km$^{2;}$
- Average Annual Rainfall: 791mm/year;
- Extent of urban/suburban land cover: 0;
- Standard Percentage Runoff: 20.9%; and
- Baseflow Index: 0.607.

11.3.71. The FEH catchment descriptors indicate a relatively high baseflow index (proportion of rainfall forming baseflow in watercourses) and a relatively low proportion forming surface water runoff (20.9%) when reviewed against local hydrogeological and topographic conditions. This is discussed further within the site's Surface Water Management Plan ("SWMP") which may be found in Technical Appendix 11-2.

Baseline Conditions - Site Surface Water Drainage

11.3.72. Surface water accumulating within the quarry floor comprises incident rainfall, and any (limited) groundwater ingress. This currently drains in a south-westerly direction via interconnected drains, ponds and culverts adjacent to the site access road and discharges to the minor watercourse to the immediate south of the site.

11.3.73. The current Development Site drainage arrangements, including photographs from the September 2018 site walkover, are presented on Drawing 11/6 in Technical Appendix 11-1.

11.3.74. In summary, runoff from the quarry floor area is routed towards an upper, northern settlement pond via open site drains. A manually operated penstock valve controls the inflow into this settlement pond, with runoff held within the upstream quarry area as site conditions require. The northern settlement pond drains into a second, southern settlement pond via a pipe beneath the site access road and the southern settlement pond outfalls to the south-west via an open drain. This drain converges with the natural tributary watercourse adjacent to the site access road with the watercourse continuing to flow through the site, predominantly culverted, discharging near the site entrance.

11.3.75. The current surface water management scheme is primarily aimed at the management of suspended solids within site runoff and is maintained as required, including desilting of the settlement ponds.

Baseline Conditions - Water Framework Directive Surface Water Body Classification

11.3.76. The Development Site lies within the catchment of the WFD Pwll Trewern, Source to Confluence with River Severn surface water body (ID: GB109054049660).

11.3.77. In accordance with the requirements of the Water Framework Directive, surface water bodies are classified based on their chemical and ecological status. The chemical status is reported as 'good' or 'fail' based on compliance with environmental standards for the priority substances defined in the Environmental Quality Standards Directive. If the surface water body is deemed as not requiring assessment for these priority substances it is classified as 'good'.

11.3.78. The ecological status is based on the assessment of four elements: biological, physico-chemical, specific pollutants and hydromorphology. The results of these tests determine the ecological status reported on a scale of 'high', 'good', 'moderate', 'poor' or 'bad'.

11.3.79. Information on the status of the Pwll Trewern WFD surface water body has been obtained from the 2014 NRW River Catchment Summary[xvii] and the Environment Agency's Catchment Data Explorer[xviii] and is summarised in Table 11-9 for the 2015 (Cycle 2) assessment.

Table 11-9: Pwll Trewern (Source to R Severn) WFD Surface Water Body Assessment

Parameter	Pwll Trewern Surface Water Body Status 2015
Water Body ID	GB109054049660
Catchment Area	22.64km^2
Length	5.041km
Water Body Type	River (not designated artificial or heavily modified)
Protected Area Designations	Freshwater Fish Protected Area, Nitrates Protected Area
Overall Status	**Poor**
Ecological Status	**Poor**
Chemical Status	**Good**
WFD Objectives: Overall Status	**Good by 2021**
Reasons for Not Achieving Good Status	**Diffuse source (agricultural and rural land management) – Phosphate** **Diffuse source (agricultural and rural land management) – Fish**

11.3.80. Table 11-9 indicates that the Pwll Trewern surface water body had a 2015 'good' chemical status but an ecological and overall status of 'poor' due to diffuse source pollution. The WFD objectives for the watercourse were 'good' overall status by 2021.

11.3.81. Severn Trent Water has identified the Pwll Trewern WFD surface water body as requiring possible investigation in AMP7 (the 7th Asset Management Period planned by the UK Water

Industry for 2020-2025) because it is failing to achieve 'good' status due to sewage related elements[xix]. Trewern sewage treatment works is located within the catchment of the watercourse.

Baseline Conditions - Surface Water Quality

11.3.82. The WFD water body assessment of Pwll Trewern is presented above. Based on local land uses and pressures, the surface water quality of Pwll Trewern and its tributaries is likely to be variable, with potential impacts from suspended solids, agricultural activities and sewage treatment discharges. Surface water catchments are small scale and therefore water quality is likely to be impacted rapidly following periods of intense rainfall, due to flushing of surface contaminants.

11.3.83. NRW has provided limited surface water quality data for Pwll Trewern at the A458 Trewern Bridge, upstream of its confluence with Main Drain and not therefore associated with the catchment area of the Development. The data (2012-2017) does not include analysis of suspended solids or turbidity but visual observations note the samples are occasionally 'turbid' or 'slightly turbid'. NRW has not provided surface water quality data for the tributary watercourse which passes through the site, the receiving watercourse (Main Drain) or Pwll Trewern downstream its confluence with Main Drain. Therefore, no baseline surface water quality data is available for the immediate downstream receiving watercourses.

11.3.84. Surface water runoff from the Development Site drains into the minor tributary watercourse which flows through the site as detailed above and on Drawing 11/6 in Technical Appendix 11-1. Following heavy rainfall, the water quality of the site discharge is visually impacted by elevated suspended solids loading, despite the on-site settlement ponds. No other significant water quality impacts are anticipated due to the limited activity within the site.

11.3.85. A surface water sample was collected from the second, southern settlement pond for laboratory analysis on 21st November 2018; laboratory results are included within Technical Appendix 13-1, Annex F.

11.3.86. In summary, the surface water quality of this single sample was generally good, with the majority of parameters recorded at a concentration below the relevant UK DWS and/or freshwater Environmental Quality Standard ("EQS"). Aluminium was recorded at a concentration of 540µg/l, slightly higher than the UK DWS of 200µg/l and the concentration of total polyaromatic hydrocarbons ("PAHs") was 0.25µg/l compared to the UK DWS of 0.1µg/l. Hydrocarbons were also detected within the sample, with 55µg/l extractable petroleum hydrocarbons ("EPH") (C10-C40) and 43µg/l diesel range organics ("DRO") (C10-C24), indicative of low level petroleum hydrocarbon contamination.

11.3.87. The suspended solids content of the surface water sample was 130mg/l; there are no current water quality standards for suspended solids but the former guideline standard from the (revoked) Freshwater Fish Directive was 25mg/l.

11.3.88. Comparison with the groundwater quality data presented in Table 11-6, confirms that the concentrations of the majority of parameters within the surface water sample are within the ranges reported for groundwater.

11.3.89. The surface water sample location is immediately upstream of the outfall from the current site drainage network and is therefore indicative of the baseline water quality of the site drainage.

Baseline Conditions - Surface Water Abstractions

11.3.90. Review of the 2017 Groundsure Report and NRW's Public Register of Water Resource Licenses identifies one active licensed abstraction from surface water sources identified within a 2km radius of the development site boundary, as detailed in Table 11-10 and on Drawing 11/3 Technical Appendix 11-1.

Table 11-10: Licensed Surface Water Abstractions (2km Radius)

Licence No.	Licence Holder	Use	Source	Location NGR (distance from site)	Annual Limit (m^3)
18/54/01/0421	Buttington New Hall	General farming & domestic	Spring	326200 308900 (822m south)	6139.37

11.3.91. The source of this licensed abstraction at Buttington New Hall is a spring and is therefore assumed to be groundwater fed.

11.3.92. Powys County Council has confirmed a total of 11 Private Water Supplies within a 2km radius of the Development Site. These all source water from groundwater sources (springs, groundwater and wells) (refer to Table 11-8 for details).

11.3.93. Therefore, no surface water abstractions have been identified within a 2km radius of the Development Site.

Baseline Conditions - Consented Discharges to Controlled Waters

11.3.94. NRW's online Geoportal for Wales has been reviewed to obtain details of current consented discharges to controlled waters within a 1km radius of the Development. Details are provided in Table 11-11 below, with locations included on Drawing 11/3 in Technical Appendix 11-1.

11.3.95. The two consented discharges identified within a 1km radius of the Development Site discharge to Pwll Trewern (or its tributary), down-gradient of the Development Site.

11.3.96. It is noted that the current site drainage from Buttington Quarry void into the tributary of Pwll Trewern has no formal discharge consent / permit.

Table 11-11: Consented Discharges to Controlled Waters (1km Radius)

Drawing Ref	Permit Ref	Permit Holder	Description	Receiving Water	Location NGR (distance from site)	Daily Flow Limit (m^3/day)
1	PB3993HK	Keith Mallows, Ty Ger Y Nant, Heldre Lane	Single Domestic Property, Septic Tank	Pwll Trewern	327639 310855 (750m NE)	1.5
2	RB3793HX	Laurie Ritchie, Plas-Y-Don Trewern	Single Domestic Property, Sewage Package Treatment Plant	Unnamed tributary of Pwll Trewern	327092 310569 (200m NE)	1.0

Baseline Conditions - Flood Risk

11.3.97. Review of Natural Resources Wales' on-line Development Advice Map confirms that the entire Development Site is located within Flood Zone A, defined as land 'at little or no risk of fluvial or coastal/tidal flooding'. NRW's on-line flood risk maps also confirm that the site is not within the extent of the historic flood map or within a flood alert or flood warning area.

11.3.98. As the Development Site is entirely within Flood Zone A, NRW has confirmed via the Scoping Direction that a Flood Consequences Assessment ("FCA") is not required for the Development Site.

11.3.99. The historic and predicted flood extent of the River Severn, to the west and north-west of the Development Site does not encroach across the railway line or A458 adjacent to the site and is constrained within the natural low-lying floodplain, as indicated on Drawing 11/5 in Technical Appendix 11-1.

11.3.100. In accordance with Technical Advice Note ("TAN") 15 all development types are acceptable in Flood Zone A assuming they do not result in increased flood risk elsewhere. This issue will be considered and addressed through the site's SWMP.

11.3.101. Policy DM6 of the Powys Local Development Plan 2011-2026 (adopted April 2018) relates to flood prevention measures and land drainage, and states:

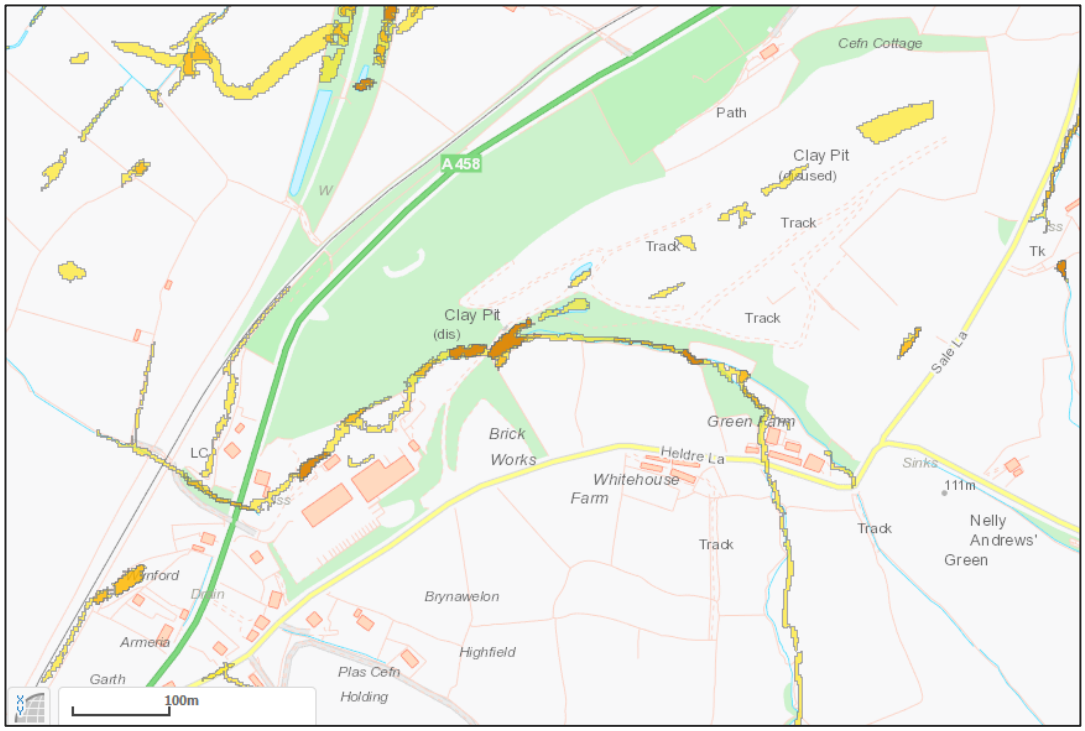
> *Development proposals must avoid unnecessary flood risk by assessing the implications of development within areas susceptible to all types of flooding; any development that unacceptably increases risk will be refused.*

11.3.102. Policy DM6 confirms that all potential sources of flooding to the proposed development must be considered, this includes fluvial, tidal, surface water and groundwater.

11.3.103. The NRW on-line flood mapping service provides details of the level of flood risk from reservoirs and surface water runoff. The mapping confirms that the development site is not within an area designated at risk of flooding from reservoirs.

11.3.104. However, the NRW flood maps identify areas at risk of surface water flooding (due to ponding of rainfall / surface water runoff) within and immediately surrounding the application site, as indicated on Figure 11-3. The areas identified at risk of surface water flooding comprise the alignment of the minor tributary watercourse to the south of the site, which crosses and approximately follows the alignment of the site access road and areas within the quarry floor. All areas at risk of surface water flooding within the area of proposed development are classified as 'low' flood risk. This is defined as land with an annual probability of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).

Figure 11-3: NRW Surface Water Flood Risk Map



11.3.105. Groundwater flooding occurs when groundwater levels rise above the ground surface, with the areas at greatest risk generally low-lying land where groundwater is at a shallow depth. High groundwater levels can also contribute to other sources of flooding by reducing the capacity of surface water to infiltrate for example. The Powys Preliminary Flood Risk Assessment did not identify any areas susceptible to groundwater flooding across the county and groundwater flooding is not considered to be a significant issue within the county[xx].

11.3.106. However, it is recognised that the elevation of the Development Site platform is approximately coincidental with local groundwater levels and ponded water is frequently observed in the current quarry floor. Groundwater inflows to the Development Site are considered limited/negligible due to the local hydrogeological characteristics and visual evidence (lack of springs/seepages and dry quarry floor during extended dry weather conditions). All surface water runoff generated within the quarry void, including groundwater inflows, will continue to gravity drain to the receiving water course via a site-specific surface water management scheme.

11.3.107. No other potential sources of flooding have been identified within the Development Site.

Likely Future Conditions

11.3.108. The design life of Buttington ERF is 30 years. This section of the chapter considers the likely condition of the water environment within this timeframe, if the Project is not approved and quarrying activities continue in accordance with the site's currently approved permissions.

11.3.109. The Welsh Government's guidance on adapting to climate change[xxi] presents the following estimates for changes to rainfall intensity as a result of long-term climate change (Table 11-12).

Table 11-12: Climate Change Guidance – Change to Extreme Rainfall Intensity (compared to 1961-1990 baseline)

Applies across all of Wales	Total potential change anticipated for 2020s (2015-2039)	Total potential change anticipated for 2050s (2040-2069)	Total potential change anticipated for 2080s (2070-2115)
Upper Estimate	10%	20%	40%
Central Estimate	5%	10%	20%

11.3.110. The predicted life of Buttington ERF is 30 years; equivalent to the 2050s. Therefore, based on the above guidance, a worse-case climate change allowance of 20%, equivalent to the upper (90th percentile) estimate for the 2050s is appropriate. This is the predicted increase from baseline 1961-1990 data.

11.3.111. This increase in rainfall intensity would result in a subsequent increase in surface water runoff rates and volumes from the Development Site, with potential impacts on downstream flood risk and surface water quality, notably suspended solids.

11.3.112. No other significant changes to the baseline water environment, in terms of water quality or water flow regimes, would be anticipated at the Development Site.

11.4. Environmental Effects Assessment

11.4.1. This section of the Chapter identifies the potential impacts of the Development on the baseline water environment detailed above. A qualitative review is presented, defining the importance of the water environment receptors, the likelihood of an impact occurring and the potential magnitude of the impact on the local groundwater and surface water environment. This section also presents the design features that are integrated into the Development to provide appropriate mitigation and/or management of these potential impacts.

11.4.2. The methodology to assess the potential effects to the water environment has been adopted from the Design Manual for Roads and Bridges - Road Drainage and the Water Environment (LA113)[xxii]. This is a well-recognised approach and can be applied to all

development types. The significance of each effect is discussed Section 11.5 – Environmental Effects Analysis.

11.4.3. The potential effects to the water environment during the construction, operation and decommissioning phases of the Development are outlined below. For each phase of the Development, there are potential effects to:

- groundwater levels and flow,
- groundwater and surface water quality, and
- surface water flows and flood risk are identified.

11.4.4. Subsequently, the mitigation measures that are incorporated into the design to negate the potential effects to the water environment, throughout the life of the Development, are outlined.

Construction Phase – Effects - Groundwater Levels & Flow

11.4.5. It is not anticipated that the construction of Buttington ERF would involve any below-ground excavation except for construction of the foundations. Site monitoring data confirm that groundwater is present within the weathered mudstones, at or just below, the quarry floor. Any localised, temporary dewatering required for below-ground construction has the potential to lower groundwater levels, effect local abstractions and/or reduce baseflow to surface water courses.

11.4.6. Any groundwater removed during temporary dewatering would be minimised through design and discharged via the site's surface water drainage system to the receiving watercourse. No groundwater or surface water abstractions have been identified within 800m of the Development Site and the radius of influence of dewatering would be restricted in extent by the relatively low permeability of the bedrock geology with hydrogeological connectivity restricted to discontinuities, the perched nature of the groundwater and the local topography. Any reduction in groundwater throughflow or baseflow contributions to surface water courses is unlikely.

11.4.7. Any below-ground excavation, including for foundations, will physically remove aquifer material and potentially remove protection to underlying aquifers. The effect of a localised impact on groundwater levels or throughflow is unlikely due to the limited scale of any below-ground excavation. Any effect on underlying groundwater quality, due to reduced unsaturated zone thickness, is also unlikely due to the shallow depth to groundwater and the low resource potential of the bedrock which is classified as a Secondary B aquifer.

Construction Phase – Effects - Groundwater and Surface Water Quality

11.4.8. During the site construction phase, the generation of suspended solids in rainfall-runoff during earth works, landscaping and vehicle tracking, has the potential to impact surface water quality of the receiving watercourse and groundwater quality beneath the Development.

11.4.9. High levels of suspended solids could be generated within surface water runoff from erosion of exposed quarry slopes and spoil stockpiles during site preparation works. There

is also a risk of elevated levels of suspended solids in runoff in dry weather if water is used for dust suppression.

11.4.10. Elevated suspended solids within a watercourse can cause potential smothering and increased turbidity causing, for example, reduced light availability for photosynthesis.

11.4.11. Suspended solids is not included within the WFD and EQSD list of priority substances and other polluting chemicals but it is acknowledged that the impact of elevated suspended solids and associated turbidity could lead to failure (or risk of failure) of 'good' ecological status of surface water bodies.

11.4.12. However, watercourses within clay and alluvial environments are typically more depositional in character and the resident ecology is generally more tolerant. It is recognised that the Development Site currently comprises exposed quarry faces and is a permitted working quarry, with Drawing 11/6, which may be found in Technical Appendix 11-1, confirming existing suspended solids impact within site drainage.

11.4.13. Proposed construction work, including the new access road, would be undertaken in close proximity to the banks of the watercourse. Therefore, there is the potential for direct disturbance of the channel and/or adjacent banks, with resultant increased suspended solids loading within the watercourse.

11.4.14. In the absence of mitigation, local surface water quality may deteriorate due to increased suspended solids loading in adverse weather conditions.

11.4.15. During construction of the Development there is a risk of spillages or leaks of fuels, oils and other potentially contaminative liquids from plant and machinery. The following potentially contaminative liquids will be stored for use on site during the construction phase:

- diesel fuel – stored within a tank designed in accordance with GPP2[xxiii], the tank will be bunded to provide secondary containment for a minimum 110% of the design volume of oil from the inner tank; and
- lubricants/grease/hydraulic oil – stored internally, with secondary spill containment.

11.4.16. Any accidental release of these contaminants could infiltrate to ground directly or enter surface water runoff, presenting a risk to local groundwater and surface water quality.

11.4.17. Construction vehicles and general site traffic represent potential sources of hydrocarbon contamination to the water environment in the event of leaks of fuel/oils. Spills during refuelling/servicing and vehicle accidents also represent potential sources of hydrocarbon contamination.

11.4.18. The use of concrete on site also represents a potential source of contamination to the water environment during the construction phase. However, no on-site batching plant is proposed, with all concrete delivered to site as required in ready-mixed form.

11.4.19. Therefore, in the absence of mitigation, there is the potential for contamination of the water environment.

Construction Phase - Effects - Surface Water Flow and Flood Risk

11.4.20. Any temporary groundwater abstraction required during the construction phase would be discharged via the site's surface water management system. In the absence of appropriate control, this could potentially increase surface water discharge rates temporarily from the site, thus increasing flood risk downstream, with a minor adverse impact.

11.4.21. It is recognised that the development of Buttington ERF with the creation of impermeable surfaces, has the potential to increase surface water runoff rates compared to pre-development conditions. Therefore, in the absence of appropriate mitigation, or in the absence of appropriate construction phasing, the Development has the potential to increase flood risk downstream.

11.4.22. There is the potential for accidental blockage or partial blockage of the tributary watercourse during the construction phase, for example due to vehicle movements causing bank collapse. Any restriction of the open channel or culvert capacity could potentially increase flood risk upstream within the Development Site.

Construction Phase – Mitigation

11.4.23. A Construction Environmental Management Plan ("CEMP") would be prepared and adopted on site to minimise adverse environmental impacts. All relevant site personnel would follow appropriate induction training regarding the requirements of the CEMP.

11.4.24. The CEMP would include a pollution incident response plan detailing actions to be followed in the event of a spill or leak of a potentially polluting substance. Appropriate spill response equipment would be securely stored on site.

11.4.25. The CEMP would include a traffic management plan aimed at preventing site vehicle incidents, which could result in the release of potentially polluting fuel/oils. The traffic management plan would include measures to minimise vehicle movements on site, ensure adequate visibility and appropriate signs and instructions, with induction training for all relevant personnel.

11.4.26. The CEMP would also include protocols for adverse weather conditions. It is acknowledged that temporary measures might be required in prolonged or intense rainfall events to minimise the generation of suspended solids in surface water runoff, such as the use of silt fences. Further details are presented on the Surface Water Management Plan ("SWMP") which may be found in Technical Appendix 11-2.

11.4.27. A SWMP has been developed for the Development in accordance with the requirements of Policy DM6 of the Powys Local Development Plan 2011-2026, The SuDS Manual[xxiv] and current Welsh guidance on SuDS design[xxv]. The principal aim of the SWMP is to ensure surface water runoff (clean and potentially contaminated) is managed to prevent unacceptable flood risk to the development, to prevent any increase in flood risk off-site and to ensure the protection of local surface water and groundwater quality.

11.4.28. The SWMP is presented within Technical Appendix 11-2 and full details of the proposed measures during the construction phase are outlined within the SWMP; these can be summarised as follows:

- surface water runoff will gravity drain to the tributary watercourse which flows through the development. During the site preparation and construction phase, the key issue with regards to surface water management would be the control of suspended solids in runoff;
- during the site preparation phase, the suspended solids loading in site runoff would be carefully managed via the use of temporary settlement ponds, silt fences and settlement tanks (e.g. siltbuster units) as required;
- temporary measures for the management of suspended solids would be implemented as required across the site, as the construction phase progresses and dependent on weather conditions; and
- elements of the final proposed SWMP would be constructed at the earliest opportunity, with runoff from final constructed surfaces routed through the proposed SuDS elements which include: filter drains at the toe of quarry slopes, permeable paving with sub-base storage beneath the carpark and an attenuation pond.

11.4.29. The current, baseline site catchment area is characterised by unconsolidated clay-rich scree slopes and an exposed clay quarry floor with limited provision of surface water settlement/attenuation ponds. Therefore, it is concluded that the proposed surface water control and management measures, outlined in the site's SWMP for the construction phase, will not result in deterioration from the current baseline management of suspended solids in surface water runoff.

11.4.30. The preparatory earthworks and slope stabilisation works would be undertaken without unnecessary delay, with all proposed areas of vegetation established promptly thereafter to minimise the generation of suspended solids in runoff.

11.4.31. Ordinary Watercourse Consent would be obtained from Powys County Council prior to any permanent or temporary works being undertaken in, or within 8m of the bank of, the tributary watercourse which flows through the Development Site. The granting of Consent, under the Land Drainage Act 1991, will ensure appropriate consideration of flood risk and environmental protection.

Operational Phase – Effects - Groundwater Levels & Flow

11.4.32. The creation of an impermeable development platform has the potential to reduce groundwater recharge to the underlying aquifer. However, any potential change in infiltration and groundwater recharge rates is considered limited due to the low permeability bedrock and limited extent of the Development Site with the potential for infiltration of runoff to occur at the margins via the surface water drainage system. The Development Site is not located above a sensitive aquifer.

11.4.33. Any potential impacts on groundwater levels and flow would be limited and localised to the Development Site, with negligible potential impact on local springs, water abstractions and base flows in watercourses.

Operational Phase – Effects - Groundwater and Surface Water Quality

11.4.34. During operation of the Development there is a risk of spillages or leaks of fuels, oils and other potentially contaminative liquids from plant and machinery. The following potentially contaminative liquids will be stored for use on site:

- diesel fuel – stored within a tank designed in accordance with GPP2[xxvi]. The tank will be bunded to provide secondary containment for a minimum 110% of the design volume of oil from the inner tank;
- ammonia – in a liquid holding tank; and
- lubricants/grease/hydraulic oil – stored internally, with secondary spill containment.

11.4.35. Any accidental release of these contaminants could infiltrate to ground directly or enter surface water runoff, presenting a moderate risk to local groundwater and surface water quality.

11.4.36. Incoming wastes and handling of wastes within the Development Site represent a potential moderate risk of leachate contamination to the water environment.

11.4.37. Wastes would be stored within the bunker of the ERF; the migration of leachate to underlying groundwater represents a potential risk to groundwater quality. The bunker has been designed to Best Available Techniques ("BAT") as required by the Environmental Permit that the Installation will be required to operate under. Consequently, the risk to groundwater is low. Further details regarding the bunker design and testing requirements are outlined below.

11.4.38. In the event of a fire, potentially contaminated fire-fighting water could cause contamination of the local water environment. However, the bunker is designed to be fully sealed and to contain all fire-fighting water.

11.4.39. The regraded quarry walls would remain a potential source of suspended solids in surface water runoff, which, in the absence of mitigation, could lead to an increased suspended solids loading within the receiving tributary watercourse.

Operational Phase – Effects - Surface Water Flow and Flood Risk

11.4.40. Site surface water drainage discharges into an unnamed minor watercourse which is a tributary of Pwll Trewern and flows through the site in a south-westerly direction. This tributary watercourse discharges into Main Drain on the floodplain of the River Severn.

11.4.41. During extreme rainfall events, any increase in surface water runoff rates from the Development Site due to the introduction of impermeable surfaces could increase flood risk downstream to properties adjacent to the site entrance, other downstream receptors and exacerbate flood risk within the wider floodplain of the River Severn.

11.4.42. The potential increase in surface water runoff rates from current site conditions due to the introduction of impermeable surfaces is considered limited, due to the low permeability geology, lack of vegetation to encourage evapotranspiration and high groundwater levels within the quarry. However, in the absence of appropriate mitigation, the potential

increase in surface water runoff rates from natural undeveloped, Greenfield conditions, (i.e. prior to quarry development), could be more substantial. Current guidance recommends that for previously developed sites, site runoff rates should be reduced to the Greenfield rates wherever possible.

11.4.43. The surface water catchment area of the quarry void will be increased from pre-development conditions following the earthworks proposed to widen the quarry rim and establish a stable site topography for the Development Site. This increase in catchment area also has the potential to increase surface water runoff from the Development Site.

11.4.44. In the event of seasonally high groundwater levels above the elevation of the development platform (90mAOD), any groundwater ingress could potentially exacerbate the local flood risk level. However, groundwater inflows would limited by the low permeability ground conditions and restricted groundwater catchment area and would drain (as currently) via the site's surface water drainage scheme.

11.4.45. In summary, in the absence of mitigation, the potential increase in surface water runoff and flood risk is low.

Operational Phase – Mitigation

11.4.46. The Development will be operated, monitored and regulated in accordance with a relevant Environmental Permit. The Environmental Permit would include provision for the discharge of site drainage (surface water) to the receiving tributary watercourse at the current discharge location.

11.4.47. Permanent site vehicles during the operational phase will be limited to a front-loading shovel and a fork-lift. These will be maintained and serviced (off-site whenever feasible) in accordance with the manufacturer's recommendations. In the event of any on-site servicing or refuelling, appropriate drip trays will be used.

11.4.48. Groundwater contamination during operation of the Development is unlikely due to the aquifer characteristics and limited groundwater present. The impermeable development platform would prevent direct infiltration to ground with all runoff managed via the proposed SWMP (see Technical Appendix 11-2).

11.4.49. All incoming wastes will be unloaded and handled only within the fully sealed bunker which is designed to be water retaining.

11.4.50. The waste bunker shall be designed by the Contractor in accordance with the requirements of *BS EN 1992-3: Eurocode 2: Design of concrete structures. Liquid containing and retaining structures,* with an appropriate grade of reinforced concrete to be suitable for a minimum design life of 40 years. The bunker design study undertaken by the Contractor shall include an examination of the options for surface finishes with the objective of: limiting spalling or cracking due to vibration and impact; and preventing the adhesion of waste to the bunker walls. The design study shall also investigate and design for all handled waste components and substances, chemicals and for ground contaminants. The bunker shall be designed to prevent diffusive and advective contaminant fluxes.

11.4.51. The Contractor will obtain approval of a sample panel, demonstrating the proposed finish prior to the works commencing to ensure ingress of groundwater, seepage or damp patches are not permitted.

11.4.52. The comprehensive SWMP presented as Technical Appendix 11-2 will ensure appropriate management of surface water runoff quality and rates throughout the life of the Development. In summary, during the operational phase of the Development, surface water runoff will be managed as follows:

- runoff from the re-profiled quarry walls will be intercepted by filter drains at the toe of the slopes. Additional proposed measures to minimise suspended solids in runoff from the quarry walls include appropriate planting and the use of silt fences, as required;
- the area of carparking would be developed as permeable paving with sub-base storage;
- all site runoff would ultimately discharge to a final settlement/attenuation pond, with controlled discharge, at the pre-development Greenfield rate, to the tributary watercourse;
- all elements of the SWMP for the ERF have been designed to accommodate the 1:100 year rainfall event, with a 20% allowance for long-term climate change;
- appropriate SuDS design is also provided within the SWMP for the site access road (see Technical Appendix TA11-2).

11.4.53. The proposed sustainable drainage techniques will result in improved control on existing surface water runoff rates, with runoff restricted to pre-development Greenfield rates. The SWMP will also result in improved surface water quality, with regards to suspended solids loading in site drainage entering the tributary watercourse, compared to existing conditions.

Decommissioning Phase – Effects

11.4.54. Decommissioning of Buttington ERF would comprise demolition of the installation to ground level. It is assumed that the hardstanding of the development platform, the site access road and the site's surface water drainage system would remain in place. The waste bunker would also be removed during decommissioning.

11.4.55. The key potential effects to the water environment during the decommissioning and demolition phase are similar to those identified for the construction phase. The use of, and refuelling or servicing of, plant and machinery poses a risk of spillages or leaks of fuel/oils which could enter the water environment directly or within surface water runoff.

11.4.56. In the absence of mitigation, there is a risk of increased suspended solids loading in surface water runoff from areas of demolition and vehicle tracking. This has the potential to clog elements of the surface water drainage system and impact water quality within the receiving watercourse.

11.4.57. Physical demolition and removal of all waste residues and operating chemicals has the potential to impact groundwater and surface water quality in the event of spills or leakages.

11.4.58. The waste bunker would be emptied, cleaned and removed during decommissioning and any void backfilled with suitable, site-derived overburden, this would represent a limited risk to the water environment.

Decommissioning Phase – Mitigation

11.4.59. A Demolition Environmental Management Plan ("DEMP") would be prepared and agreed with NRW prior to decommissioning and demolition commencing. All relevant site personnel would follow appropriate induction training regarding the requirements of the DEMP.

11.4.60. The DEMP would include appropriate measures for protection of the water environment including a pollution incident response plan and a traffic management plan, as outlined for the CEMP.

11.4.61. Temporary measures for the management of suspended solids in surface water runoff, such as silt fences or siltbuster settlement tanks, would be introduced as required. The frequency of monitoring and maintenance of the site's surface water drainage system would be reviewed within the DEMP, to reduce the risk of clogging of SuDS elements.

11.4.62. Any waste residues and chemicals would be tankered off site and deposited at an appropriate facility.

All Phases - WFD Assessment Screening

11.4.63. The above assessment of potential effects to the water environment during construction, operation and decommissioning of Buttington ERF informs the need for a WFD Assessment and this section of the Chapter presents a WFD Assessment screening.

11.4.64. The application site is located within the catchment of the following WFD water bodies: Pwll Trewern surface water body (ID: GB109054049660) and Severn Uplands – Lower Palaeozoic groundwater body (ID: GB40902G205300).

11.4.65. The status (2015) and objectives (2021) of these waterbodies are presented in Tables 11-5 and 11-9. This screening exercise initially identifies whether the proposed Development has potential impact pathways to these water bodies, in accordance with The Planning Inspectorate's advice note[xxvii].

11.4.66. The overall aims and objectives of the WFD are to:

- enhance the status and prevent further deterioration of surface water bodies, groundwater bodies and their ecosystems;
- ensure progressive reduction of groundwater pollution;
- reduce pollution of water, especially by Priority Substances and Certain Other Pollutants (as defined by the WFD);
- contribute to mitigating the effects of floods and droughts;
- achieve at least good surface water status for all surface water bodies and good chemical status in groundwater bodies (or good ecological potential in the case of artificial or heavily modified water bodies); and

- promote sustainable water use.

11.4.67. Buttington ERF will be located within the existing void of Buttington Quarry at an elevation of 90mAOD, approximately coincident with the local groundwater level beneath the void. Perched groundwater is present within the weathered mudstones beneath the Development.

11.4.68. Perched groundwater levels within the quarry walls are higher than those beneath the quarry floor, indicating a local inward hydraulic gradient towards the main quarry void. Shallow groundwater throughflow contributes to the existing site drainage within the quarry void or provides baseflow to the tributary watercourse which flows through the Development Site.

11.4.69. Perched groundwater flows within the Development Site are limited by the very limited catchment area for recharge and relatively low permeability of the bedrock geology; the majority of incident rainfall is likely to form surface water runoff.

11.4.70. Groundwater beneath the Development Site comprises perched groundwater with a local inward hydraulic gradient towards the main quarry void. This localised, perched groundwater system is not considered representative of the deeper, regional Lower Palaeozoic WFD groundwater body which extends across 2036.7km^2. Therefore, it is concluded that no potential pathway exists from the Development Site to the regional Lower Palaeozoic groundwater body and no WFD assessment is required for this groundwater body.

11.4.71. The Development Site lies within the catchment of the WFD Pwll Trewern surface water body, although the site's surface water drainage discharges to a minor tributary watercourse approximately 2km upstream of its confluence with Pwll Trewern.

11.4.72. Surface water drainage from the existing Buttington Quarry void has discharged via two small on-site settlement ponds to this tributary watercourse for many years and therefore would be incorporated within the 2015 baseline data for Pwll Trewern surface water body.

11.4.73. Surface water drainage from the Development would comprise clean surface water runoff only, managed via the Development proposed SWMP. The quality of surface water runoff from the Development entering the tributary watercourse is likely to be improved, relatively to current baseline conditions. Therefore, the Development meets the aims and objectives of the WFD for the Pwll Trewern surface water body and no WFD assessment is required.

11.4.74. No substances listed on the Environmental Quality Standards Directive ("EQSD") list for WFD assessments, published by the Environment Agency in December 2016, would be released during construction or operation of the Development.

11.4.75. The Development is considered compatible with the objectives of the WFD for the WFD Lower Palaeozoic groundwater body and the Pwll Trewern surface water body and supports the improvement of these waterbodies.

The Development Overall

11.4.76. In summary, the main potential effects of the Development on the water environment are deterioration in surface water quality within the receiving watercourse and increased surface water runoff rates exacerbating downstream flood risk. However, the existing baseline conditions are represented by exposed, weathered quarry faces with high suspended solids content evident within the site runoff. The existing surface water management measures provide a degree of management of the quality and rate of surface water runoff, but elevated suspended solids loading in site runoff is visually evident following intense and/or prolonged rainfall events.

11.4.77. The proposed mitigation measures to be implemented throughout the life of the Development, notably the comprehensive SWMP, will ensure the avoidance of any detrimental impacts to the water environment. The SWMP will result in an improvement of the site runoff quality and quantity compared to current baseline conditions, with runoff restricted to pre-development Greenfield rates and water quality treatment trains introduced for improvement management of suspended solids.

11.4.78. Therefore, it is concluded that the Development will result in a small beneficial effect, with regards to surface water quality and flow within the receiving watercourse and would not contribute to a failure of a WFD water body to meet Good Ecological Status.

The Development in Combination with Other Developments

11.4.79. At time of writing, there are no other developments in the area which would lead to cumulative effects in the area

Interactive Effects

11.4.80. The potential interaction of effects with other KEA's is summarised in Table 11-13.

Table 11-13 : Interactive Effects on Water Environment

KEA Interaction	Interactive Effects
Water Environment and Ecology	The potential impact of site drainage (runoff) on the ecology of the receiving watercourse has been considered through the SWMP and the use of SuDS to provide a net beneficial impact on the quality of site runoff. The SuDS elements of the surface water drainage system have been designed with input from the project ecologists to ensure ecological benefits are maximised within the constraints of the site.
Water Environment and Transport	There is a potential influence of site traffic on surface water quality due to the generation of suspended solids in runoff and potential spills/leaks of hydrocarbons.
Water Environment and Landscape	The SuDS elements of the proposed surface water drainage system have been incorporated within the final landform and landscape proposals for the Development.
Water Environment and Geotechnical	The geotechnical requirement for earthworks including slope stabilisation works during the site preparation phase has the potential to impact surface water quality due to the generation of suspended solids. Careful management of site runoff during the site preparation and construction phase, in accordance with the SWMP, will be required to negate this potential impact. The geotechnical design of any dewatering system for the construction phase could potentially impact groundwater and surface water flows and quality.

11.5. Environmental Effects Analysis

11.5.1. A detailed environmental effects analysis of the construction, operational and decommissioning phases is provided in Table 11-17. The evaluation criteria are presented in Tables 11-14, 11-15, and 11-16.

11.5.2. The approach considers the importance of the water environment receptors, as outlined in Table 11-14. For this KEA the importance of the water environment receptor must be considered, with the receptor importance based on its ability to support water abstractions or fisheries, its WFD classification, and the presence of protected/designated habitats.

11.5.3. The magnitude of the impact, together with other evaluation criteria are presented in Table 11-15.

11.5.4. The overall significance of potential effects is estimated based on the magnitude of the impact and the sensitivity of the water environment, as summarised in Table 11-16. The other impact descriptors in Table 11-15, provide further insight to the nature of the effects. Consideration of the likelihood of the impact occurring (very likely to unlikely) and potential source-pathway-receptor linkages is included within the assessment process.

11.5.5. Please note that for the Water Environment some activities occur in all three phases of the development, consequently, to avoid repetition, one table has been prepared and the period of the Development to which the activity relates is noted therein.

Table 11-14: Estimating the Importance of Water Environment Receptors

Importance/ Sensitivity	Criteria	Examples
Very High	Nationally significant receptor of high importance.	**Surface Water:** Watercourse with a WFD classification and Q_{95} ≥1.0m^3/s. Site or species protected/designated under EC or UK habitat legislation (e.g. SSSI, SAC, Ramsar site). Designated salmonid/cyprinid fishery **Groundwater:** Principal aquifer providing a regionally important resource and/or supporting a site protected under habitat legislation. Groundwater locally supports a GWDTE. SPZ1
High	Locally significant receptor of high importance.	**Surface Water:** Watercourse having a WFD classification and Q_{95} < 1.0m^3/s. Species protected under EC or UK habitat legislation. **Groundwater:** principal aquifer providing locally important resource or supporting river ecosystem. Groundwater supports a GWTDE. SPZ2
Medium	Of moderate quality and rarity.	**Surface Water:** Watercourses not having a WFD classification and Q_{95} > 0.001m^3/s. **Groundwater:** Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3
Low	Lower quality.	**Surface Water:** Watercourses not having a WFD classification and Q_{95} < 0.001m^3/s. **Groundwater:** Unproductive strata.

Notes to Table
GWDTE = Groundwater dependent terrestrial ecosystem
SPZ = Source Protection Zone
Q_{95} = The river flow (in m^3/s) equalled or exceeded for 95% of the flow record.

Table 11-15: Estimating the Magnitude of an Impact on Water Environment Receptors

Criteria	Description

Magnitude of Impact (Mg)	• **Major adverse** -Results in loss of the receptor and/or quality and integrity of the receptor for example
	  • Surface Water:
	  – Compliance failure of EQS values.
	  – Loss or extensive change to a fishery.
	  – Loss of regionally important water supply.
	  – Loss or extensive change to a designated nature conservation site.
	  – Reduction in water body WFD classification.
	  • Groundwater:
	  – Loss of, or extensive change to, an aquifer.
	  – Loss of regionally important water supply.
	  – Potential high risk of pollution from runoff.
	  – Risk of pollution from spillages ≥ 2% annually
	  – Loss of, or extensive change to, GWDTE or baseflow contribution to protected surface water bodies
	  – Reduction in water body WFD classification.
	• **Moderate Adverse** - results in effect on integrity of receptor, or loss of part of the receptor for example:
	  • Surface Water:
	  – impact to surface water quality but compliance with EQS values;
	  – Risk of pollution from spillages ≥ 1% but <2% annually
	  – Partial loss in productivity of a fishery;
	  – Degradation of regionally important public water supply or loss of major supplies.
	  – Contribution to reduction in water body WFD classification.
	  • Groundwater:
	  – Partial loss or change to an aquifer.
	  – Degradation of regionally important public water supply or loss of major supplies.
	  – Medium risk of pollution from runoff.
	  – Risk of pollution from spillages ≥ 1% but <2% annually.
	  – Partial loss of the integrity of GWDTE.
	  – Contribution to reduction in water body WFD classification.
	• **Minor Adverse** - results in some measurable change in receptor quality or vulnerability for example:
	  • Surface Water:
	  – Minor effects on surface water quality and water supplies.
	  – Risk of pollution from spillages ≥0.5% but <1% annually.
	  • Groundwater:
	  – Potential low risk of pollution from runoff.
	  – Risk of pollution from spillages ≥0.5% but <1% annually.
	  – Minor effects on an aquifer, GWDTE and abstractions

Table 11-15: Estimating the Magnitude of an Impact on Water Environment Receptors (cont)

Criteria	Examples

Magnitude of Impact (Mg)	• **Negligible** - results in effect on receptor, but of insufficient magnitude to affect the use or integrity. The Development is unlikely to affect the integrity of the water environment
	• **Minor Beneficial -** results in some beneficial effect on receptor or a reduced risk of negative effect occurring, for example
	  ◦ Surface Water:
	  – Reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).
	  ◦ Groundwater:
	  – Reductions in waterlogging and groundwater flooding.
	  – Reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).
	• **Moderate Beneficial** - results in moderate improvement of receptor quality, for example:
	  ◦ Surface Water:
	  – Contribution to improvement in water body WFD classification.
	  – Reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually.
	  ◦ Groundwater:
	  – Reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually.
	  – Contribution to improvement in water body WFD classification.
	  – Support to significant improvements in damaged GWDTE.
	• **Major Beneficial** - results in major improvement of receptor quality, for example**:**
	  ◦ Surface Water:
	  – Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse.
	  – Improvement in water body WFD classification.
	  ◦ Groundwater:
	  – Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring.
	  – Recharge of an aquifer.
	  – Improvement in water body WFD classification

Geographic Extent of Impact (GE)	• Within ERF Boundary – 0km • Up to 2km from ERF • Up to 10km from ERF • Over 10km from ERF
Frequency of Impact (F)	• Single event • Potentially annual activity • Monthly occurrence • Continuous activity • Variable depending on weather conditions

Table 11-15: Estimating the Magnitude of an Impact on Water Environment Receptors (cont)

Criteria	Examples
Duration of Impact (D)	• 0-6 hours • 1 day • Up to 60 hours • 1 week • 1 month • 2-6 months • 6-12 months • 12-36 months • Over 36 months
Reversibility of Impact (R)	• Unknown - there is insufficient research/experience to indicate whether the environmental effect is reversible • High - previous research/experience indicates the environmental effect is reversible • Medium - previous research/experience indicates the environmental effect may be reversible • Low - previous research/ experience indicates that there is a small likelihood that the environmental effect is reversible • Nil - previous research/ experience indicates that the environmental effect is irreversible
Ecological, Cultural and Socio-economic Context of Impact (ESC)	• Relatively pristine area not adversely affected by human activity • Evidence of human activity • High level of human activity

Table 11-16: Table Estimating the Overall Significance of Potential Effects

Receptor Importance					
	Very High	Neutral	Moderate/Large	Large/Very Large	Very Large
	High	Neutral	Slight/Moderate	Moderate/Large	Large/Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Slight/Moderate
		Negligible	**Minor**	**Moderate**	**Major**
		Magnitude of Impact			

Receptor Importance - Groundwater

11.5.6. The groundwater environment beneath the Development Site can be classified as **Low/Medium** sensitivity based on the criteria in Table 11-14 due to the following characteristics:

- low productivity aquifer (Secondary B);
- not located within a SPZ;
- WFD Class 'Poor';
- located within a Drinking Water Protected Area but no downstream abstractions have been identified within 1km of the Development;
- high vulnerability due to absence of superficial deposits and limited unsaturated zone; and
- shallow groundwater throughflow is likely to provide local baseflow to minor watercourses.

Receptor Importance – Surface Water

11.5.7. The receiving surface water environment downstream of the Development Site can be classified as **Medium** sensitivity based on the criteria in Table 11-14 due to the following characteristics:

- site drainage discharges to a tributary watercourse of Pwll Trewern which flows through the Development;
- The low flow rate (Q_{95}) of the tributary watercourse, at the confluence of the site discharge, is <1.0m^3/s;
- WFD Class 'Poor' with a 2021 objective of 'Good' for Pwll Trewern. The Development seeks to meet the objectives of the WFD; and
- located within a Freshwater Fish Protected Area.

Table 11-17: Environmental Effects Analysis – Water Environment

Activity	Potential Effect	Evaluation Criteria					
		Mg	**GE**	**F**	**D**	**R**	**ESC**
Construction and Decommissioning General earthworks, slope stabilisation and vehicle tracking	Reduced surface water quality due to elevated suspended solids loading in site runoff	Moderate	<2 km	Cont	12-36 M	High	High
	Conclusion: The environmental impact of this activity on the water environment is considered to be of **Moderate Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • CEMP & DEMP prepared and adopted on site with appropriate induction training for relevant site personnel. • Phasing of construction works to ensure appropriate surface water management measures are in place prior to construction commencing. • Appropriate use of temporary silt control measures, such as silt fences and/or 'siltbuster' settlement tanks, as required in areas of exposed quarry faces or spoil, or in adverse weather conditions. These measures will also provide additional upstream protection of the site's surface water drainage system during the decommissioning phase. • All new slopes created within the main quarry void to be hydraseeded with an annual Westerwold grass mix to rapidly establish vegetation cover and minimise suspended solids loading in runoff, prior to final planting schemes establishing.						
Construction - Dewatering associated with below ground development	Reduced groundwater levels due to dewatering, with resultant impact on baseflow to watercourses and local abstractions	Minor	<2 km	Cont	2-6 M	High	High
	Conclusion: The environmental impact of this activity on the water environment is considered to be of **Slight Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • Dewatering trials would be undertaken if considered appropriate, to establish an appropriate method of construction to minimise groundwater ingress. • Abstracted groundwater would be discharged via the site's surface water drainage system to the receiving watercourse, thus alleviating any potential reduction in baseflow. • No groundwater or surface water abstractions have been identified within 0.8km of the Development, therefore no further mitigation required.						

Table 11-1718: Environmental Effects Analysis – Water Environment

Activity	Potential Effect	Evaluation Criteria					
		Mg	**GE**	**F**	**D**	**R**	**ESC**
Construction – development below ground, discharge of abstracted groundwater to surface water	Discharge of abstracted groundwater to the receiving tributary watercourse has the potential to temporarily increase flood risk downstream	Minor	<2 km	Cont	2-6 M	High	High
	Conclusion: The environmental impact of this activity on the water environment is considered to be of **Slight Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • Dewatering trials would be undertaken, if considered appropriate to establish an appropriate method of construction to minimise groundwater ingress. These trials would inform the rate of groundwater abstraction required to be discharged to the receiving watercourse. • Abstracted groundwater would be discharged via the proposed surface water management system, with controlled discharge to the receiving watercourse. Additional, temporary on-site attenuation would be provided, if required, to maintain the overall site discharge rate at or below the 1:2 year Greenfield runoff rate, as outlined in the SWMP						
Construction, Operation & Decommissioning – accidental spillage of potentially contaminative liquids (fuels/oils)	Reduced surface water quality in tributary watercourse which flows through the Development, due to discharge of pollutants in site runoff.	Moderate	<10 km	Single	12-36 M	Med	High
	Conclusion: The environmental impact of this activity on the water environment is considered to be of **Moderate Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • CEMP & DEMP prepared and adopted on site with appropriate induction training for relevant site personnel. CEMP & DEMP to include a pollution incident response plan. • Appropriate spill response equipment stored securely on site. • Traffic management plan adopted on site including measures to minimise vehicle movements on site, ensure adequate visibility and appropriate signage. • Appropriate storage of potentially polluting liquids in bunded tanks with secondary spill containment. • Concrete delivered to site as required in ready-mixed form (no on-site batching plant). • Servicing and refuelling of vehicles on site to be minimised through the CEMP/DEMP. Any servicing or refuelling to be undertaken over proprietary absorbent spill mat or tray.						

Table 11-1719: Environmental Effects Analysis – Water Environment – Construction and Decommissioning (cont)

Activity	Potential Effect	Evaluation Criteria					
		Mg	**GE**	**F**	**D**	**R**	**ESC**
Construction & Decommissioning – bank collapse / partial or total blockage of tributary watercourse	Reduced surface water quality and flow capacity within the tributary watercourse which flows through the Development. Potential increased flood risk upstream, within the Development.	Minor	<2 km	Single	1M	High	High
	Conclusion: The environmental impact of this activity on the water environment is considered to be of **Slight Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • CEMP & DEMP prepared and adopted on site. • Temporary fencing installed along the banks of the sections of open watercourse. • Culverted sections of the watercourse to be surveyed and any remedial works (i.e. removal of blockages or repairs) undertaken prior to construction works commencing. • Powys County Council ordinary watercourse consent to be obtained for all works in or over the watercourse. • Routine visual inspection of the open sections of watercourse to be incorporated within the CEMP & DEMP, with any required remedial works undertaken promptly.						
Construction and Operation – introduction of impermeable surfaces within the Development.	Increased surface water runoff rates and volumes from the Development to the receiving tributary watercourse with potential increased flood risk downstream.	Minor	<2 km	Cont	>36 M	High	High
	Conclusion: The environmental impact of the development on the water environment is considered to be of **Slight Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • SWMP prepared and adopted on site with appropriate training for relevant site personnel. • Surface water runoff rates to be attenuated within the Development to pre-development Greenfield rates, providing improved control of site runoff compared to current conditions. • The SWMP has been prepared in accordance with the Welsh National Standards for SuDS and The SuDS Manual and has been subject to SAB approval pre-application review by Powys County Council. SAB approval of the SWMP would be obtained prior to any works commencing.						

Table 11-1720: Environmental Effects Analysis – Water Environment – Construction and Decommissioning (cont)

Activity	Potential Effect	Evaluation Criteria					
		Mg	**GE**	**F**	**D**	**R**	**ESC**
Operation – presence of an impermeable development platform	The impermeable development platform could lead to a reduction in infiltration and groundwater recharge to the underlying mudstone Secondary B aquifer.	Negligible	0 km	Cont	>36 M	High	High
	Conclusion: The environmental impact of this activity on the water environment is considered to be of **Neutral Significance.** The mitigation measures outlined below will ensure the significance is minimised.						
	Mitigation: • SuDS elements within the SWMP permit infiltration to ground where feasible • The baseline conditions within the footprint of the development platform would offer negligible potential for infiltration due to low permeability bedrock and perched groundwater at or near ground surface. • Local perched groundwater and surface water runoff discharges to the tributary watercourse which flows through the Development. During all phases of the Development, this will continue, with site drainage discharging to the watercourse.						
Operation – import, handling and storage of wastes	Potential discharge of contaminated leachate into surface water and groundwater during waste handling and storage.	Moderate	<10 km	Cont	>36 M	Med	High
	Conclusion: The environmental impact of this activity on the water environment is considered to be of **Moderate Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • The operation of the ERF would be in accordance with an Environmental Permit issued by Natural Resources Wales. • Waste unloading and handling would be restricted to the enclosed tipping hall, with wastes deposited within the fully sealed bunker. • The waste bunker shall be designed in accordance with the requirements of BS EN 1992-3: Eurocode 2: Design of concrete structures. Liquid containing and retaining structures, with an appropriate grade of reinforced concrete to be suitable for a minimum design life of 40 years. • A detailed risk assessment and design study would inform the bunker design and would be submitted in support of the Environmental Permit application.						

Table 11-1721: Environmental Effects Analysis – Water Environment – Construction and Decommissioning (cont)

Activity	Potential Effect	Evaluation Criteria					
		Mg	GE	F	D	R	ESC
Operation – presence of sub-water table, below ground development (if required)	Impermeable sub-water table construction could act as a barrier to groundwater flow with variation in local groundwater levels and potential emergence of groundwater at surface.	Minor	0 km	Cont	>36 M	High	High
	Conclusion: The environmental impact of this activity (if required) on the water environment is considered to be of **Slight Significance.** Mitigation measures as outlined below will be required to minimise significance.						
	Mitigation: • The extent of any sub-water table development (if required) would be limited and would be installed within relatively low permeability bedrock geology comprising mudstones classified as a Secondary B aquifer. • Groundwater flow within the bedrock predominantly occurs via discrete discontinuities, with flow dependent on their connectivity. A groundwater drainage system would be installed around any sub-water table structures, as required by geotechnical engineering design, to maintain connectivity between any aquifer discontinuities and to facilitate groundwater flow around the structure.						

11.6. Residual Environmental Effects

11.6.1. Due to the design features that are integrated into the Development, notably the proposed SWMP and relevant measures incorporated within the site's CEMP and DEMP, there would be no significant residual effects of the Development on the water environment.

11.6.2. The comprehensive SWMP would result in improved control of both surface water quality and quantity discharging from the Development Site to the receiving watercourse, compared to current baseline conditions.

11.6.3. KEA specific significance criteria for the Water Environment are defined in Table 11-15 and summarised below:

- **Major Adverse (significant) residual environmental effect**= increased flood risk, significantly reduced water quality (failure of EQS values), reduction in WFD classification, loss of major water supplies.
- **Moderate Adverse (significant) residual environmental effect**= local increase in flood risk, reduced water quality (but compliant with EQS values), degradation of water supplies, medium risk of water pollution.
- **Minor Adverse (not significant) residual environmental effect**= minor effects on local water quality and water supplies.
- **Negligible (not significant) residual environmental effect**= no discernible impact on water quality, water resources or flood risk.

- **Minor Beneficial residual environmental effect**= minor reduction in flood risk and spillage risk.
- **Moderate Beneficial residual environmental effect**= significant reduction in flood risk and spillage risk, contribution to improvement in WFD classification.
- **Major Beneficial residual environmental effect**= removal of existing polluting discharge, recharge of an aquifer, improvement in WFD classification.

11.6.4. Residual environmental effects for the Project, taking account of the proposed mitigation measures, are provided in Table 11-18.

Table 11-22: Summary of Residual Environmental Effects – Water Environment

Development Phase	Residual Adverse Environmental Effect	Significance	Likely Effect on the Environment
Construction	Reduced surface water quality due to elevated suspended solids loading in site runoff	Minor Adverse Not Significant	Temporary, slight increase in suspended solids loading from existing baseline during adverse weather conditions. Anticipated adverse effects may not be detectable beyond the boundary of the Development Site
	Reduced groundwater levels due to potential dewatering during construction, with resultant impact on baseflow to watercourses and local abstractions	Negligible Not Significant	No discernible impact beyond the boundary of the Development Site
	Discharge of abstracted groundwater to the receiving watercourse has the potential to temporarily increase flood risk downstream	Negligible Not Significant	No discernible impact beyond the boundary of the Development Site
	Reduced surface water quality in receiving watercourse due to accidental discharge of chemical pollutants in site runoff	Minor Adverse Not Significant	Adverse impact would only occur in the event of an accidental release of chemical pollutants in proximity to the watercourse or drainage network. Adverse effects may not be detectable beyond the boundary of the Development Site.

Table 11-23: Summary of Residual Environmental Effects – Water Environment

Development Phase	Residual Adverse Environmental Effect	Significance	Likely Effect on the Environment
Operation	Reduced surface water quality in receiving watercourse due to accidental discharge of chemical pollutants in site runoff	Minor Adverse Not Significant	Adverse impact would only occur in the event of an accidental release of chemical pollutants in proximity to the watercourse or drainage network. Adverse effects may not be detectable beyond the boundary of the Development Site.
	Impermeable, below-ground, sub-water table development could act as a barrier to groundwater flow with variation in local groundwater levels and potential emergence of groundwater at surface.	Negligible Not Significant	No discernible impact beyond the boundary of the Development Site
	Increased surface water runoff rates and volumes from the Development Site to the receiving tributary watercourse with potential increased flood risk downstream.	Minor Beneficial	SWMP will provide improved control of surface water runoff rates and quality entering the receiving watercourse compared to baseline conditions.
	Potential discharge of contaminated leachate into surface water and groundwater during waste handling and storage	Negligible Not Significant	No discernible impact beyond the boundary of the Development Site
Decommissioning	Reduced surface water quality due to elevated suspended solids loading in site runoff	Minor Adverse Not Significant	Temporary, slight increase in suspended solids loading from existing baseline during adverse weather conditions. Anticipated adverse effects may not be detectable beyond the boundary of the Development Site
	Reduced surface water quality in receiving watercourse due to accidental discharge of chemical pollutants in site runoff	Minor Adverse Not Significant	Adverse impact would only occur in the event of an accidental release of chemical pollutants in proximity to the watercourse or drainage network. Adverse effects may not be detectable beyond the boundary of the Development Site

11.7. Summary

11.7.1. The Development Site currently comprises an historic mudstone and clay quarry void with associated access road and storage areas. The bedrock geology comprises Silurian shales and mudstones which dip steeply towards the south-east and are highly weathered where exposed.

11.7.2. The bedrock geology is classified as a Secondary B aquifer, with porosity and permeability limited to the near-surface weathered horizon and discontinuities including bedding planes and fractures.

11.7.3. Groundwater levels have been locally influenced by quarrying, within the site monitoring boreholes indicate a hydraulic gradient into the quarry void, with groundwater levels at or just below ground level in the quarry floor. Incident rainfall forms surface water runoff or shallow, perched groundwater throughflow, providing baseflow to the tributary watercourse which flows through the site.

11.7.4. The watercourse is a tributary of Pwll Trewern (a WFD surface water body) and is culverted for the majority of its course through the Development Site.

11.7.5. The baseline groundwater and surface water environment within the Development Site is strongly influenced by the historic quarrying activities. Site drainage is managed informally via a series of settlement/attenuation ponds but elevated suspended solids are evident in runoff entering the tributary watercourse.

11.7.6. The Development Site is not at significant risk of flooding and therefore an FCA is not required to support the planning application.

11.7.7. In the absence of appropriate mitigation and design the proposed Development of Buttington ERF has the potential to:

- increase suspended solids content in site drainage entering the receiving watercourse during site preparation and construction.
- increase surface water runoff rates and volumes due to the introduction of impermeable surfaces;
- impact groundwater and surface water quality due to storage and handling of hazardous wastes and the use or accidental release of other chemical pollutants including hydrocarbons.

11.7.8. A comprehensive SWMP has been prepared to address the management of surface water runoff throughout the life of the Development. The SWMP maximises the use of SuDS within the site constraints and the outline drainage design has received a positive pre-application response from Powys County Council's Land Drainage team.

11.7.9. The CEMP and DEMP will ensure appropriate construction and demolition techniques are employed to minimise the risk of pollution to groundwater and surface water. Measures would include appropriate staff induction and the secure storage of appropriate spill response equipment on site.

11.7.10. The environmental effects analysis for the water environment concludes that there would be no significant residual effects, with the SWMP providing a minor beneficial effect on site drainage (quality and quantity) compared to baseline conditions.

11.8. References

[i] Email dated 10th October 2018 from Michelle Lewis, External Relations Officer, Natural Resources Wales, to Nicola Sugg, NSugg Ltd.
[ii] Email dated 9th August 2018 from Joanne Vasse, Technical Officer, Environmental Protection, Powys County Council, to Nicola Sugg, NSugg Ltd.
[iii] Welsh Government, 2018, Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems.
[iv] British Geological Survey, Onshore GeoIndex online mapping, accessed September 2018.
[v] Terrafirma, February 2019, Slope Stability Assessment, Buttington Quarry, Buttington, Welshpool.
[vi] Countryside Council for Wales, 2004, Site of Special Scientific Interest Citation, Buttington Brickworks.
[vii] http://www.largeimages.bgs.ac.uk/iip/hydromaps.html?id=england-wales.jp2, accessed September 2018
[viii] Environment Agency, 2005, Technical Report NC/99/74/17, Baseline Report Series: 17. The Ordovician and Silurian meta-sedimentary aquifers of central and south-west Wales.
[ix] British Geological Survey, 2000, The physical properties of minor aquifers in England and Wales.
[x] British Geological Survey, Geoindex Onshore mapping, accessed September 2018.
[xi] http://nrfa.ceh.ac.uk/data/station/spatial/54005 accessed September 2018
[xii] http://environment.data.gov.uk/catchment-planning/WaterBody/GB40902G205300 accessed August 2018.
[xiii] https://nrwregulatory.naturalresources.wales/Permits accessed September 2018.
[xiv] E-mail, 9th August 2018, from Joanne Vasse, Technical Officer, Environmental Protection, Environmental Health, Powys County Council.
[xv] http://environment.data.gov.uk/catchment-planning/WaterBody/GB109054049660 accessed September 2018
[xvi] https://fehweb.ceh.ac.uk/ accessed September 2018.
[xvii] Natural Resources Wales, February 2014, Water Framework Directive, River Catchment Summary, Pwll Trewern – Source to Confluence River Severn.
[xviii] http://environment.data.gov.uk/catchment-planning/WaterBody/GB109054049660 accessed August 2018.
[xix] Severn Trent Water, Presentation at Water Resource Technical Forum, Session 3, 15th June 2017.
[xx] Powys County Council, April 2014, Local Flood Risk Management Strategy 2013-2017.
[xxi] Welsh Government, December 2017, Adapting to Climate Change: Guidance for Flood and Coastal Erosion Risk Management Authorities in Wales.
[xxii] Highways England, August 2019, Design Manual for Roads and Bridges, LA113 Road drainage and the water environment (formerly HD45/09). Revision 0.
[xxiii] NRW, 2017, Above ground oil storage tanks: GPP2.
[xxiv] CIRIA, 2015, The SuDS Manual, Report ref. C753.
[xxv] Welsh Government, 2018, Statutory standards for sustainable drainage systems - designing, constructing, operating and maintaining surface water drainage systems.
[xxvi] NRW, 2017, Above ground oil storage tanks: GPP2.
[xxvii] The Planning Inspectorate, June 2017, Advice note 18 – The Water Framework Directive.

Technical Appendix 11-1
Drawings

NOTES

1. Geological information reproduced from British Geological Survey's Geoindex Onshore mapping service accessed September 2018.

LEGEND

- Application Site Boundary
- (1) Alluvium - Gravel, Sand, Silt and Clay
- (2) Head - Clay, Silt, Sand and Gravel
- (3) Glaciofluvial Fan Deposits - Sand and Gravel
- (4) Glaciolacustrine Deposits - Clay and Silt
- (5) Till - Diamicton
- (6) Superficial Deposits Absent (bedrock at or near surface)
- (7) Made Ground

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SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment
(Project Ref: NS_0118_01)

DRAWING TITLE
Superficial Geology

DRAWING NUMBER	REVISION
11/1	0
SCALE	DATE
1:12,500 @ A3	09.06.2020

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NOTES

1. Geological information reproduced from British Geological Survey's Geoindex Onshore mapping service accessed September 2018.

LEGEND

- Application Site Boundary
- (1) Knucklas Castle Formation - Mudstone, Siltstone and Sandstone
- (2) Cwm-Yr-Hob Member - Mudstone, Siltstone and Sandstone
- (3) Bailey Hill Formation - Sandstone and Siltstone, Interbedded
- (4) Irfon Formation - Mudstone and Siltstone
- (5) Gyfenni Wood Shale Formation - Mudstone
- (6) Mottled Mudstone Member, Wenlock Age - Mudstone
- (7) Trewern Brook Mudstone Formation - Mudstone
- (8) Banwy Member - Mudstone
- (9) Tarannon Mudstone Formation -Mudstone
- (10) Cefn Formation - Mudstone and Sandstone
- (11) Stone House Shale Formation - Tuff, Felsic
- (12) Stone House Shale Formation - Mudstone
- (13) Nantglyn Flags Formation - Mudstone
- (14) Nant-Ysgollon Mudstone Formation - Mudstone
- (15) Unnamed Igneous Intrusion, Ordovician - Microgabbro
- Fault

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SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment
(Project Ref: NS_0118_01)

DRAWING TITLE
Bedrock Geology

DRAWING NUMBER	REVISION
11/2	0
SCALE	DATE
1:12,500 @ A3	09.06.2020

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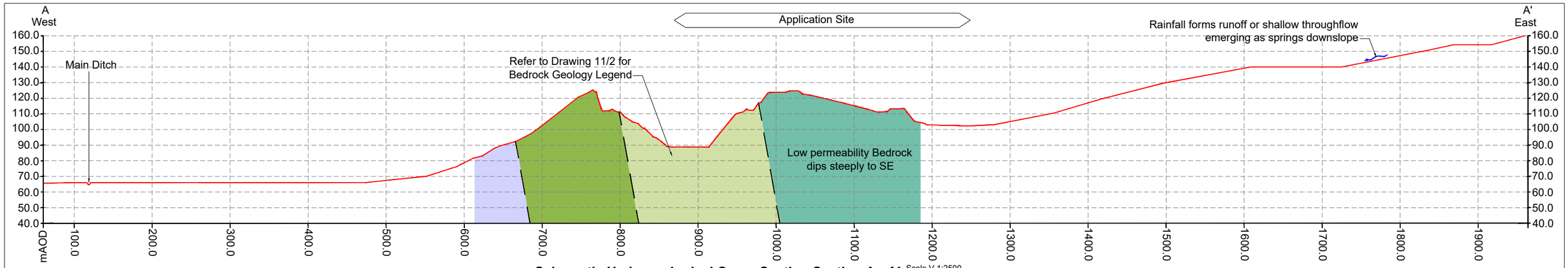

Schematic Hydrogeological Cross Section Section A - A' Scale V 1:2500 H 1:5000

Llwyn Melyn/Rowan Tree Barn/Rhyd Barn/The Stables/Long Meadow/Oaklands House/The Carthouse

Lower Heldre

Middle Heldre

Nantyrbrochan/Upper Heldre Farm/The Granar

Diamond Cottage

Penybank/Pobceiniog

Little Heldre

Southview

Top House

Middle House

Buttington New Hall

Welshpool Livestock Sales

Cletterwood Farm

Plan Scale 1:15,000

NOTES

1. The application site is not within or in the vicinity of a Groundwater Source Protection Zone

LEGEND

- Application Site Boundary
- Private Water Supply within 2km radius
- Licensed Abstraction from Groundwater or Surface Water within 2km radius
- Discharge Consents within 1km radius

Aquifer Designation

- Secondary A
- Secondary B
- Secondary (Undifferentiated)
- Unproductive

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SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment
(Project Ref: NS_0118_01)

DRAWING TITLE
Hydrogeological Site Setting

DRAWING NUMBER	REVISION
11/3	1
SCALE	DATE
As Shown @ A3	09.06.2020

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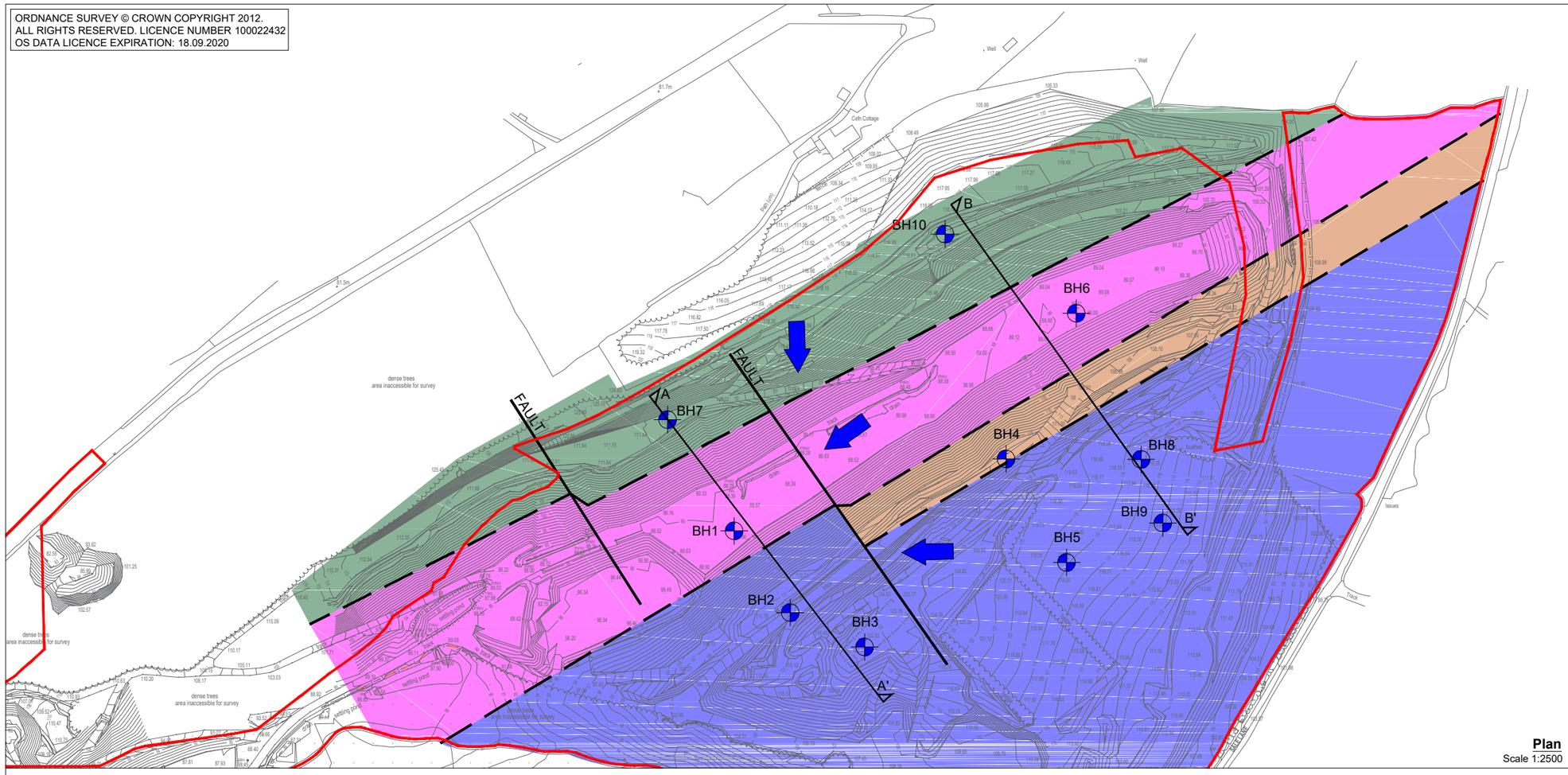
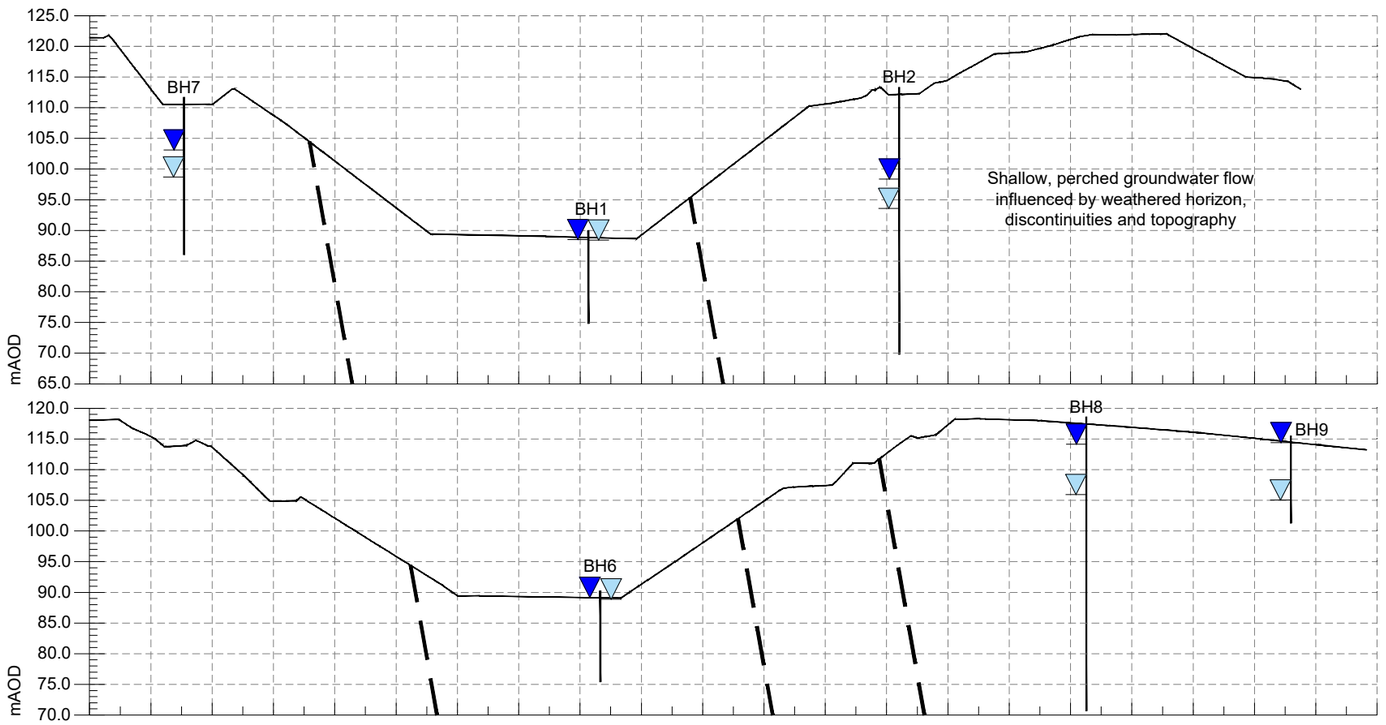


Plan
Scale 1:2500



Section A - A'
Scale H 1:1000
V 1:1000

Section B - B'
Scale H 1:1000
V 1:1000

NOTES

1. Bedrock Geology provided by Broad Environmental Limited Slope Stability Assessment Report Dated February 2019

LEGEND

- Application Site Boundary
- Borehole Locations
- Maximum Recorded Groundwater Level, three monitoring events, Nov 2018 – March 2020
- Minimum Recorded Groundwater Level, three monitoring events, Nov 2018 – March 2020
- Probable Direction of shallow Groundwater through flow

Bedrock Geology

- Cefn Formation
- Tarannon Mudstone Formation
- Banwy Member
- Trewern Brook Mudstone Formation
- Inferred Boundary Between Geological Units

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SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment
(Project Ref: NS_0118_01)

DRAWING TITLE
Local Hydrogeology

DRAWING NUMBER	REVISION
11/4	0
SCALE	DATE
1:2500 @ A3	09.06.2020

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Pwll Trewern downstream of Watery Lane, approaching River Severn

NOTES

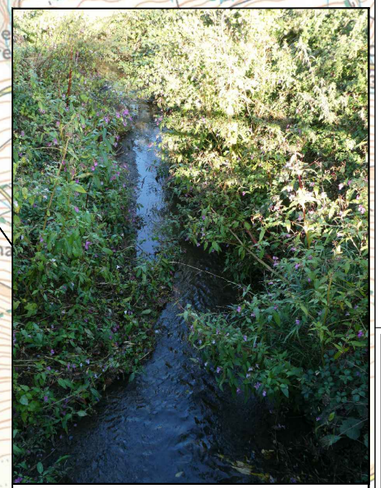
1. Flood Zones reproduced from Natural Resources Wales' on-line Development Advice Map, accessed September 2018.
2. Photographs were taken on 25th September 2018.

LEGEND

- Application Site Boundary
- Powysland Internal Drainage Board boundary
- Tributary Watercourse

NRW Flood Zones

- Zone C1
- Zone C2
- Zone B
- Zone A



Pwll Trewern at Trewern Bridge

Tributary ordinary watercourse (including site drainage)

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Broad Energy (Wales) Limited

SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment
(Project Ref: NS_0118_01)

DRAWING TITLE
Hydrological Site Setting

DRAWING NUMBER	REVISION
11/5	0
SCALE	DATE
1:15000 @ A3	09.06.2020

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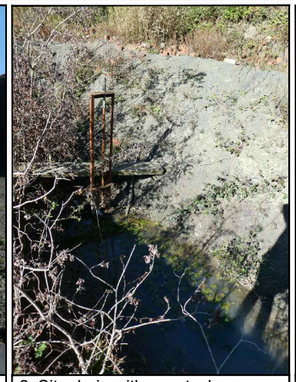
1. Ponded water in quarry floor drains to South-West



2. Site drain with penstock flow control

3.Upper Northern settlement pond

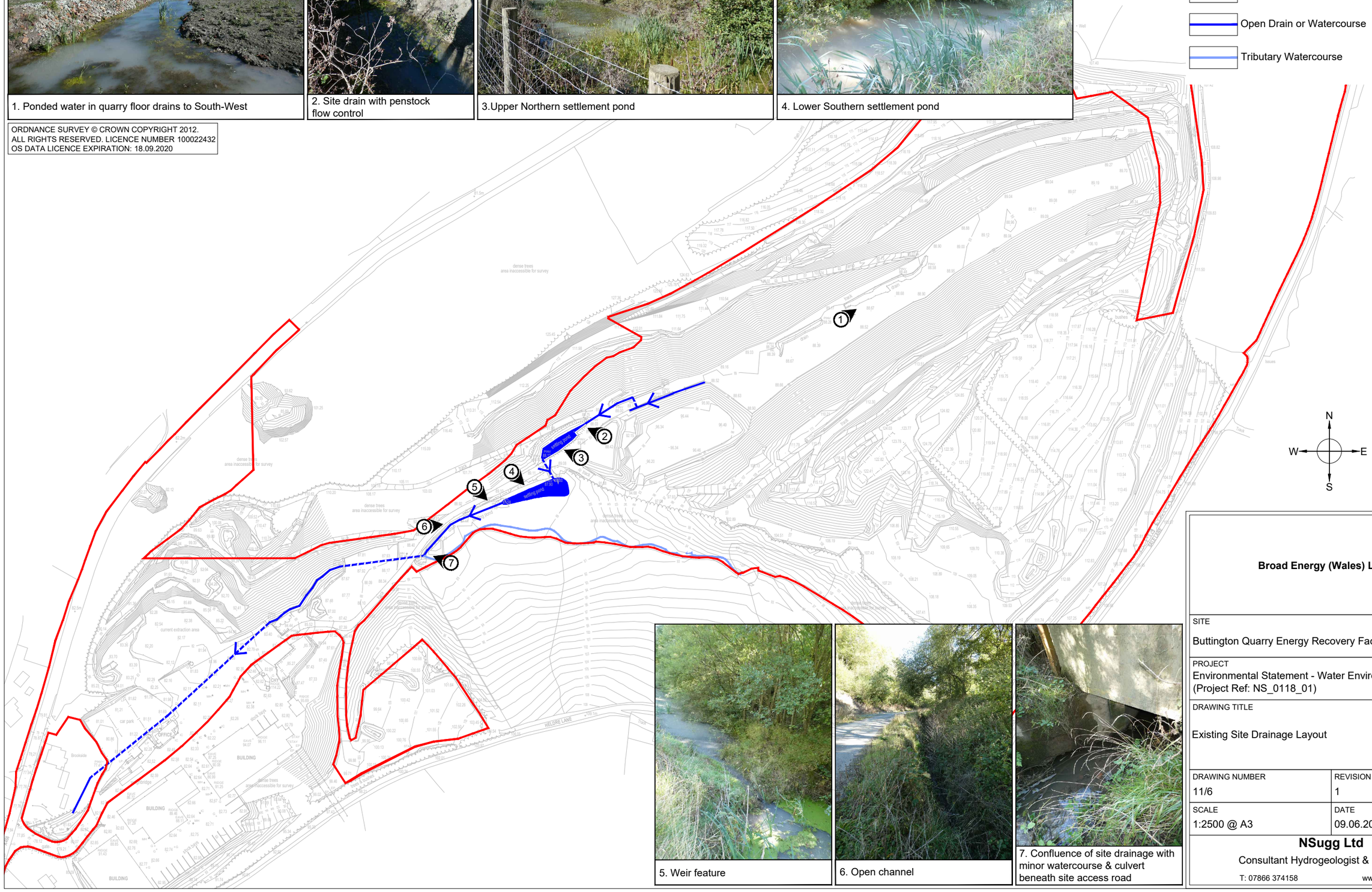
4. Lower Southern settlement pond

NOTES

1. Photographs were taken on 25th September 2018.

LEGEND

- Application Site Boundary
- Culvert
- Open Drain or Watercourse
- Tributary Watercourse



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5. Weir feature

6. Open channel

7. Confluence of site drainage with minor watercourse & culvert beneath site access road

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SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment
(Project Ref: NS_0118_01)

DRAWING TITLE
Existing Site Drainage Layout

DRAWING NUMBER	REVISION
11/6	1
SCALE	DATE
1:2500 @ A3	09.06.2020

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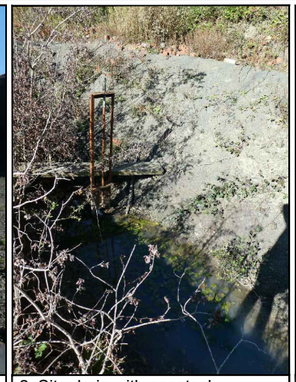
Technical Appendix 11-2
Surface Water Management Plan

ECL Ref: ECL.001.01.02/ES
DATE: August 2020
ISSUE: FOR CONSULTATION

1. Ponded water in quarry floor drains to South-West



2. Site drain with penstock flow control

3.Upper Northern settlement pond

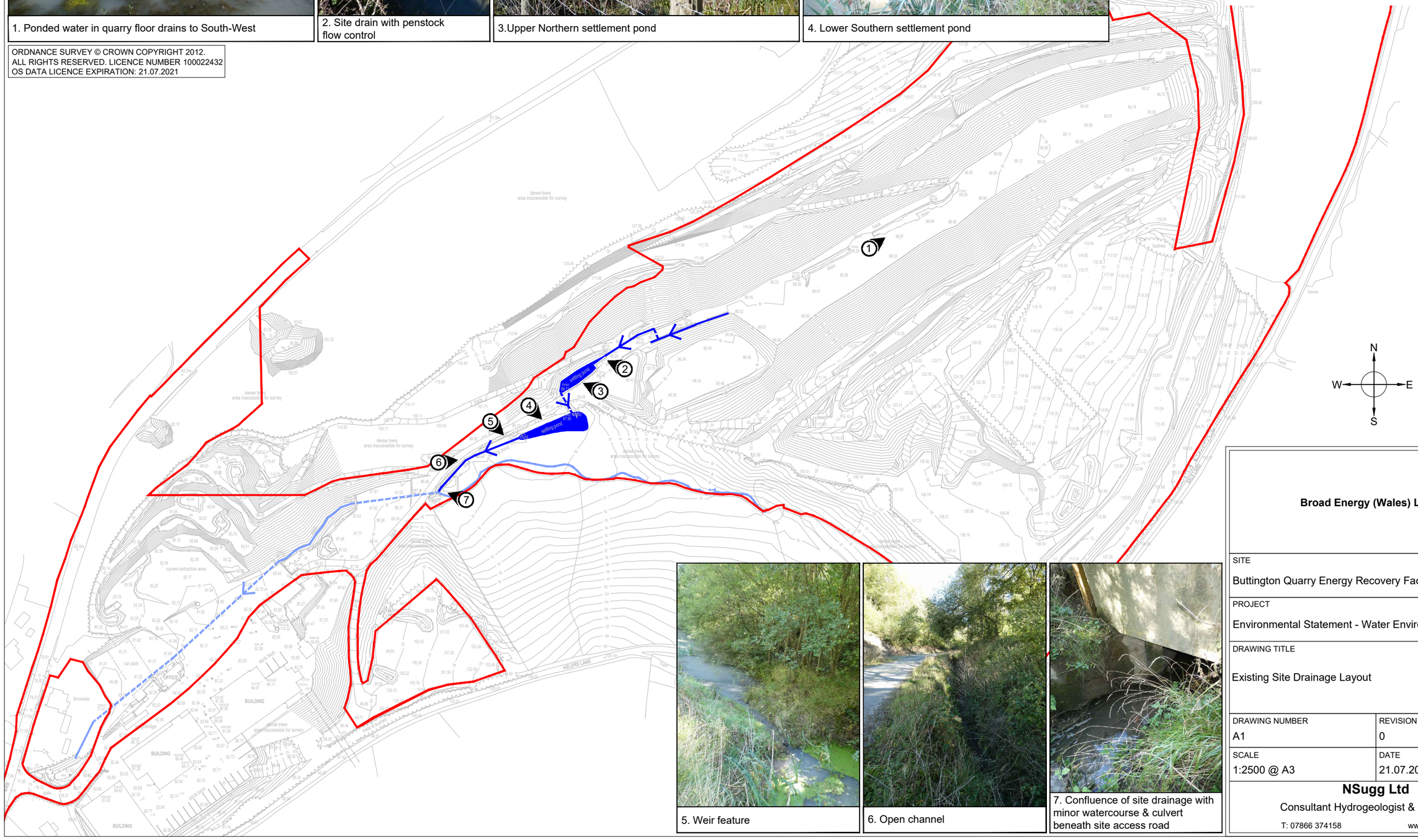
4. Lower Southern settlement pond

NOTES

1. Photographs were taken on 25th September 2018.

LEGEND

- APPLICATION SITE BOUNDARY
- CULVERT
- OPEN DRAIN OR WATERCOURSE
- TRIBUTARY WATERCOURSE



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5. Weir feature

6. Open channel

7. Confluence of site drainage with minor watercourse & culvert beneath site access road

Broad Energy (Wales) Limited

SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment

DRAWING TITLE
Existing Site Drainage Layout

DRAWING NUMBER	REVISION
A1	0
SCALE	DATE
1:2500 @ A3	21.07.2020

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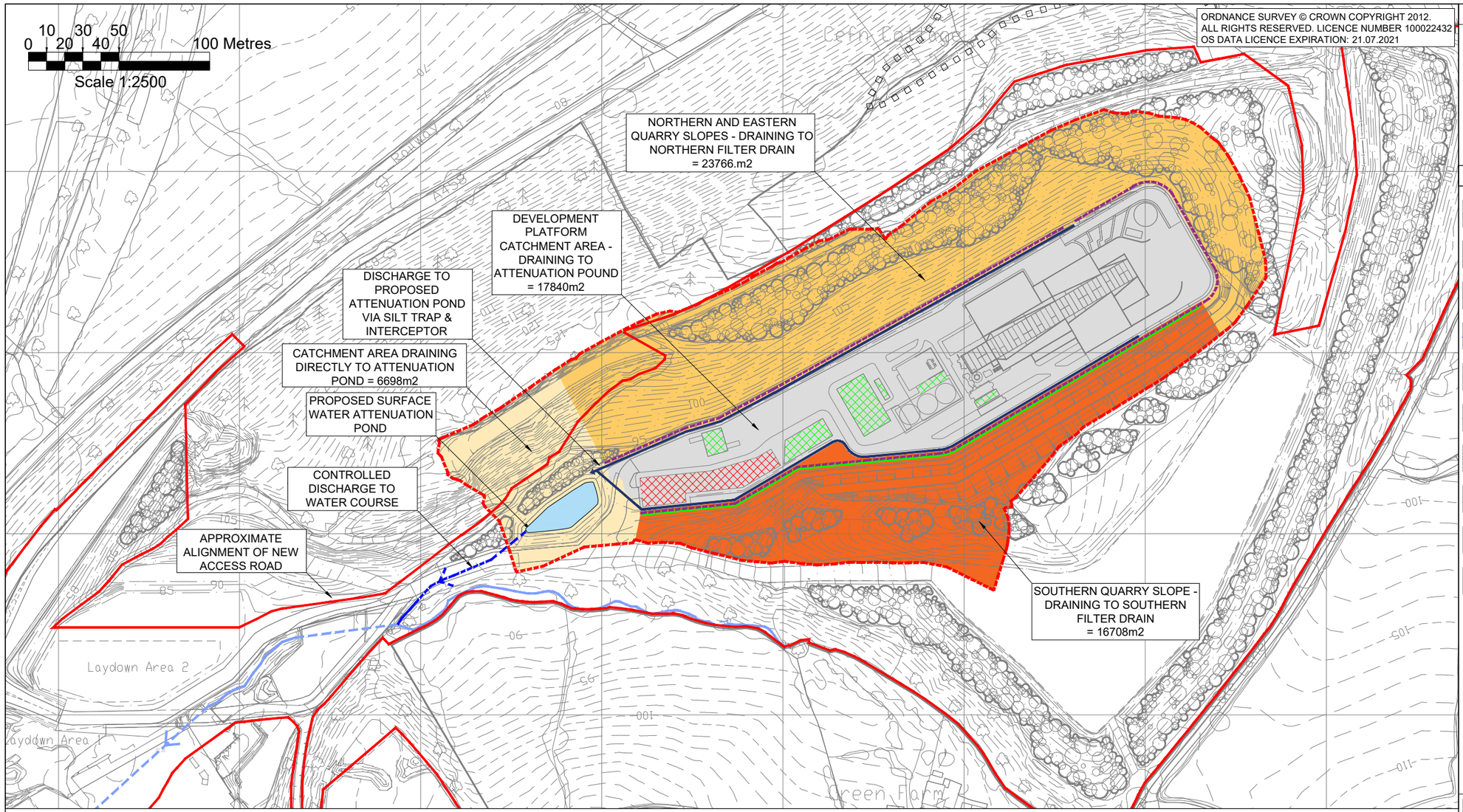
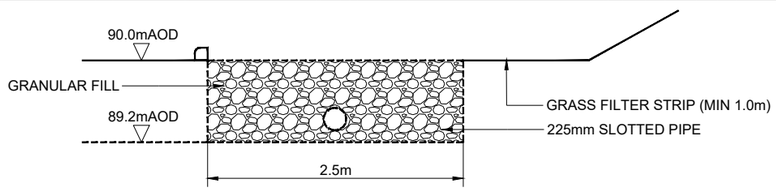
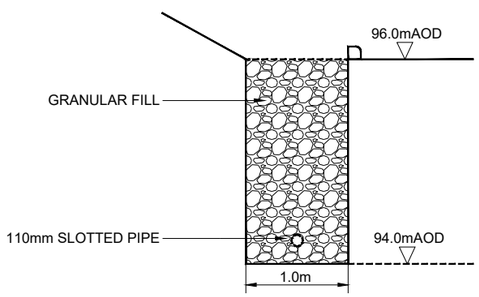
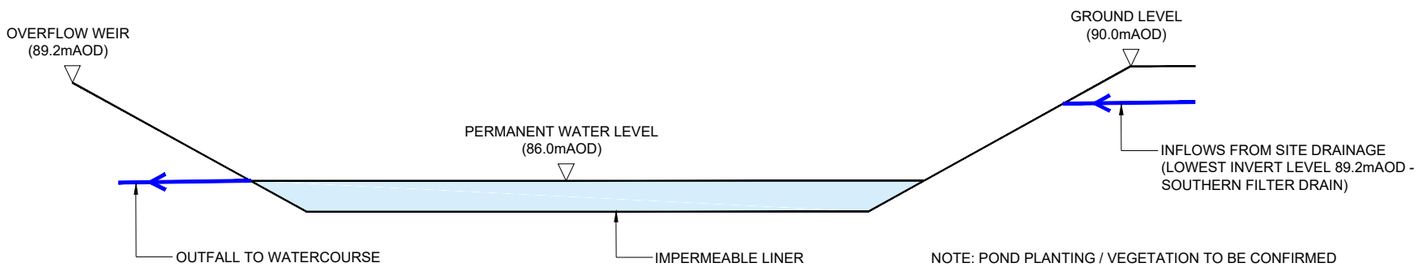




SOUTHERN FILTER DRAIN
(N.T.S)



NORTHERN FILTER DRAIN
(N.T.S)



ATTENUATION / SETTLEMENT POND
(N.T.S)

NOTE: POND PLANTING / VEGETATION TO BE CONFIRMED AFTER ECOLOGICAL & BIODIVERSITY DESIGN INPUT

NOTES

1. Drawing information taken from drawing No. BT1180-D2 dated April 2020

LEGEND

- SITE BOUNDARY
- CATCHMENT BOUNDARY FOR SITE DRAINAGE SYSTEM (6.71 Ha)
- TRIBUTARY WATERCOURSE
- CULVERT
- OPEN DRAIN OR WATERCOURSE
- NORTHERN DRAIN
- PERIMETER KERB DRAIN (OR SIMILAR) DRAINING THE DEVELOPMENT AREA
- GRASS FILTER STRIP (Min 1.0m WIDTH) TO SOUTHERN FILTER DRAIN, INSTALLED ON LOWER 'BENCH'
- PERMEABLE PAVING (995m2)
- ROOF AREAS DRAINING TO PERMEABLE PAVING SUB-BASE (1067m2)

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Broad Energy (Wales) Limited

SITE	Buttington Quarry Energy Recovery Facility
PROJECT	Environmental Statement - Water Environment
DRAWING TITLE	Outline Surface Water Management Plan – ERF Development
DRAWING NUMBER: A2	REVISION: 0
SCALE: 1:2500 @ A3	DATE: 21.07.2020

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NOTES

1. Drawing information taken from drawing No. BT1180-D2 dated April 2020

LEGEND

- SITE BOUNDARY
- TRIBUTARY WATERCOURSE
- CULVERT
- OPEN DRAIN OR WATERCOURSE

This section of the access road lies within the surface water catchment of the ERF Attenuation Pond

ERF Attenuation Pond

ERF Development

Proposed site access road - Gravity drainage to below ground geocellular storage. Final design dependent on ground conditions and site survey.

Laydown Area 2

Geocellular storage (Below ground)

Controlled discharge to watercourse

Laydown Area 1

326600E

N
W
E
S

1:1250
25m 0 25m 50m 75m 100m 125m

Broad Energy (Wales) Limited

SITE
Buttington Quarry Energy Recovery Facility

PROJECT
Environmental Statement - Water Environment

DRAWING TITLE
Outline Surface Water Management Plan – Site Access Road

DRAWING NUMBER	REVISION
A3	0
SCALE	DATE
1:1250 @ A3	21.07.2020

NSugg Ltd
Consultant Hydrogeologist & Hydrologist
T: 07866 374158 www.nsugg.co.uk