PROPOSED INERT WASTE INFILL, PASTURE HOUSE QUARRY, SOUTHOWRAM, WEST YORKSHIRE

HYDROGEOLOGICAL RISK ASSESSMENT

Prepared for

Silkstone Environmental Limited

October 2021
Ref:033/53/phq/hra/1021

S M Foster Associates Limited
Hydrological and Hydrogeological Consultants

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1		**12/10/2021**

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1. Introduction

1.1 This report has been prepared in response to instruction dated 24th February 2021 from Silkstone Environmental Limited (SEL). The report presents a Hydrogeological Risk Assessment (HRA) related to proposed infilling of Pasture House Quarry with inert waste. The HRA is prepared to support a bespoke recovery permit application. A waste recovery plan for the site was approved in March 2021.

1.2 Waste recovery activity is required to enable the site to be restored to original ground level. Waste to be deposited at the site would consist of a combination of inert quarry overburden that would be mixed with concrete sludge from the applicant's block manufacturing plant at Brookfoot Works, 700m to the south east.

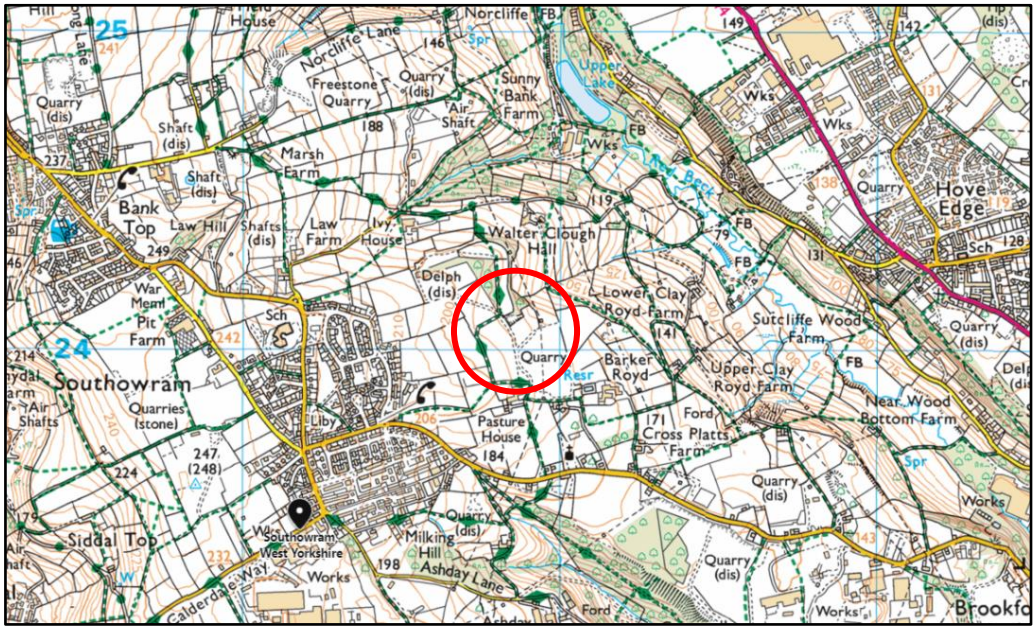
1.3 This HRA has been prepared in accordance with current government guidance regarding hydrogeological risk assessment for inert waste disposal. Following definition of local hydrogeological conditions, informed by site investigation and monitoring, a conceptual hydrogeological site model (CHSM) has been developed. The CHSM indicates that the proposed development would not represent a risk to surface water or groundwater resources. However, as the site location on a Secondary A Aquifer is considered to be a 'sensitive location' quantitative risk assessment has been undertaken through application of the Environment Agency approved LandSim risk modelling system. The report concludes with proposed monitoring and management measures for the site.

2. Site location and hydrological context

2.1 Pasture House Quarry is located on land to the north of Pasture House Farm, approximately 500m east of the town of Southowram, nr Halifax in West Yorkshire. Site location is shown on Figure 1. The existing quarry workings are established to the north of Church Lane. As indicated on the Envirocheck geological report at Appendix A, previous areas of working to the north and west of the current excavation area have been backfilled and restored to original ground level.

2.2 The Site is accessed via a dedicated quarry access road from Church Lane. The Site and surrounding area are predominantly rural with a small number of residential properties located to the south and east of the quarry access road. The main residential areas in proximity to the Site are residential areas at the eastern side of Southowram.

Figure 1: Site location © Ordnance Survey



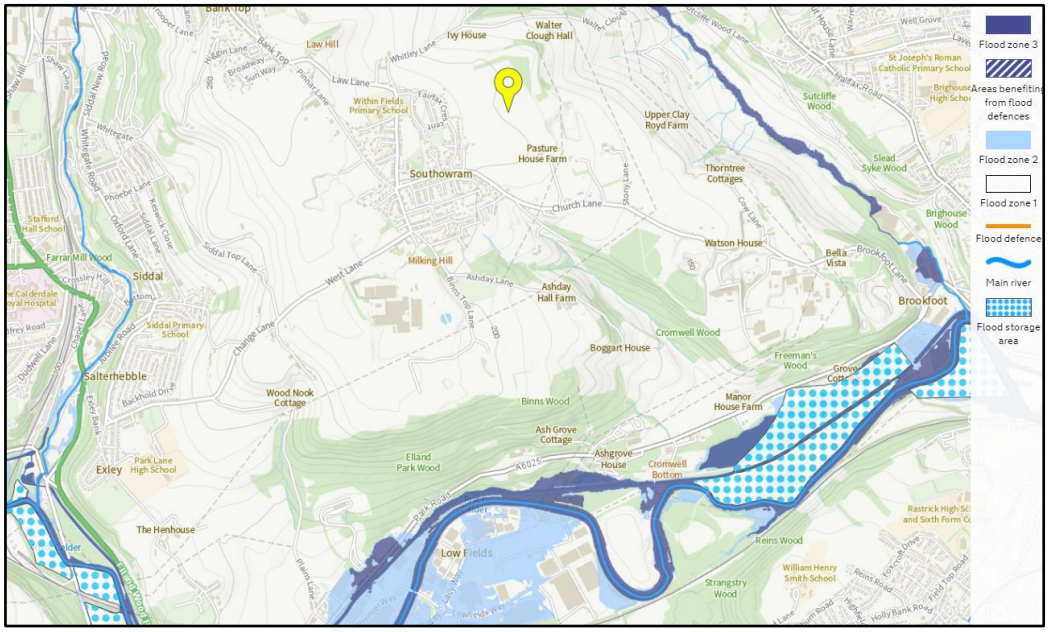
2.3 Pasture House Quarry is established on high ground that forms the western side of Red Beck Valley. Existing ground level around the Site boundary falls from a maximum elevation of approximately 199mAOD at the western boundary to a minimum elevation of approximately 184mAOD at the eastern boundary. In general, ground levels fall in an easterly direction, reducing rapidly towards Red Beck which flows at an elevation of approximately 70mAOD to 80mAOD approximately 1km to the east.

2.4 The Site is situated in the surface water catchment of Red Beck, a tributary of the River Calder which flows west to east approximately 1.5km to the south. Red Beck flows north west to south east approximately 1km east of the Site. There are no surface watercourses, or other surface water features within the surrounding area. The existing quarry workings are free-draining with no off-site discharge of surface water. The nearest surface water features are a series of small streams that emerge from issues located approximately 500m to the east and north east of the Site. The location of the Site in relation to local hydrology is shown on Drawing 033/53/01.

2.5 At a distance of approximately 500m south of the Site, two small streams emerge from issues to the south of Southowram. The streams combine to form Cromwell Wood Stream which flows in an easterly direction along the base of Cromwell Wood before passing underground at sinks.

2.6 The elevated location of the Site ensures that it is at low risk of fluvial flooding, as shown on the Environment Agency Flood Map for Planning, an extract from which is included as Figure 2, and also at low risk of surface water flooding as indicated on the Environment Agency Long Term Flood Risk Map. Reference to Defra's Magic map application confirms that the Site is not within a source protection zone and is not subject to any surface water or groundwater quality designation.

Figure 2: Flood Map for Planning extract © Environment Agency



2.7 The proposed waste recovery activity would be undertaken within the boundary of the existing quarry workings leading to backfilling and restoration to original ground level to recreate the pre-extraction ground level gradient towards the north east.

3. Proposed waste recovery operation

3.1 Pasture House Quarry is an operational sandstone quarry with planning permission for sandstone extraction and importation of inert waste for restoration back to original ground levels. Sandstone resources at the quarry are now exhausted and there is inadequate residual overburden available to achieve the planning objective of restoration to original ground level. Inert waste importation is therefore required.

3.2 Inert waste would be imported from the applicant's stone processing facilities at Brookfoot Works approximately 700m to the south east. The waste would consist of stone and sand sludge from stone cutting operations and concrete sludge from the block manufacturing plant. This material would be mixed with quarry rock overburden at Pasture House Quarry to provide an inert restoration material.

3.3 The inert materials that would be imported to the Site from Brookfoot Works would be restricted to the following waste codes.

01 01 02	Wastes from mineral non-metalliferous excavation
10 13 14	Waste concrete and concrete sludge
17 05 04	Soil and stones
20 02 02	Soil and stones

3.4 The Site extends to a total surface area of approximately 2.0ha. A Site plan showing the application boundary, direction of working and indicative cross-sectional profile through the Site is included at Appendix B. The final restoration scheme is also shown on

drawings at Appendix B. Waste deposition at the Site is expected to take place at an average rate of approximately 20,000 tonnes per year for a period of 10 years.

4. Hydrogeological context

4.1 Baseline hydrological and hydrogeological information relating to the Site and surrounding area is presented in the ESID Report prepared by SEL. Summary information relevant to this HRA is re-stated in the following paragraphs.

4.2 British Geological Survey (BGS) mapping of the area indicates that the Site is underlain by Lower Coal Measures bedrock consisting of interbedded sandstone, siltstone and mudstone. Pasture House Quarry is established in the Elland Flags, a discrete sandstone unit within the Lower Coal Measures sequence. The Elland Flags consist of fine to medium-grained, flaggy to thickly bedded micaceous sandstone that occurs as a number of sandstone leaves interbedded with carbonaceous mudstone. There is no record of superficial deposits above the bedrock.

4.3 A detailed interpretation of local bedrock geology was undertaken during hydrogeological studies at the adjacent Cromwell Wood Quarry which is also established in the Elland Flags. Borehole investigations at Cromwell Wood established bedrock geology beneath the Elland Flags. The Elland Flags are underlain by approximately 10m-15m of coal measures mudstone, above a thin sandstone unit, referred to here as the 'Upper Sandstone'. The Upper Sandstone is underlain by approximately 20m of coal measures mudstone above the 80 Yard Rock sandstone which has nominal thickness of up to 5m.

4.4 Six new groundwater monitoring boreholes were constructed around the perimeter of Pasture House Quarry in 2021. The boreholes included three boreholes, one at each location, that extended to the 80 Yard Rock. A borehole location plan and borehole logs are included at Appendix B. The three deep boreholes proved the presence of a thickness of approximately 20m of mudstone beneath the Elland Flags, underlain by a 5m thick sandstone ('Upper Sandstone'), and a further 15m thickness of mudstone above the 80 Yard Rock which has an average thickness of 5m.

4.5 The Lower Coal Measures sequence at and in the vicinity of the Site is designated a 'Secondary A Aquifer' by the Environmental Agency. The absence of superficial cover results in a perceived high vulnerability to groundwater pollution, although this designation takes no account of groundwater depth or the presence of intervening strata.

Local groundwater flow directions

4.6 Reference to new groundwater level data from monitoring boreholes at the site together with a detailed evaluation of local and regional hydrogeological characteristics has led to the development of a robust understanding of baseline hydrogeology at the Site. The following factors are relevant to hydrogeological interpretation.

- The geological structure of the area with stratigraphic dip to the south east tends to promote regional groundwater drainage to the south and east;

- Topographically, the Calder Valley and associated Red Beck Valley influence the direction of surface runoff and the location of groundwater discharge points;

- Investigation boreholes constructed to the 80 Yard Rock at a depth of approximately 60 mbgl have demonstrated the consistent presence of a 2m thick sandstone unit (Upper Sandstone) within the mudstone beneath the Elland Flags;

- Some boreholes have proven the presence of localised unrecorded mine working in the vicinity of the 80 Yard Rock to the south of the Site;

- Detailed analysis of borehole configuration, groundwater levels variation and knowledge of local groundwater drainage characteristics has led to the conclusion that the Upper Sandstone and the 80 Yard Rock act as separate and discrete aquifers separated by low hydraulic conductivity mudstone;

- The presence of a spring line within the mudstone beneath the Elland Flags along the south western side of the Red Beck Valley. The elevation is consistent with the projected outcrop of the Sandstone Unit referred to above; and

- The presence of springs and issues to the south of the Site, feeding the stream in Cromwell Wood.

4.7 Groundwater contours and groundwater flow directions for each of the two aquifer units are shown on Drawings 033/53/02 and 033/53/03. It is apparent that the general groundwater flow direction through both the Sandstone unit within the mudstone and the underlying 80 Yard Rock is to the south and east towards Brookfoot and the Red Beck Valley. Potential groundwater receptors are also marked on both drawings.

4.8 The role of the mudstone units with regard to aquifer recharge requires further comment. It is considered that the mudstone unit immediately beneath the Elland Flags is likely to have enhanced hydraulic conductivity due to the stress relaxation effect of mineral extraction. A lack of water in the overlying Elland Flags tends to confirm the potential for infiltration though this upper mudstone unit across the site. It is therefore concluded that the primary source of recharge to the Upper Sandstone which occurs at approximately 10m below the top of the mudstone, is infiltration through fractures and fissures in the mudstone itself.

4.9 In contrast, the underlying mudstone which separates the Upper Sandstone from the 80 Yard Rock appears to have particularly low hydraulic conductivity and acts to confine groundwater within the 80 Yard Rock aquifer. Groundwater level monitoring data for this unit indicates a hydraulic gradient from the north west suggesting a greater component of lateral flow than the higher Upper Sandstone.

Groundwater quality

4.10 The quality of groundwater un the Upper Sandstone and the 80 Yard Rock has been monitored at each of the three new monitoring boreholes since June 2021. A monitoring borehole location plan is included at Appendix C. Boreholes 1A and 1B are located up-

gradient of the application site. Boreholes 2A, 2B, 3A and 3B are located down-gradient of the application site. Groundwater quality data for samples obtained from each borehole during June, July and August 2021 are included at Appendix D.

4.11 Analytical results indicate that the background concentration of some heavy metals is naturally elevated in groundwater flowing in both the Upper Sandstone and the 80 Yard Rock in the vicinity of the Site. There is no evidence to suggest that groundwater quality varies as it flows beneath the Site. Persistently elevated concentrations iron, chromium. lead and nickel are observed in the analysis. Iron concentrations tend to be higher in the 80 Yard Rock than the shallower Upper Sandstone. The concentration of other substances in the analyses generally remain below the UK Drinking Water Standard concentration.

4.12 Table 1 shows the variation in concentration of substances that are found to be present at elevated concentration in groundwater.

Table 1: Substances found at elevated concentration in groundwater (mg/l)

Substance	UKDWS	Upper Sandstone			80 Yard Rock		
		Min	Max	Mean	Min	Max	Mean
Iron	0.20	12	118	70	13	184	136
Chromium	0.05	0.017	0.12	0.077	0.019	0.21	0.10
Lead	0.01	0.016	0.16	0.10	0.019	0.49	0.23
Nickel	0.02	0.017	0.15	0.09	0.022	0.37	0.16

4.13 Elevated heavy metal concentration is likely to be a consequence of naturally occurring metals in the sandstone units and is potentially influenced by the presence of historic mine workings in the area.

5. Conceptual hydrogeological site model

5.1 The results of the hydrological and hydrogeological baseline assessment have been used to develop a conceptual hydrogeological site model (CHSM) of the Site and surrounding area. The conceptual model provides the basis for subsequent hydrogeological risk assessment. In addition to the two groundwater contour plots presented as Drawings 033/53/02 and 033/53/03, the conceptual hydrogeological model is shown schematically as Drawing 033/53/04.

5.2 The conceptual hydrogeological model aims to define groundwater flow characteristics for defined water-bearing strata using the standard source-pathway-receptor approach. In addition to site-specific information derived from past and present ground investigation at Pasture House Quarry development of the conceptual model been undertaken by reference to previous hydrogeological studies at the adjacent Cromwell Wood Quarry and the conceptual hydrogeological model that was developed for that site.

Sources

5.3 The only potential source of contaminants associated with deposition of inert waste would be any substances present at elevated concentration within the respective waste materials. Materials to be accepted at the site are defined as follows.

01 01 02	Wastes from mineral non-metalliferous excavation
10 13 14	Waste concrete and concrete sludge
17 05 04	Soil and stones
20 02 02	Soil and stones

5.4 The non-metalliferous excavation waste is the mineral overburden from the same excavation and therefore would not introduce any new contaminants to the site. There is no expectation that 'soil and stones' under either code would have any polluting potential. Consideration of risk to groundwater is therefore based on the chemical composition of concrete and concrete sludge. Reference non-hazardous substances have therefore been defined as follows.

1. Calcium
2. Potassium
3. Sodium

5.5 A review of recent research[1] into cement leachate chemistry indicates the following reference concentrations for intermediate age cements.

1. Potassium (as KOH)	-	0.3g/l
2. Sodium (as NaOH)	-	0.01g/l
3. Calcium (as OH_2)	-	1.2g/l

These reference substance concentrations have been used as the 'worst case' source term for quantitative risk modelling.

Pathways

5.6 Groundwater flowpaths in the Upper Sandstone and the underlying 80 Yard Rock are shown on Drawing 033/53/04. Both aquifers are relatively thin with recharge limited by overlying low permeability mudstone deposits. Available evidence suggests that groundwater tends to flow down stratigraphic dip, with additional influence of a series of small-magnitude discharge points to the local surface water system. Potential groundwater flow paths can be defined as follows:

- Lateral flow at the base of the Elland Flags;
- Rainfall recharge though the upper mudstone to the Upper Sandstone and easterly drainage through the sandstone to springs on the western side of the Red Beck; and

[1] Junjie, C, Chen, Manhui, W et al. (2020) The Couplings of Rock/Carbonate Groundwater/Cement Leachate. Environmental Geotechnics, 7 (7). pp. 467-477. ISSN 2051-803X

- Rainfall recharge through the upper mudstone, Upper Sandstone and lower mudstone, or lateral drainage from historic mine workings, to the 80yard Rock and south-easterly drainage to springs and issues at the Calder Valley.

5.7 No evidence of the presence of groundwater in the Elland Flags has been found in any of the past or present boreholes constructed at or in the vicinity of the existing quarry workings which have remained dry and free-draining throughout. The presence of extensive areas of previously worked and backfilled land to the north and west would tend to prevent the development of lateral drainage pathways at the base of the Elland Flags. Reference to Drawings 033/53/02 and 033/53/03 indicates that the springs and issues emerging north west of Thorntree Cottages, approximately 750m east of the Site, may originate from the base of the Elland Flags. If this is the case, it is considered likely that the source catchment for the spring would be restricted to previously unworked land to the east of Pasture House Quarry with no direct hydraulic linkage to the application Site.

5.8 As shown on Drawing 033/53/02, available evidence indicates that any groundwater present in the Upper Sandstone is flowing in an easterly direction towards Red Beck, although only one potential discharge point has been identified during this assessment, as shown. Groundwater elevation in the Upper Sandstone appears to be reasonably coincident with the top of the aquifer. South of the Pasture House Quarry area, there is potential discharge from the Upper Sandstone to springs in the Brookfoot area, approximately 1.6km south east of the Site area and south east of the intervening, partially restored, Cromwell Wood Quarry site.

5.9 As shown on Drawing 033/53/03, groundwater in the 80 Yard Rock in the vicinity of Pasture House Quarry appears to be draining in an easterly direction towards Red Beck with several definable discharge points that feed drainage tributaries of the beck. To the south, groundwater in the 80 Yard Rock drains in a south easterly direction towards the Calder Valley although there are no identifiable discharges from the 80 yard Rock on the northern side of the valley.

Receptors

5.10 Potential receptors of any impact on local groundwater systems associated with inert waste deposition at Pasture House Quarry have been referenced in preceding sections of this report and are shown on Drawings 033/53/02, 033/53/03 and 033/53/04. More specifically, potential receptors can be defined as follows.

(i) Groundwater present in the Upper Sandstone aquifer;
(ii) Groundwater present in the 80 Yard Rock aquifer;
(iii) Springs potentially draining from the Upper Sandstone in the Red Beck valley; and
(iv) Springs potentially draining from the 80 Yard Rock in the Red Beck valley.

5.11 There are no licensed groundwater abstractions within a 1km radius of the Site. No private water supplies have been identified within a 1km radius of the Site. Defra Magic mapping indicates that there are no statutory or non-statutory groundwater dependent ecological or landscape designations or features within a 1km radius of the Site.

6. Risk assessment

Approach to risk assessment

6.1 Inert waste, by definition, consists of materials that have low polluting potential. However, potential risk to groundwater needs to be considered in relation to the waste type and local environmental conditions. Risk assessment is typically undertaken using a tiered approach as set out in Environment Agency guidance as follow.

- Tier 1 – qualitative risk screening – investigate what the risks are, whether more detailed assessment is needed and what that would need to focus on (risk prioritisation);
- Tier 2 – generic quantitative risk assessment – to collect more information to make an informed decision on the risk posed by the site and to identify compliance points;
- Tier 3 – detailed quantitative risk assessment – to collect more information and formulate a plan if there are clear source-pathway-receptor relationships.

6.2 As the proposed activity is an inert waste recovery activity, Tier 1 qualitative risk screening has been undertaken with the following objectives.

(i) justification for the level (tier) of risk assessment applied to the site,

(ii) prioritisation of the most important source-pathway-receptor relationships for further evaluation, if required.

Tier 1 - Qualitative risk assessment

6.3 Qualitative risk assessment, based on the CHSM, incorporates the following analysis.

(i) Calculation of the dilution factor for the discharge diluted by groundwater flowing in the mixing zone beneath the site.

(ii) Calculation of the attenuation factor for selected substances for downwards movement to the point of arrival in groundwater beneath the site.

6.4 The CHSM has identified potential pollutant pathways between the Site and springs that discharge to Red Beck. However, the CHSM has established that the proposed waste recovery operation, incorporating infilling with inert waste, would not include materials that represent a risk to groundwater or surface water quality. Qualitative risk screening based on the CHSM therefore results in the conclusion that the proposed waste recovery operation would not represent a hazard to water resources.

6.5 Environment Agency guidance[2] related to risk assessment for bespoke waste recovery permit applications states as follows.

[2] Waste recovery plans and deposit for recovery permits - GOV.UK (www.gov.uk)

'If your conceptual site model shows that the waste you propose to use is unlikely to be a hazard to groundwater or surface water, then you do not need to carry out a quantitative groundwater risk assessment.'

6.6 On this basis, there is no requirement for further consideration of hydrogeological risk. However, the same guidance identifies the potential need for quantitative risk assessment for sites located in sensitive environments, including on or in a Secondary A Aquifer. To ensure compliance with all relevant risk assessment requirements a Tier 2 - quantitative risk assessment has been undertaken through development and implementation of a LandSim model for the Site.

Tier 2 - Quantitative risk assessment

6.7 LandSim modelling incorporates both aquifer dilution and substance attenuation processes. In accordance with the CHSM modelling has been undertaken for the following selected substances.

4. Potassium (as KOH) - 0.3g/l
5. Sodium (as NaOH) - 0.01g/l
6. Calcium (as OH_2) - 1.2g/l

6.8 Full LandSim configuration details are included with the LandSim report at Appendix E. The following summary details are relevant.

- Infilling would take place over 10 years
- The model incorporates a single infill cell
- Post-completion infiltration is consistent with no engineered cap
- Average waste thickness is defined as 10m
- A basal liner is not included
- The Coal Measures Mudstone is defined as the unsaturated zone
- The Upper Sandstone is defined as the aquifer
- Compliance points are established at the downstream Site boundary

6.9 The Coal Measures Mudstone at the base of the Site represents a natural geological barrier. Mudstone thickness is defined in the model as a uniform distribution between 10m and 15m as determined from borehole logs.

6.10 All three selected substances are non-hazardous substances. The compliance location for non-hazardous substances is defined as the downstream boundary of the application Site. Substance concentrations in the source term are therefore subject to attenuation in the unsaturated zone and dilution in the aquifer, prior to reaching the compliance point. Partition coefficients for all three substances are LandSim default values and diffusion coefficients are calculated in accordance with LandSim guidance.

Emissions to groundwater

6.11 LandSim model results are included in full at Appendix E. Results are summarised in Table 2 for both the base of the unsaturated zone and the boundary compliance point. All results are determined at a 95% confidence level.

Table 2: LandSim modelling results

Substance	Peak concentration at base of unsaturated zone (mg/l)	Peak concentration at boundary compliance point (mg/l)	Timing of peak concentration (yrs)
Calcium	1195	0.00	300
Potassium	296	0.00	30
Sodium	10	0.00	30

6.12 LandSim model results demonstrate that, at the appropriate compliance point, there would be no discernible concentration of any of the three selected substances. Concentrations at the base of the unsaturated zone represent source concentration with minor attenuation through the unsaturated zone. It is noted that both potassium and sodium are unattenuated throughout the model.

6.13 As the down-gradient boundary compliance point is up-gradient of all defined receptors, quantitative risk assessment confirms that the proposed waste recovery operation would not represent a risk to groundwater or surface water resources.

7. Surface water management

7.1 During infilling operations, surface water runoff from operational areas would drain to the lowest points within the excavation area for slow seepage to underlying strata, as at present. Internal surface water drainage would be managed to minimise potential for sediment entrainment. Temporary localised ponding at seepage locations would provide a silt settlement function.

7.2 Following completion of infilling operations and restoration of the Site to original ground levels, surface water runoff is expected to return to pre-extraction greenfield rates. In common with surrounding land, it is proposed that any runoff generated from restored Site surfaces is allowed to drain naturally in a down-gradient direction without requirement for positive drainage.

7.3 It is recognised that historically backfilled areas to the north and west of the Site are designed to support passive surface water drainage, without the use of positive drainage systems, and that this approach has been effective without risk of surface water ponding or increase in local flood risk. As discussed at Section 2, the current Environment Agency Long Term Flood Risk Map for the area indicates that the Site and surrounding area is at very low risk of surface water flooding.

8. Monitoring and management

8.1 The Environment Agency provides guidance[3] on the requirement for groundwater or surface water monitoring in relation to inert waste disposal, as follows.

'If your risk assessment shows that the risk to groundwater from your operation is non-existent, or very low, the Environment Agency may decide that groundwater monitoring is not necessary. Depending on the size and type of discharge from your activity you may still have to monitor any potential impact on groundwater by checking your discharge against limit values. These requirements will be specified in your permit.'

8.2 The application Site is equipped with up-gradient and down-gradient monitoring boreholes in both the Upper Sandstone and the 80 Yard Rock. Although risk assessment has demonstrated no discernible risk to groundwater resources, it is proposed that background monitoring in each of the six new boreholes continues on a quarterly basis from commencement of infilling operations.

8.3 It is proposed that quarterly monitoring is undertaken at Boreholes 1A, 1B, 2A, 2B, 3A and 3B. Baseline groundwater quality monitoring (June – August 2021) has demonstrated that the concertation in groundwater of the majority of substances included in the baseline analytical suite are below the UK Drinking Water standard. There is, therefore, no basis for continuing to monitor the concentration of the full analytical suite. The following analytical suite is proposed.

pH	Sulphate
Electrical conductivity	Iron
Ammoniacal nitrogen	Chromium
Chloride	Lead
Calcium	Nickel
Magnesium	Aluminium
Potassium	Manganese
Sodium	EPH_{10-40}

Control and compliance levels

8.4 As baseline groundwater quality data for some of the proposed monitoring suite are not currently available, it is proposed that control and compliance levels are defined following review of at least three consecutive monitoring rounds based on the proposed analytical suite.

9. Summary and conclusions

9.1 This Hydrogeological Risk Assessment (HRA) has been prepared to support an environmental permit application associated with inert waste infilling as part of a waste recovery operation at Pasture House Quarry, Southowram, West Yorkshire.

[3] Groundwater risk assessment for your environmental permit - GOV.UK (www.gov.uk)

9.2 Risk assessment has been based on a robust conceptual understanding of local hydrogeological conditions leading to development of clear source-pathway-receptor linkages. The Conceptual Hydrogeological Site Model (CHSM) leads to the conclusion that the proposed waste recovery operation would not represent a hazard to water resources.

9.3 Due to the location of the Site in a sensitive area, as defined by the underlying Secondary A Aquifer, risk assessment has been progressed to the quantitative stage through development and implementation of a LandSim model of the Site. Quantified risk assessment has demonstrated that there would be no discernible concentration of selected substances at the down-gradient compliance point at the Site boundary. Quantitative risk assessment confirms that the proposed waste recovery operation would not represent a risk to groundwater or surface water resources.

9.4 During infilling operations, surface water would be manged within the Site boundary by collection by an internal drainage system and natural drainage to underlying strata, as at present. Following completion and restoration of the Site, surface water runoff from the restored surface would return to greenfield rates. There are no proposals for installation of a positive drainage system at the restored Site.

9.5 Whilst risk assessment has demonstrated that the proposed development would not represent a hazard to groundwater or surface water resources, it is proposed that up-gradient and down-gradient groundwater monitoring continues for the lifetime of the proposed development.

For S M Foster Associates Limited

Stephen M Foster
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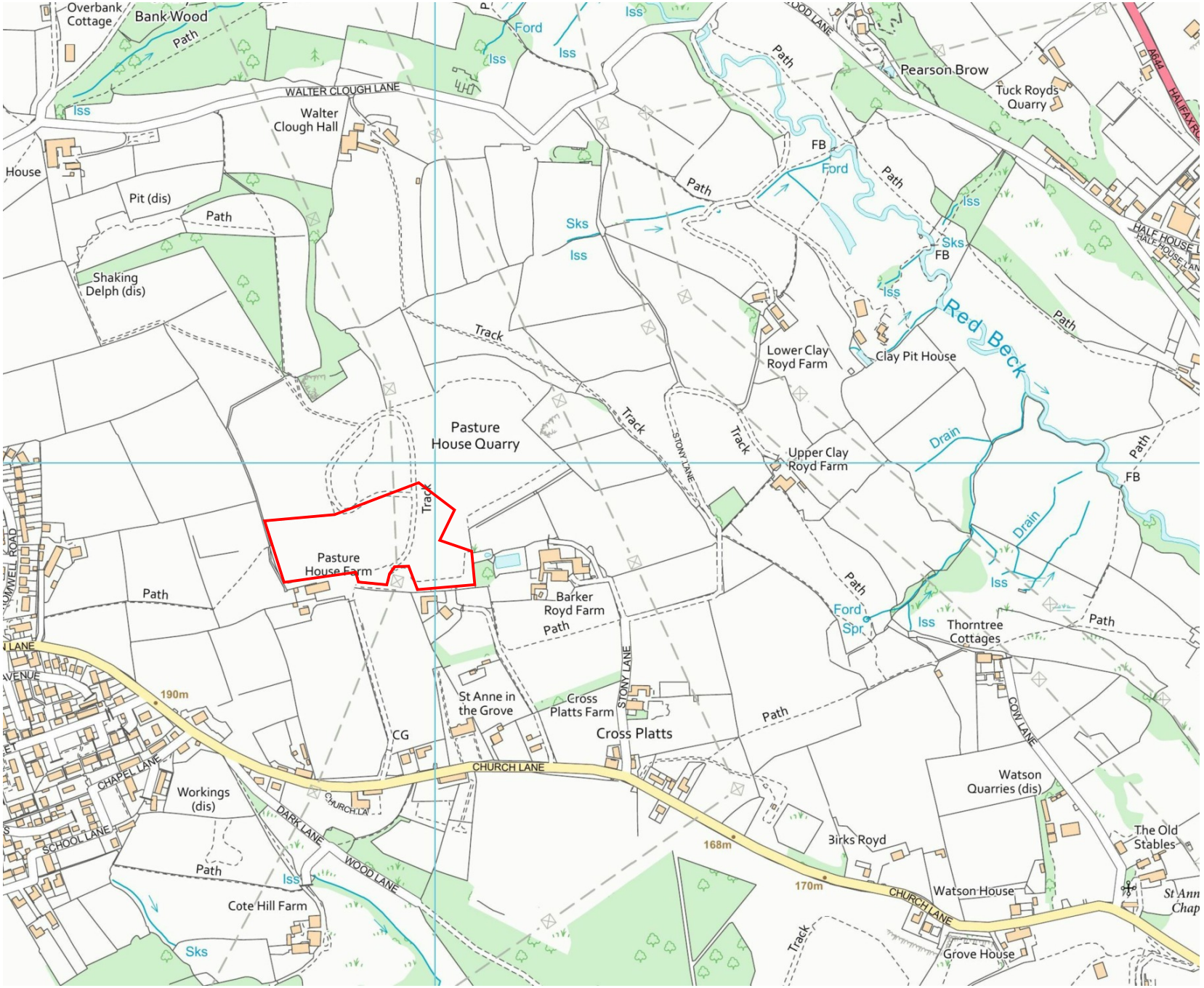
Principal Consultant

Drawings



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Approximate application boundary

CLIENT:

SILKSTONE ENVIRONMENTAL LIMITED

PROJECT:

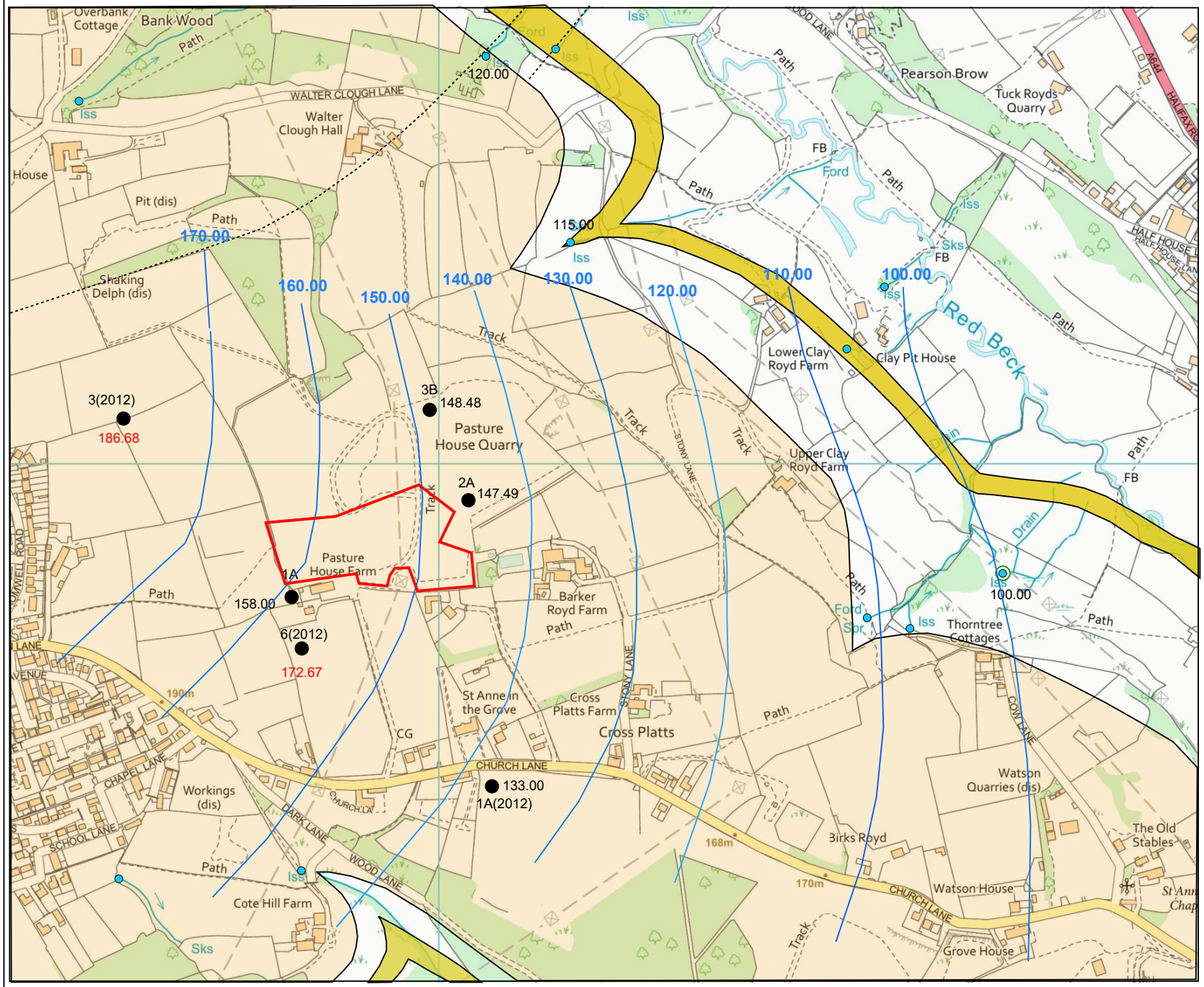
PROPOSED INERT WASTE INFILL, PASTURE HOUSE QUARRY, SOUTHOWRAM, WEST YORKSHIRE

HYDROGEOLOGICAL RISK ASSESSMENT

Ref: 033/53/01/1021	Date: October 2021
Approved: smf	Scale: as indicated

DRAWING 033/53/01

SITE LOCATION AND LOCAL HYDROLOGY



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3A
120.41 — Monitoring borehole location with groundwater elevation mAOD

Springs/issues with elevation mAOD

Potential emission from Upper Sandstone

Lateral extent of Elland Flags

Lateral extent of 80 Yard Rock

CLIENT:

SILKSTONE ENVIRONMENTAL LIMITED

PROJECT:

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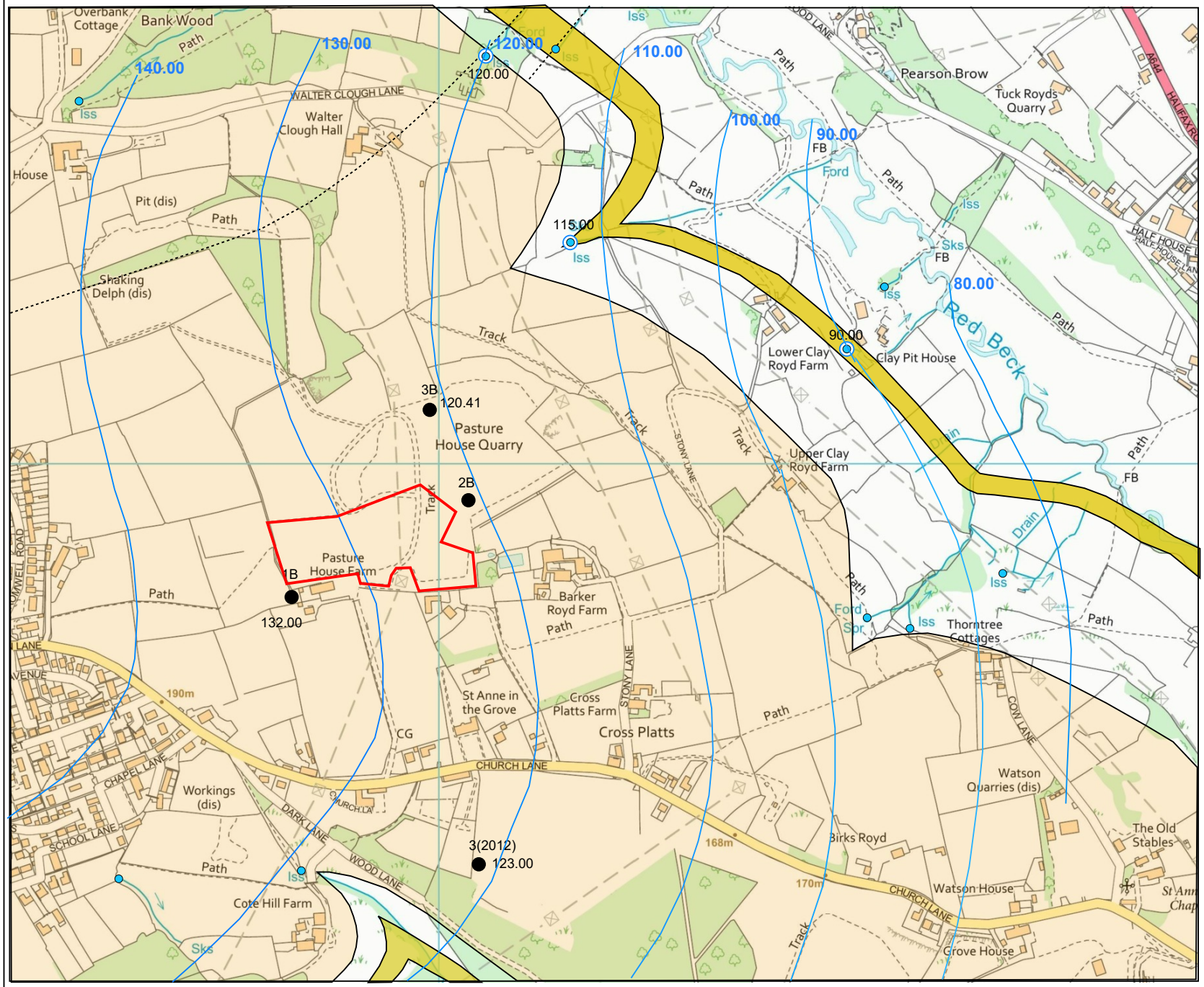
DRAWING 033/53/02
GROUNDWATER CONTOURS IN THE UPPER SANDSTONE



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3B
120.41 Monitoring borehole location with groundwater elevation mAOD

Springs/issues with elevation mAOD

Potential emission from 80YD Rock

Lateral extent of Elland Flags

Lateral extent of 80 Yard Rock

CLIENT:

SILKSTONE ENVIRONMENTAL LIMITED

PROJECT:

PROPOSED INERT WASTE INFILL, PASTURE HOUSE QUARRY, SOUTHOWRAM, WEST YORKSHIRE

HYDROGEOLOGICAL RISK ASSESSMENT

Ref: 033/53/03/1021	Date: October 2021
Approved: smf	Scale: as indicated

DRAWING 033/53/03
GROUNDWATER CONTOURS IN THE 80 YARD ROCK

SECTION B - B'
NORTH WEST TO SOUTH EAST

Notes:

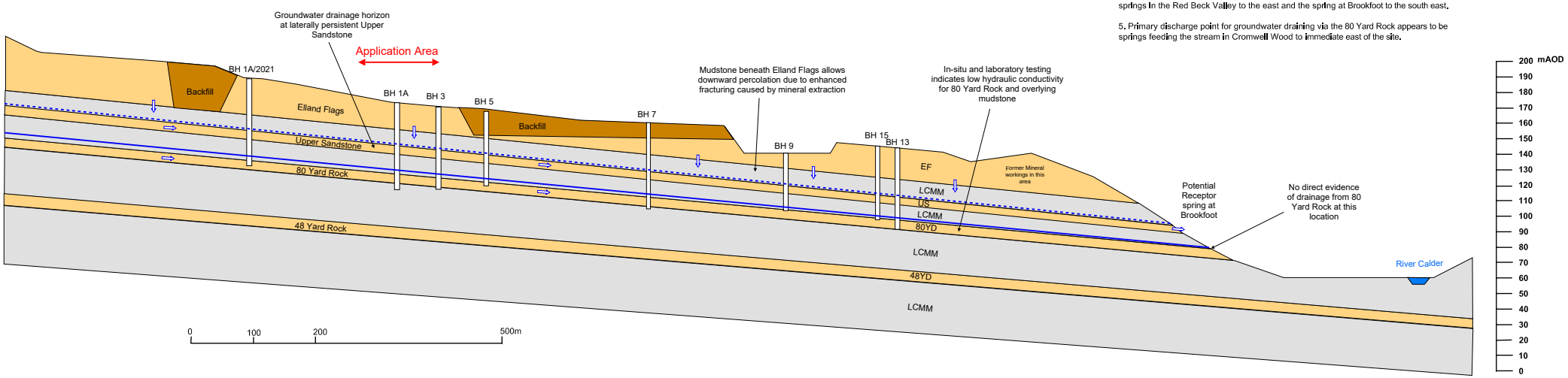
1. Groundwater level monitoring indicates that the Sandstone Unit in the mudstone and the underlying 80 Yard Rock both act as seperate and hydraulically discrete groundwater drainage pathways.

2. Recharge to the Sandstone Unit occurs vertically via percolation through upper sections of mudstone beneath Elland Flags

3. Recharge to the 80 Yard Rock appears to come from lateral drainage from the north possibly related to minewater draining via deep mine working in fomer Walter Clough Colliery to north of Cromwell Wood.

4. Primary discharge point for groundwater draining via Sandstone Unit appears to be the springs in the Red Beck Valley to the east and the spring at Brookfoot to the south east.

5. Primary discharge point for groundwater draining via the 80 Yard Rock appears to be springs feeding the stream in Cromwell Wood to immediate east of the site.



LOWER COAL MEASURES STRATA

EF	Elland Flags
LCMM	Mudstone
US	Upper Sandstone
LCMM	Mudstone
80YD	80 Yard Rock
LCMM	Mudstone
48YD	48 Yard Rock
LCMM	Mudstone

HYDROLOGY

- Groundwater level in Upper Sandstone
- Groundwater level in 80 Yard Rock
- Groundwater flow direction

CLIENT: SILKSTONE ENVIRONMENTAL LIMITED
PROJECT: PROPOSED INERT WASTE INFILL, PASTURE HOUSE QUARRY, SOUTHOWRAM

DRAWING 033/53/04
CONCEPTUAL HYDROGEOLOGICAL MODEL

REF: 033/53/4/1021 | **DATE:** October 2021

APPROVED: smf | **SCALE:** As indicated

S M Foster Associates Limited
Hydrological and Hydrogeological Consultants

7 Bownas Road, Boston Spa, Wetherby
West Yorkshire, LS23 6EX, UK
Tel: 01937 849950, Fax: 01937 849951
Email:stephen.foster@smfassociates.co.uk

Appendix A

Envirocheck geological report

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WMGR	Infilled Ground	Artificial Deposit	Not Supplied - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Not Supplied - Holocene
	SLIP	Landslide Deposit	Unknown/Unclassified Entry	Not Supplied - Quaternary

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	MG	Millstone Grit Group [See also Migr]	Mudstone, Siltstone and Sandstone	Not Supplied - Namurian
		Faults		
		Rock Segments		

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	GFDMP	Glaciofluvial Deposits, Mid Pleistocene	Sand and Gravel	Not Supplied - Cromerian
	HEAD	Head	Clay, Silt, Sand and Gravel	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	EF	Elland Flags	Sandstone	Not Supplied - Westphalian
	PLCM	Pennine Lower Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	EYR	80 Yard Rock	Sandstone	Not Supplied - Westphalian
	PLCM	Pennine Lower Coal Measures Formation	Sandstone	Not Supplied - Westphalian
	GM	Greenmoor Rock	Sandstone	Not Supplied - Westphalian
	STNR	Stanningley Rock	Sandstone	Not Supplied - Westphalian
	MBR	Middle Band Rock	Sandstone	Not Supplied - Westphalian
	SBF	Soft Bed Flags	Sandstone	Not Supplied - Westphalian
	GR	Grenoside Sandstone	Sandstone	Not Supplied - Westphalian
	KKBS	Kirkburton Sandstone	Sandstone	Not Supplied - Westphalian
	RR	Rough Rock	Sandstone	Not Supplied - Namurian
	RF	Rough Rock Flags	Sandstone	Not Supplied - Namurian

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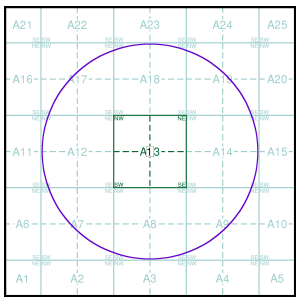
Geology 1:50,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	**1**
Map Sheet No:	**077**
Map Name:	**Huddersfield**
Map Date:	**2003**
Bedrock Geology:	**Available**
Superficial Geology:	**Available**
Artificial Geology:	**Available**
Faults:	**Not Supplied**
Landslip:	**Available**
Rock Segments:	**Not Supplied**

Geology 1:50,000 Maps - Slice A



Order Details:

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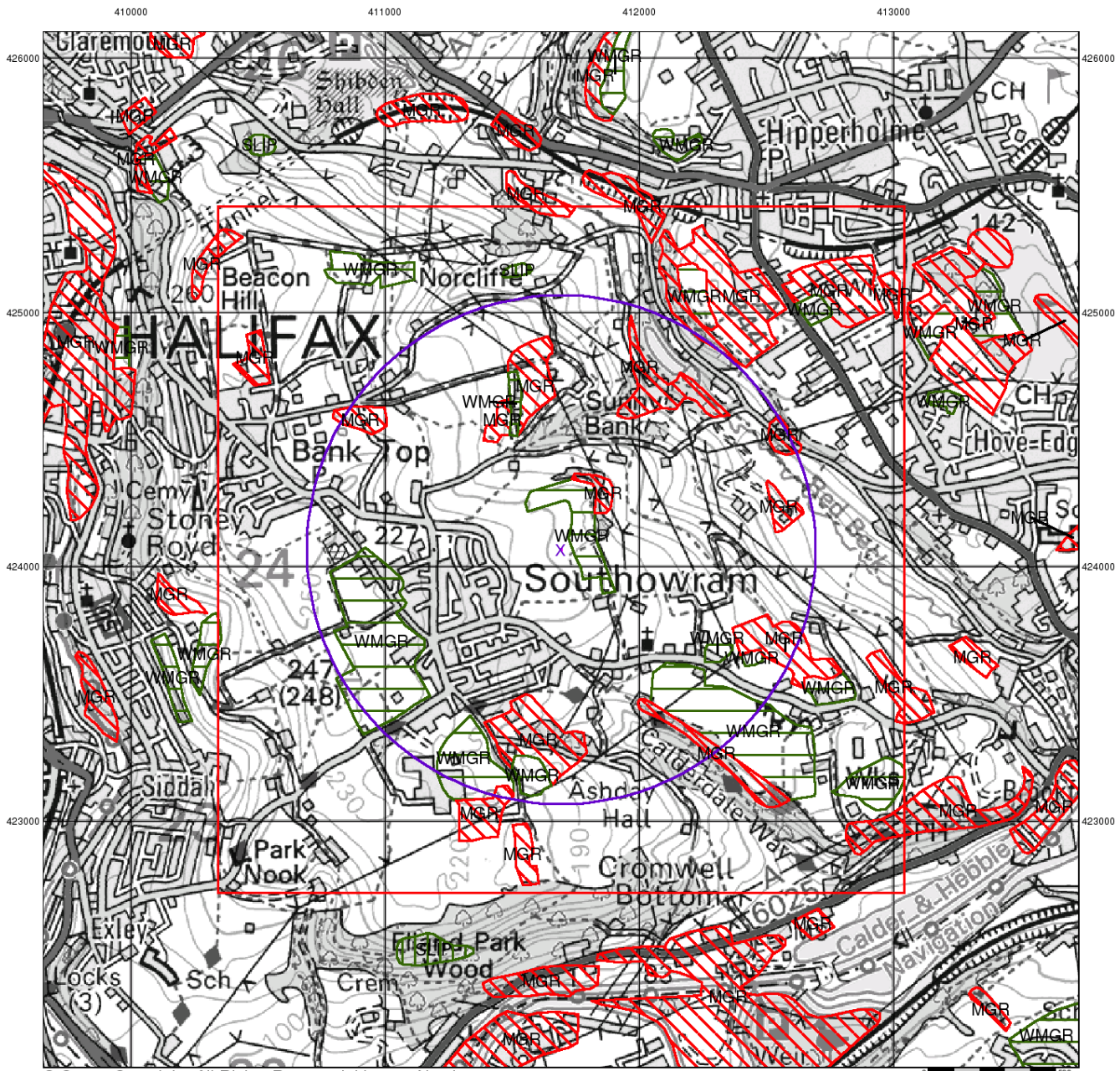
Customer Reference:	Pasture
National Grid Reference:	411690, 424070
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details:

Site at, Southowram, Calderdale

Landmark® INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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Artificial Ground and Landslip

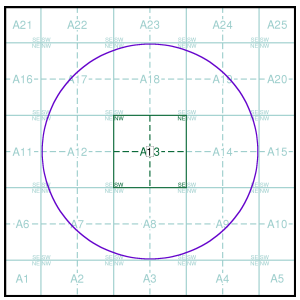
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A



Order Details:

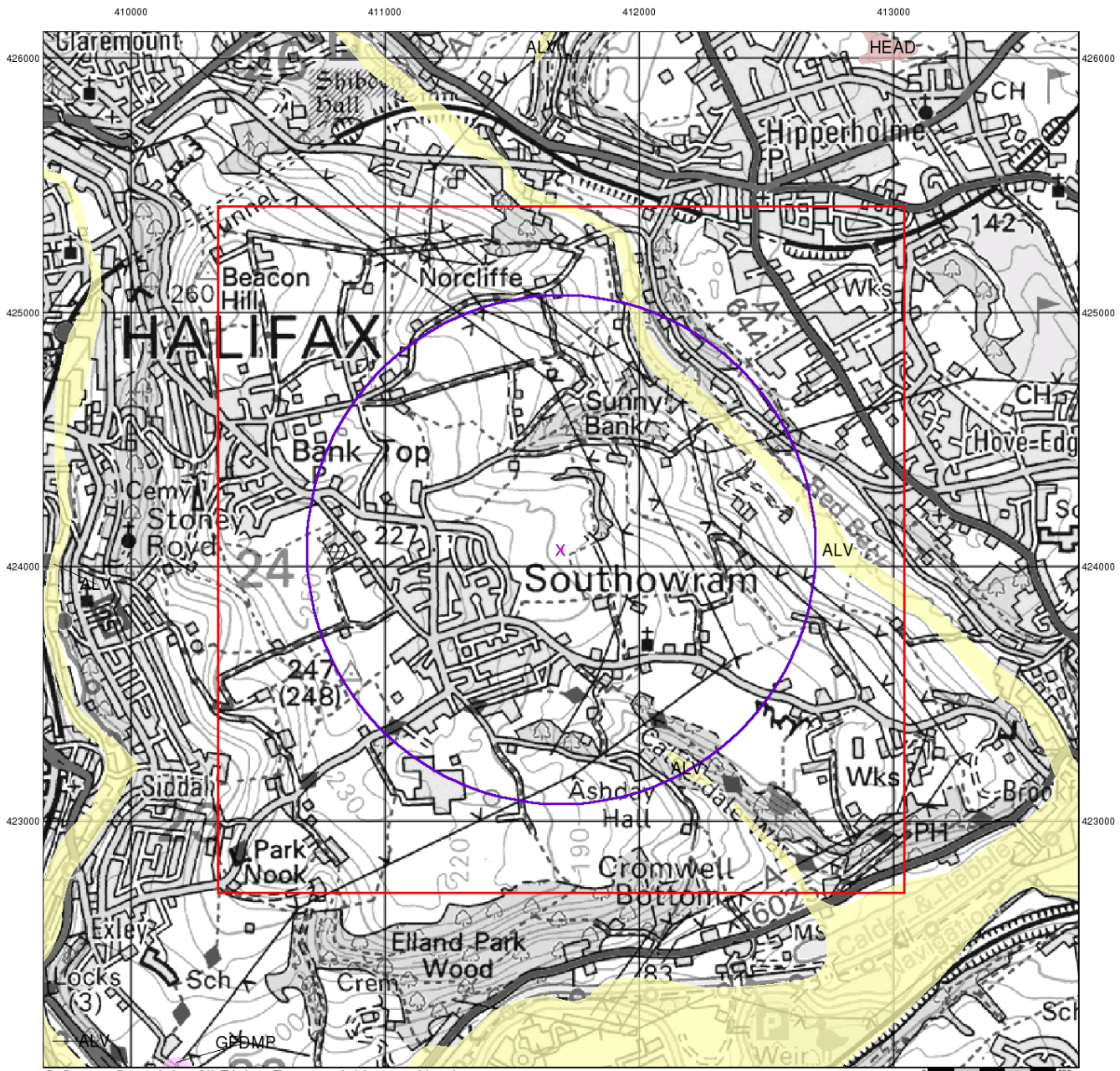
Order Number:	280535908_1_1
Customer Reference:	Pasture
National Grid Reference:	411690, 424070
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details:

Site at, Southowram, Calderdale

Landmark® INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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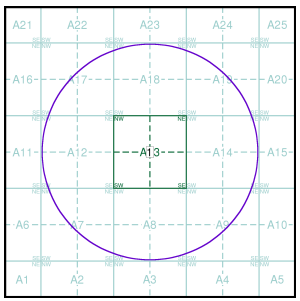
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



Order Details:

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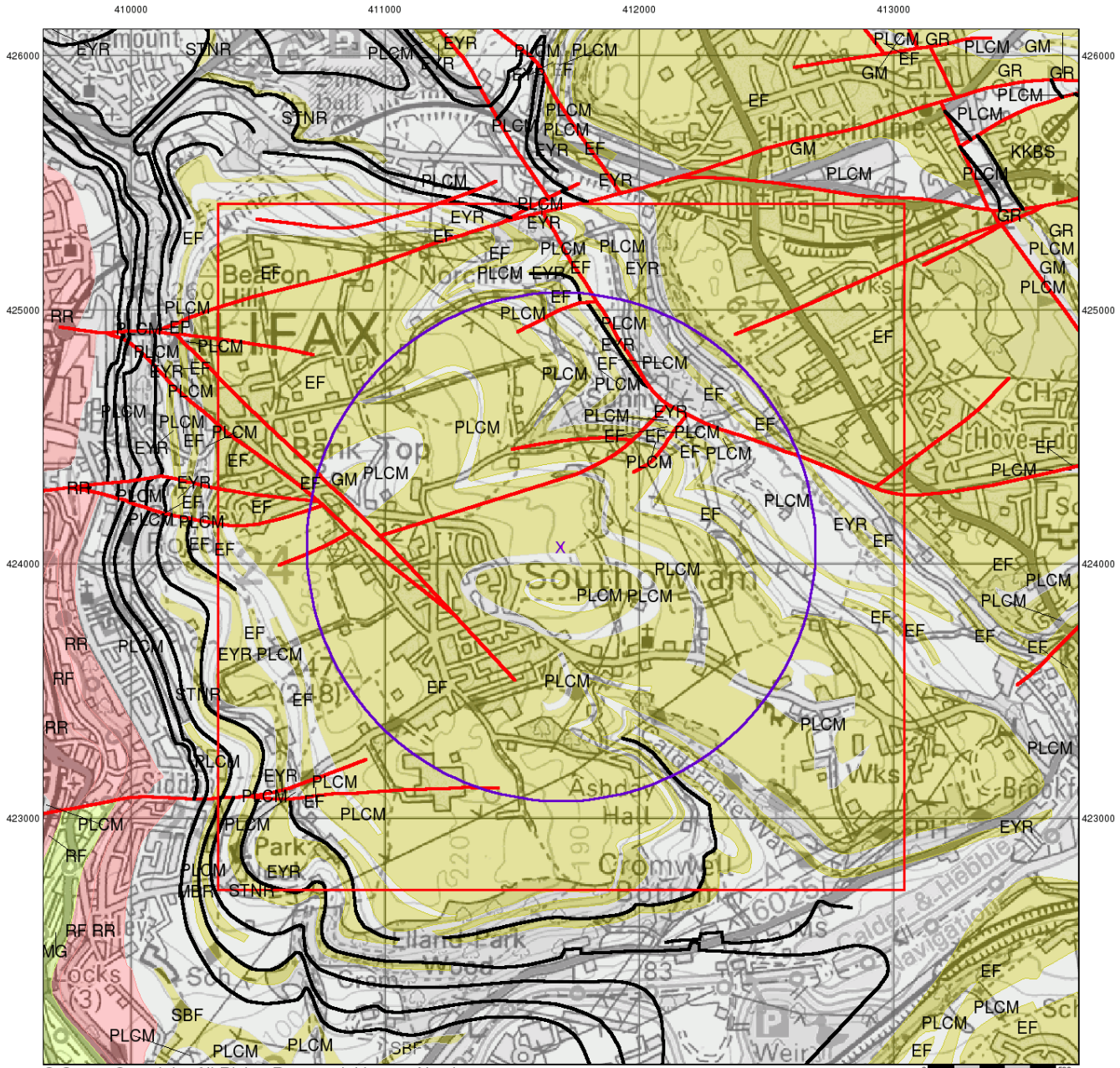
Customer Reference:	Pasture
National Grid Reference:	411690, 424070
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details:

Site at, Southowram, Calderdale

Landmark® INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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Bedrock and Faults

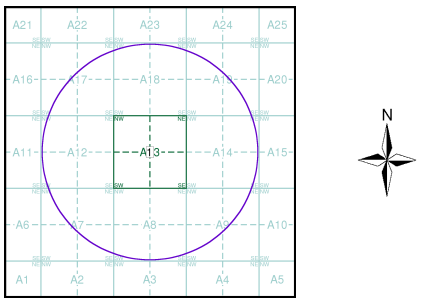
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



Order Details:

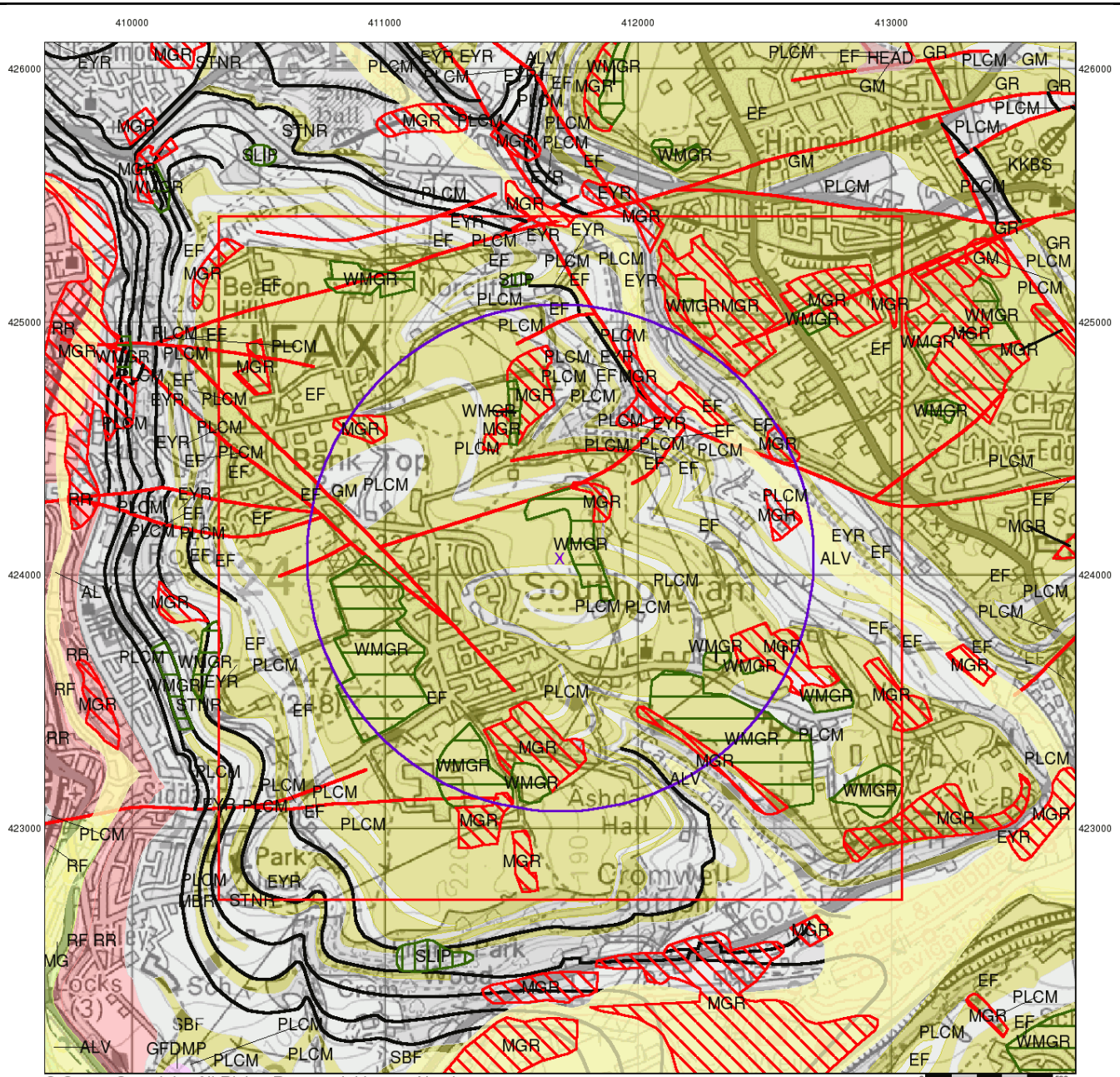
Order Number:	280535908_1_1
Customer Reference:	Pasture
National Grid Reference:	411690, 424070
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details:

Site at, Southowram, Calderdale

Landmark® INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

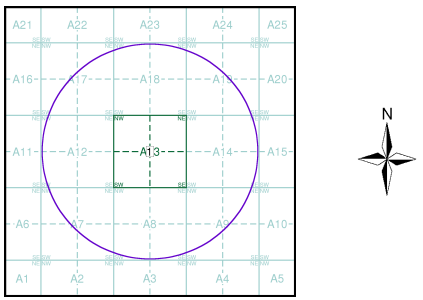
Additional Information

More information on 1:50,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice A



Order Details:

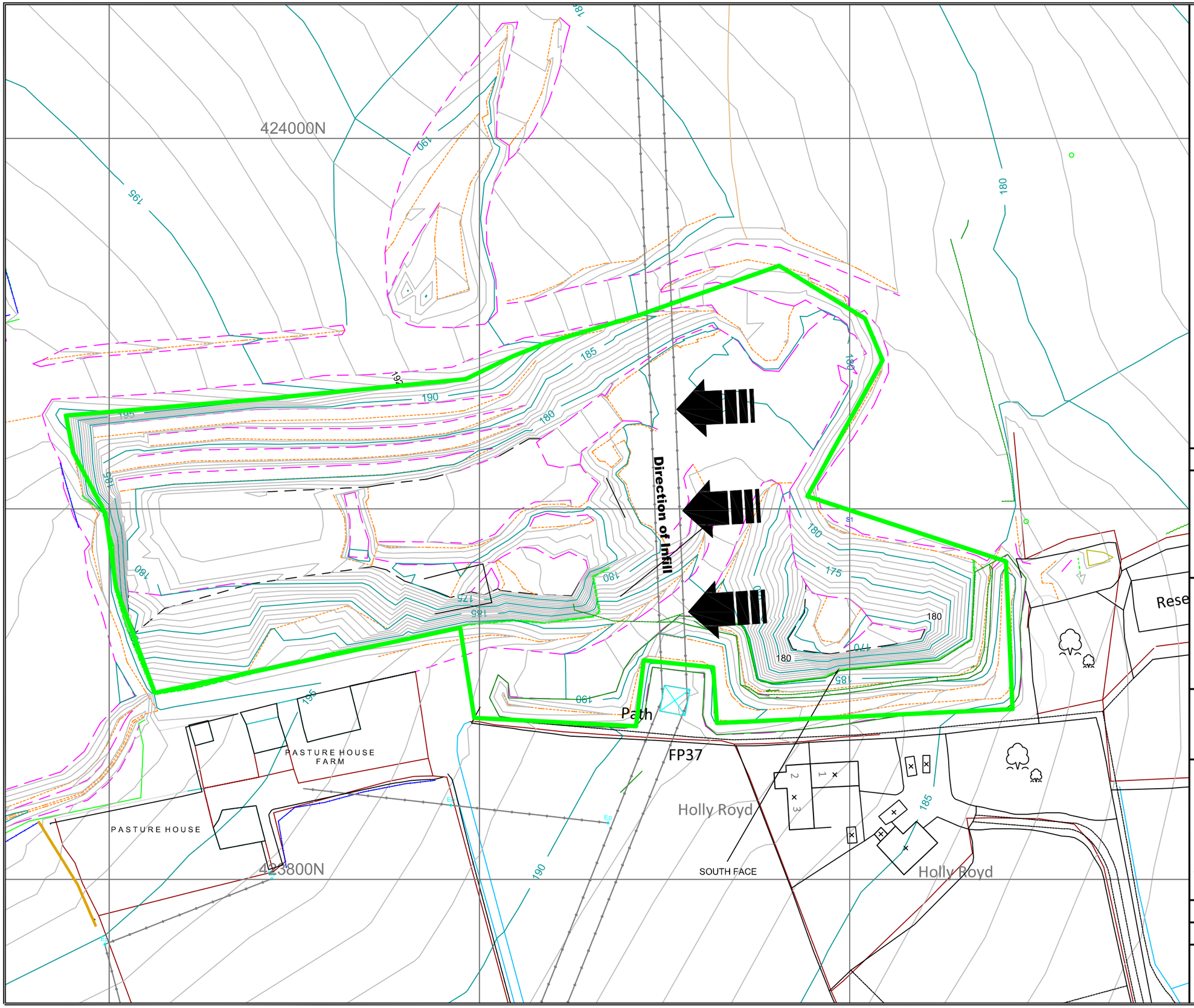
Order Number:	280535908_1_1
Customer Reference:	Pasture
National Grid Reference:	411690, 424070
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details:

Site at, Southowram, Calderdale

Appendix B

Site layout and restoration drawings



Proposed Waste Recovery Area

Rev	Description	Date	Drawn	Chkd

Client:

Marshalls

Project:

PASTURE HOUSE QUARRY
BESPOKE RECOVERY PERMIT
APPLICATION

Plan Title:

SITE LAYOUT & WASTE

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk
7, Hall Annex, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH
Tel (0114) 2573487 Fax (0114) 2573459

Project No. 20293	Dwg No. ESSD 4	Rev
Date: SEP 21	Drawn: PS	Chkd:	Scale: 1:1000 @ A3

Enclosure

424000N

423900N

423800N

FP29

FP37

PASTURE HOUSE FARM

PASTURE HOUSE

Holly Royd

Holly Royd

Pond

Edge of Topsoil

Edge of Topsoil

Waste Recovery Area

Native Species Hedgerows

Hedgerow trees

Restored Pastureland in Eastern Extension

Native Woodland Planting

Previously Restored Areas

170 Restoration contours (m AOD)

Rev	Description	Date	Drawn	Chkd

Client:

Marshalls

Project:

PASTURE HOUSE QUARRY

Plan Title:

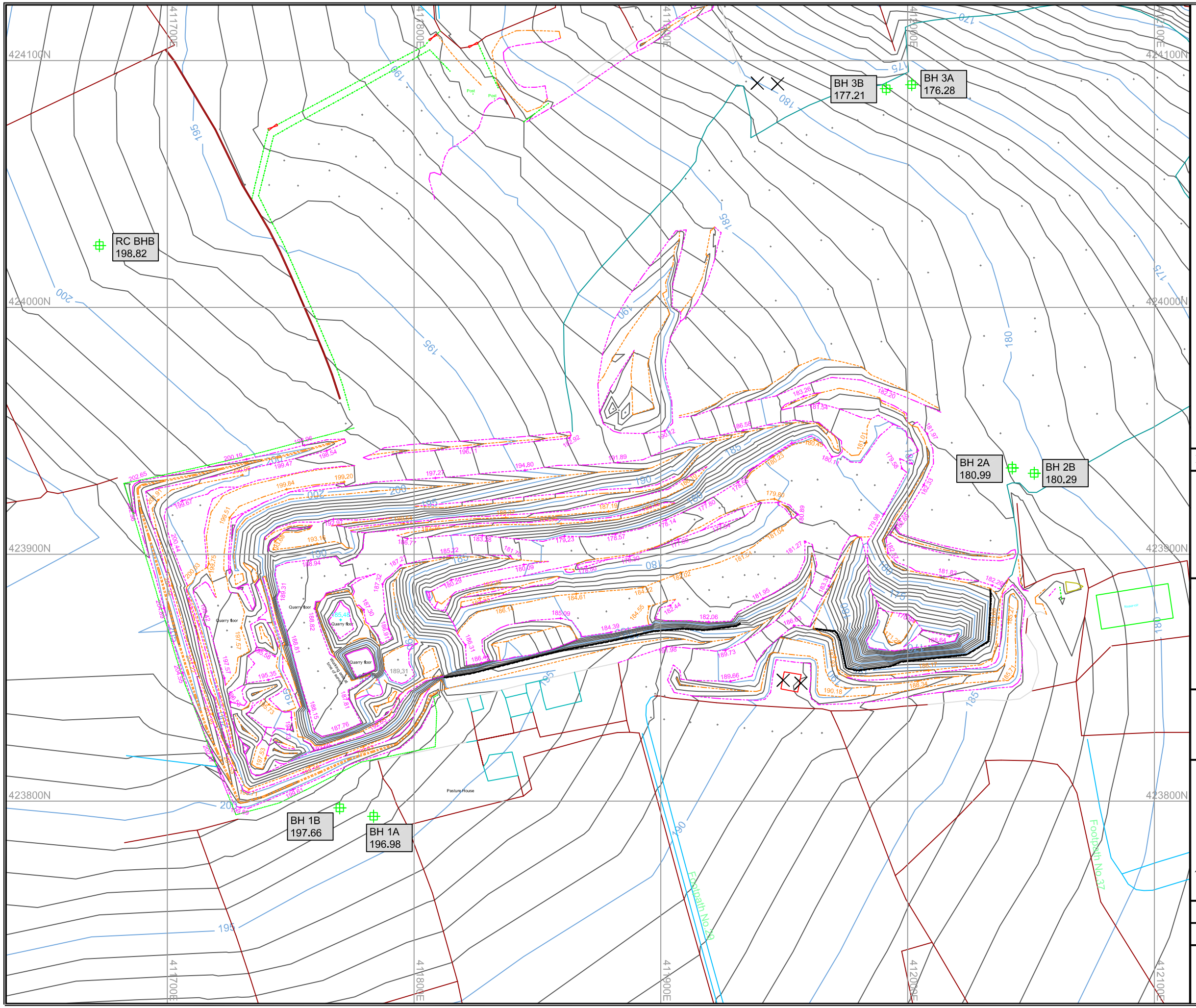
Approved Restoration Plan

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk
7, Hall Annex, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH
Tel (0114) 2573487 Fax (0114) 2573459

Project No. 20293	Dwg No. ESSD 5	Rev
Date: Sept 21	Drawn: PS	Chkd:	Scale: 1:1000 @ A3

Appendix C

Borehole locations and logs



LEGEND

- Bottom of Bank
- Top of Bank
- Fence
- Building
- Wall
- Quarry Face
- 1m Contours
- 5m Contours
- Levels
- Borehole ID & ground level

Rev	Description	Date	Drawn	Chkd

Client:

Marshalls

Project:

PASTURE HOUSE QUARRY
& WESTERN EXTENSION

Plan Title:

BOREHOLE LOCATIONS

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk
7, Hall Annex, Thorncliffe Park, Chapeltown, Sheffield, S35 2PH
Tel (0114) 2573487 Fax (0114) 2573459

Project No. 14191	Dwg No. 14191_BH21	Rev

Date: 06/21	Drawn: MS	Chkd: RD	Scale: 1:1500 @ A3

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH1A**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	01-06-21 07-06-21	196.98		
Contractor				Sheet
Ace Drilling Services				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				195.98		1.00	Brown CLAY		
						(5.50)	INTERBEDDED SANDSTONE & MUDSTONE		
				190.48		6.50			
				188.48		(2.00) 8.50	SANDSTONE		
				186.98		10.00	MUDSTONE		
						(34.00)	INTERBEDDED SANDSTONE & MUDSTONE		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH1A**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	01-06-21 07-06-21	196.98		
Contractor				Sheet
Ace Drilling Services				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							INTERBEDDED SANDSTONE & MUDSTONE *(continued)*		
				152.98		44.00			

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
07-06-21	00.00	44.00	16.50		36.9					

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH1B**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	09-06-21 10-06-21	197.66		
Contractor				Sheet
Ace Drilling Services				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				196.16		1.50	Silty CLAY with sandtone gravel		
						(6.50)	INTERBEDDED SANDSTONE & MUDSTONE		
				189.66		8.00			
				187.66		(2.00) 10.00	MUDSTONE		
							INTERBEDDED SANDSTONE & MUDSTONE		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH1B**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	09-06-21 10-06-21	197.66		
Contractor				Sheet
Ace Drilling Services				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							INTERBEDDED SANDSTONE & MUDSTONE *(continued)*		
						(58.90)			
				128.76		68.90			

Boring Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
09-06-21	00.00	68.90	2.00		60
10-06-21	00.00	68.90	2.00		53.9

Chiselling

From	To	Hours

Water Added

From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH2A**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	25-05-21 26-05-21	180.99		
Contractor				Sheet
Ace Drilling Services				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				180.49		0.50	Silty CLAY with sandtone gravel		
						(2.50)	SANDSTONE with Sandy Clay bands (Weathered SST)		
				177.99		3.00			
							MUDSTONE		
				176.49		4.50			
							INTERBEDDED SANDSTONE & MUDSTONE		
						(37.50)			

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH2A**
Job No: 20329	Date: 25-05-21, 26-05-21	Ground Level (m): 180.99	Co-Ordinates: ()	
Contractor: Ace Drilling Services				Sheet: 2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							INTERBEDDED SANDSTONE & MUDSTONE *(continued)*		
				138.99		42.00			

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
26-05-21	00.00	42.00	10.50		35.3					

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client: Marshalls	Method/ Plant Used: Beretta T44	Logged By: SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

Silkstone
Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH2B**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	21-05-21 25-05-21	180.29		
Contractor				Sheet
Ace Drilling Services				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				179.79		0.50	Silty CLAY with sandtone gravel		
						(2.50)	SANDSTONE with Sandy Clay bands (Weathered SST)		
				177.29		3.00			
						(10.50)	SANDSTONE		
				166.79		13.50			
						(3.00)	MUDSTONE		
				163.79		16.50			
							INTERBEDDED SANDSTONE & MUDSTONE		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

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Environmental Ltd
www.silkstoneenvironmental.co.uk

Silkstone Environmental Ltd
7 Hall Annex, Thorncliffe Park
Chapeltown, S35 2PH
Telephone: 0114 2573487

BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH2B**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	21-05-21 25-05-21	180.29		
Contractor				Sheet
Ace Drilling Services				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							INTERBEDDED SANDSTONE & MUDSTONE *(continued)*		
						(46.50)			
				117.29		63.00			

Boring Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
24-05-21	00.00	63.00	7.50		57.6
25-05-21	00.00	63.00	7.50		53.8

Chiselling

From	To	Hours

Water Added

From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

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BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH3A**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	19-05-21 21-05-21	176.28		
Contractor				Sheet
Ace Drilling Services				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				175.78		0.50	Silty CLAY with sandtone gravel		
						(5.50)	SANDSTONE with Sandy Clay bands (Weathered SST)		
				170.28		6.00			
						(6.00)	SANDSTONE		
				164.28		12.00			
						(26.50)	INTERBEDDED SANDSTONE & MUDSTONE		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

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BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH3A**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	19-05-21 21-05-21	176.28		
Contractor				Sheet
Ace Drilling Services				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							INTERBEDDED SANDSTONE & MUDSTONE *(continued)*		
				137.78		38.50			

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
20-05-21	00.00	38.50	10.50		31					
21-05-21	00.00	38.50	10.50		28					

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

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BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH3B**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	05-05-21 19-05-21	177.21		
Contractor				Sheet
Ace Drilling Services				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				175.21		(2.00) 2.00	CLAY with Sandstone fragments		
				172.71		(2.50) 4.50	SANDSTONE with Sandy Clay bands (Weathered SST)		
				166.21		(6.50) 11.00	SANDSTONE		
				165.71		11.50	INTERBEDDED SANDSTONE & MUDSTONE		
				157.71		(8.00) 19.50	MUDSTONE		
							INTERBEDDED SANDSTONE & MUDSTONE		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

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BOREHOLE LOG

Project				BOREHOLE No
Pasture House Monitoring Boreholes				**BH3B**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20329	05-05-21 19-05-21	177.21		
Contractor				Sheet
Ace Drilling Services				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							INTERBEDDED SANDSTONE & MUDSTONE *(continued)*		
						(44.00)			
				113.71		63.50			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
14-05-21	00.00	63.50	21.00		55.7
17-05-21	00.00	63.50	21.00		56.2

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

1 - Extensive notes relating to the borehole kept on site diary sheets.

All dimensions in metres Scale 1:218.75	Client Marshalls	Method/ Plant Used Beretta T44	Logged By SEL/Ace Drilling

BH LOG 20M 20329 PASTURE HOUSE - MONITORING BOREHOLES.GPJ GINT STD AGS 3_1.GDT 9/7/21

Appendix D

Groundwater quality data

C 2152425 Silkstone Environmental Ltd: Pasture House Quarry June

Laboratory Number			**20554456**	**20554457**	**20554458**	**20554459**	**20554460**	**20554461**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH2A**	**BH2B**	**BH3A**	**BH3B**
Sample Date/Time			**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Barium, Total as Ba	WAS049	mg/l	0.67	0.921	0.054	1.21	0.227	0.786
Cobalt , Total as Co	WAS049	mg/l	0.056	0.063	0.008	0.14	0.054	0.12
Iron , Total as Fe	WAS049	mg/l	83.9	95.8	12	174	75.4	184
Mercury, Total as Hg	WAS013	mg/l	<0.00001	<0.00001	0.00002	0.00001	<0.00001	<0.00001
Molybdenum , Total as Mo	WAS049	mg/l	<0.030	<0.030	<0.003	<0.060	<0.030	<0.030
Silver , Total as Ag	WAS049	mg/l	<0.0070	<0.0070	<0.0007	<0.0140	<0.0070	<0.0070
Thallium , Total as Tl	WAS049	mg/l	<0.120	<0.120	<0.012	<0.240	<0.120	<0.120
Tin , Total as Sn	WAS049	mg/l	<0.070	<0.070	0.015	0.173	<0.070	<0.070
Vanadium , Total as V	WAS049	mg/l	0.052	0.07	0.012	0.134	0.052	0.122
pH	WAS039	pH units	7.8	8	7.8	7.8	7.8	7.8
Conductivity- Electrical 20C	WAS039	uS/cm	463	598	357	348	230	770
Ammoniacal Nitrogen as N	WAS036	mg/l	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
Chloride as Cl	WAS036	mg/l	43.5	65.7	16.8	19.2	8.1	12.5
Nitrate as N	WAS036	mg/l	3.6	5.5	<0.7	<0.7	2.5	<0.7
Nitrite as N	WAS036	mg/l	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Nitrogen, Total Oxidised as N	WAS036	mg/l	3.6	5.5	<0.7	<0.7	2.5	<0.7
Phosphorus , Total as P	WAS049	mg/l	1.44	1.82	0.2	<2.40	1.43	2.14
BOD + ATU (5 day)	WAS001	mg/l	1	2	3	4	<1	<1
COD (Total)	WAS040	mg/l	SEE A/C	700	57	600	111	930
Fluoride as F	WAS029	mg/l	0.3	0.3	0.3	0.3	0.3	0.3
1,2,3-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<10	<10	<10
1,2,4-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<10	<10	<10
1,3,5-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<10	<10	<10
Aldrin	GEO47	ng/l	<4	<4	<4	<4	<4	<4
alpha-Endosulphan	GEO47	ng/l	<4	<4	<4	<4	<4	<4
alpha-HCH	GEO47	ng/l	<3	<3	<3	<3	<3	<3
beta-Endosulphan	GEO47	ng/l	<4	<4	<4	<4	<4	<4
beta-HCH	GEO47	ng/l	<3	<3	<3	<3	<3	<3
alpha-Chlordane	GEO47	ng/l	<3	<3	<3	<3	<3	<3
Dichlobenil	GEO47	ng/l	<2	<2	<2	<2	<2	<2
Dieldrin	GEO47	ng/l	<4	<4	<4	<4	<4	<4
Endrin	GEO47	ng/l	<4	<4	<4	<4	<4	<4
gamma-HCH	GEO47	ng/l	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7
Heptachlor Epoxide	GEO47	ng/l	<4	<4	<4	<4	<4	<4
Hexachlorobenzene	GEO47	ng/l	<2	<2	<2	<2	<2	<2
Hexachlorobutadiene	GEO47	ng/l	<7	<7	<7	<7	<7	<7
Isodrin	GEO47	ng/l	<4	<4	<4	<4	<4	<4
o,p - DDE	GEO47	ng/l	<2	<2	<2	<2	<2	<2
p,p - DDE	GEO47	ng/l	<2	<2	<2	<2	<2	<2
o,p - TDE	GEO47	ng/l	<2	<2	<2	<2	<2	<2
p,p - TDE	GEO47	ng/l	<2	<2	<2	<2	<2	<2
o,p - DDT	GEO47	ng/l	<2	<2	<2	<2	<2	<2
p,p - DDT	GEO47	ng/l	<4	<4	<4	<4	<4	<4

Key

N/S - Not Scheduled

I/S - Insufficient Sample

To Follow - analysis incomplete (interim reports only)

C 2152425 Silkstone Environmental Ltd: Pasture House Quarry June

Laboratory Number			**20554456**	**20554457**	**20554458**	**20554459**	**20554460**	**20554461**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH2A**	**BH2B**	**BH3A**	**BH3B**
Sample Date/Time			**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Tecnazene	GEO47	ng/l	<10	<10	<10	<10	<10	<10
gamma-Chlordane	GEO47	ng/l	<4	<4	<4	<4	<4	<4
Triallate	GEO47	ng/l	<10	<10	<10	<10	<10	<10
Trifluralin	GEO47	ng/l	<30	<30	<30	<30	<30	<30
EH >C6 - C40	GEO35	ug/l	<10	<10	139	<10	<10	<10
EH >C6 - C8	GEO35	ug/l	<10	<10	<10	<10	<10	<10
EH >C8 - C10	GEO35	ug/l	<10	<10	<10	<10	<10	<10
EH >C16 - C24	GEO35	ug/l	<10	<10	18	<10	<10	<10
EH >C24 - C40	GEO35	ug/l	<10	<10	121	<10	<10	<10
EH >C10 - C16	GEO35	ug/l	<10	<10	<10	<10	<10	<10
1,1,1,2-Tetrachloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,1,1-Trichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,1,2,2-Tetrachloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,1,2-Trichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,1-Dichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,1-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,1-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2,3-Trichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2,3-Trichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2,4-Trichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2,4-Trimethylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2-Dibromo-3-chloropropane	GEO76	ug/l	<2.00	<2.00	<2.00	<10.0	<2.00	<2.00
1,2-Dibromoethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2-Dichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,2-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,3,5-Trimethylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,3-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,3-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
1,4-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
2,2-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
2-Chlorotoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
4-Chlorotoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Antimony, total as Sb (mg/l)	WAS076	mg/l	<0.016	<0.0016	<0.0016	<0.0016	<0.0016	<0.0016
Arsenic, total as As (mg/l)	WAS076	mg/l	0.0084	0.012	0.002	0.012	0.0025	0.014
Benzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Beryllium, total as Be (ug/l)	WAS076	ug/l	6.7	6.2	<0.60	7.1	1.4	4.9
Boron, total as B (mg/l)	WAS076	mg/l	<0.60	0.09	<0.06	<0.06	<0.06	0.14
Bromobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Bromochloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Bromodichloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Bromoform	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Bromomethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00

Key

N/S - Not Scheduled

I/S - Insufficient Sample

To Follow - analysis incomplete (interim reports only)

C 2152425 Silkstone Environmental Ltd: Pasture House Quarry June

Laboratory Number			**20554456**	**20554457**	**20554458**	**20554459**	**20554460**	**20554461**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH2A**	**BH2B**	**BH3A**	**BH3B**
Sample Date/Time			**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**	**17/06/2021 00:00:00**
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Cadmium, total as Cd (mg/l)	WAS076	mg/l	0.0018	0.002	0.00014	0.0021	0.00029	0.0023
Carbon Tetrachloride	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Chlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Chloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Chloroform	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Chloromethane	GEO76	ug/l	<2.00	<2.00	<2.00	<10.0	<2.00	<2.00
Chromium, total as Cr (mg/l)	WAS076	mg/l	0.12	0.084	0.017	0.12	0.045	0.13
cis-1,2-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
cis-1,3-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Copper, total as Cu (mg/l)	WAS076	mg/l	0.16	0.15	0.017	0.22	0.05	0.3
Dibromochloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Dibromomethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Dichlorodifluoromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Dichloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Ethyl Benzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Hexachlorobutadiene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
iso-Propylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Lead, total as Pb (mg/l)	WAS076	mg/l	0.16	0.15	0.016	0.2	0.035	0.49
m&p Xylene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
MTBE	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Naphthalene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
n-butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Nickel, total as Ni (mg/l)	WAS076	mg/l	0.13	0.14	0.017	0.2	0.053	0.15
n-propylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
o-Xylene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
p-isopropyltoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
sec-butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Selenium, total as Se (mg/l)	WAS076	mg/l	<0.0060	0.0049	<0.00060	0.0054	0.001	0.0023
Styrene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Tellurium, total as Te (mg/l)	WAS076	mg/l	<0.0035	<0.00035	<0.00035	<0.00035	<0.00035	<0.00035
tert-Butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Tetrachloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Titanium, total as Ti(ug/l)	WAS076	ug/l	149	57	94	113	74	71
Toluene	GEO76	ug/l	<1.00	1.98	<1.00	<5.00	<1.00	1.35
trans-1,2-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
trans-1,3-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Trichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Trichlorofluoromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Uranium, total as U(mg/l)	WAS076	mg/l	0.0028	0.004	0.00045	0.0046	0.00077	0.0026
Vinyl Chloride	GEO76	ug/l	<0.500	<0.500	<0.500	<2.50	<0.500	<0.500
Xylene, Total	GEO76	ug/l	<1.00	<1.00	<1.00	<5.00	<1.00	<1.00
Zinc, total as Zn (mg/l)	WAS076	mg/l	0.4	0.32	0.064	0.39	0.1	0.56
SVOC (W) by GC MS	SUBCON	ug/l	see report	see report	see report	see report	see report	see report

Key

N/S - Not Scheduled

I/S - Insufficient Sample

To Follow - analysis incomplete (interim reports only)

C 2173448 Silkstone Environmental Ltd: Pasture House Quarry July

Laboratory Number			**20691626**	**20691627**	**20691628**	**20691629**	**20691630**	**20691631**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH2A**	**BH2B**	**BH3A**	**BH3B**
Sample Date/Time			**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Barium, Total as Ba	WAS049	mg/l	0.598	1.34	0.65	1.89	0.283	0.785
Cobalt , Total as Co	WAS049	mg/l	0.132	0.219	0.141	0.287	0.085	0.106
Iron , Total as Fe	WAS049	mg/l	57.6	168	118	224	90.6	172
Mercury, Total as Hg	WAS013	mg/l	0.00002	<0.00001	0.00003	0.00001	<0.00001	<0.00001
Molybdenum , Total as Mo	WAS049	mg/l	<0.030	0.133	<0.030	<0.060	<0.030	<0.030
Silver , Total as Ag	WAS049	mg/l	<0.0070	<0.0140	<0.0070	<0.0140	<0.0070	<0.0070
Thallium , Total as Tl	WAS049	mg/l	<0.120	<0.240	<0.120	<0.240	<0.120	<0.120
Tin , Total as Sn	WAS049	mg/l	0.118	0.303	<0.070	<0.140	<0.070	<0.070
Vanadium , Total as V	WAS049	mg/l	0.07	0.116	0.084	0.212	0.059	0.12
pH	WAS039	pH units	7.8	7.7	7.8	8.1	7.8	7.5
Conductivity- Electrical 20C	WAS039	uS/cm	463	619	350	373	230	794
Ammoniacal Nitrogen as N	WAS036	mg/l	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
Chloride as Cl	WAS036	mg/l	42.3	66.9	17	17.7	7.3	13.3
Nitrate as N	WAS036	mg/l	3.7	5.5	<0.7	<0.7	2.2	<0.7
Nitrite as N	WAS036	mg/l	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Nitrogen, Total Oxidised as N	WAS036	mg/l	3.7	5.5	<0.7	<0.7	2.2	<0.7
Phosphorus , Total as P	WAS049	mg/l	2.05	4.46	2.44	<6.00	2.83	2.14
BOD + ATU (5 day)	WAS001	mg/l	1	1	2	4	3	3
COD (Total)	WAS040	mg/l	960	1150	570	755	202	1110
Fluoride as F	WAS029	mg/l	0.3	0.3	0.3	0.3	0.3	0.3
1,2,3-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<43	<10	<10
1,2,4-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<34	<10	<10
1,3,5-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<57	<10	<10
Aldrin	GEO47	ng/l	<4	<4	<4	<51	<4	<4
alpha-Endosulphan	GEO47	ng/l	<4	<4	<4	<85	<4	<4
alpha-HCH	GEO47	ng/l	<3	<3	<3	<43	<3	<3
beta-Endosulphan	GEO47	ng/l	<4	<4	<4	<63	<4	<4
beta-HCH	GEO47	ng/l	<3	<3	<3	<39	<3	<3
alpha-Chlordane	GEO47	ng/l	<3	<3	<3	<61	<3	<3
Dichlobenil	GEO47	ng/l	<2	<2	<2	<42	<2	<2
Dieldrin	GEO47	ng/l	<4	<4	<4	<55	<4	<4
Endrin	GEO47	ng/l	<4	<4	<4	<65	<4	<4
gamma-HCH	GEO47	ng/l	<2.7	<2.7	<2.7	<42.3	<2.7	<2.7
Heptachlor Epoxide	GEO47	ng/l	<4	<4	<4	<68	<4	<4
Hexachlorobenzene	GEO47	ng/l	<2	<2	<2	<40	<2	<2
Hexachlorobutadiene	GEO47	ng/l	<7	<7	<7	<34	<7	<7
Isodrin	GEO47	ng/l	<4	<4	<4	<63	<4	<4
o,p - DDE	GEO47	ng/l	<2	<2	<2	<40	<2	<2
p,p - DDE	GEO47	ng/l	<2	<2	<2	<44	<2	<2
o,p - TDE	GEO47	ng/l	<2	<2	<2	<43	<2	<2
p,p - TDE	GEO47	ng/l	<2	<2	<2	<39	<2	<2
o,p - DDT	GEO47	ng/l	<2	<2	<2	<46	<2	<2
p,p - DDT	GEO47	ng/l	<4	<4	<4	<65	<4	<4

Key

N/S - Not Scheduled

I/S - Insufficient Sample

To Follow - analysis incomplete (interim reports only)

C 2173448 Silkstone Environmental Ltd: Pasture House Quarry July

Laboratory Number			**20691626**	**20691627**	**20691628**	**20691629**	**20691630**	**20691631**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH2A**	**BH2B**	**BH3A**	**BH3B**
Sample Date/Time			**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Tecnazene	GEO47	ng/l	<10	<10	<10	<168	<10	<10
gamma-Chlordane	GEO47	ng/l	<4	<4	<4	<60	<4	<4
Triallate	GEO47	ng/l	<10	<10	<10	<206	<10	<10
Trifluralin	GEO47	ng/l	<30	<30	<30	<180	<30	<30
EH >C6 - C40	GEO35	ug/l	<10	<10	<10	<10	<10	<10
EH >C6 - C8	GEO35	ug/l	<10	<10	<10	<10	<10	<10
EH >C8 - C10	GEO35	ug/l	<10	<10	<10	<10	<10	<10
EH >C16 - C24	GEO35	ug/l	<10	<10	<10	<10	<10	<10
EH >C24 - C40	GEO35	ug/l	<10	<10	<10	<10	<10	<10
EH >C10 - C16	GEO35	ug/l	<10	<10	<10	<10	<10	<10
1,1,1,2-Tetrachloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,1-Trichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2,2-Tetrachloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1,2-Trichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2,4-Trimethylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dibromo-3-chloropropane	GEO76	ug/l	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
1,2-Dibromoethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3,5-Trimethylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,3-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
1,4-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2,2-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
2-Chlorotoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
4-Chlorotoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Antimony, total as Sb (mg/l)	WAS076	mg/l	<0.0016	<0.0016	<0.0016	<0.0016	<0.0016	<0.0016
Arsenic, total as As (mg/l)	WAS076	mg/l	0.0085	0.023	0.0069	0.022	0.0039	0.02
Benzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Beryllium, total as Be (ug/l)	WAS076	ug/l	6	11	4.9	12	2.8	6.3
Boron, total as B (mg/l)	WAS076	mg/l	<0.06	0.1	<0.06	<0.06	<0.06	0.16
Bromobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromochloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromodichloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromoform	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Bromomethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

Key

N/S - Not Scheduled

I/S - Insufficient Sample

To Follow - analysis incomplete (interim reports only)

C 2173448 Silkstone Environmental Ltd: Pasture House Quarry July

Laboratory Number			**20691626**	**20691627**	**20691628**	**20691629**	**20691630**	**20691631**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH2A**	**BH2B**	**BH3A**	**BH3B**
Sample Date/Time			**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**	**27/07/2021 00:00:00**
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Cadmium, total as Cd (mg/l)	WAS076	mg/l	0.0028	0.0044	0.0019	0.0034	0.00053	0.0024
Carbon Tetrachloride	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloroform	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Chloromethane	GEO76	ug/l	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
Chromium, total as Cr (mg/l)	WAS076	mg/l	0.089	0.11	0.12	0.21	0.071	0.096
cis-1,2-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
cis-1,3-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Copper, total as Cu (mg/l)	WAS076	mg/l	0.16	0.26	0.19	0.39	0.11	0.31
Dibromochloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dibromomethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichlorodifluoromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Dichloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Ethyl Benzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Hexachlorobutadiene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
iso-Propylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Lead, total as Pb (mg/l)	WAS076	mg/l	0.19	0.3	0.19	0.34	0.094	0.48
m&p Xylene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
MTBE	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Naphthalene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
n-butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Nickel, total as Ni (mg/l)	WAS076	mg/l	0.12	0.21	0.15	0.37	0.097	0.15
n-propylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
o-Xylene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
p-isopropyltoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
sec-butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Selenium, total as Se (mg/l)	WAS076	mg/l	<0.00060	0.0074	0.0034	0.0065	0.0023	0.0027
Styrene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Tellurium, total as Te (mg/l)	WAS076	mg/l	<0.00035	<0.00035	<0.00035	<0.00035	<0.00035	<0.00035
tert-Butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Tetrachloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Titanium, total as Ti(ug/l)	WAS076	ug/l	81	60	91	54	71	47
Toluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
trans-1,2-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
trans-1,3-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Trichlorofluoromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Uranium, total as U(mg/l)	WAS076	mg/l	0.0022	0.0048	0.0031	0.0081	0.0011	0.0028
Vinyl Chloride	GEO76	ug/l	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
Xylene, Total	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Zinc, total as Zn (mg/l)	WAS076	mg/l	0.35	0.51	0.38	0.57	0.19	0.44
SVOC (W) by GC MS	SUBCON	ug/l	See Report	See Report	See Report	See Report	See Report	See Report

Key

N/S - Not Scheduled

I/S - Insufficient Sample

To Follow - analysis incomplete (interim reports only)

C 2188219 Silkstone Environmental Ltd: Pasture House Quarry August

Laboratory Number			**20789180**	**20789181**	**20789182**	**20789183**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH3A**	**BH3B**
Sample Date/Time						
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Barium, Total as Ba	WAS049	mg/l	0.27	0.065	0.232	0.306
Cobalt , Total as Co	WAS049	mg/l	0.069	0.015	0.064	0.025
Iron , Total as Fe	WAS049	mg/l	58	13.4	70	59.1
Mercury, Total as Hg	WAS013	mg/l	0.00004	0.00003	0.00003	0.00008
Molybdenum , Total as Mo	WAS049	mg/l	<0.030	0.005	0.138	0.082
Silver , Total as Ag	WAS049	mg/l	<0.0070	<0.0007	<0.0070	<0.0007
Thallium , Total as Tl	WAS049	mg/l	<0.120	<0.012	<0.120	<0.012
Tin , Total as Sn	WAS049	mg/l	<0.070	<0.007	<0.070	<0.070
Vanadium , Total as V	WAS049	mg/l	0.043	0.015	0.046	0.04
pH	WAS039	pH units	7.6	7.6	7.7	7.3
Conductivity- Electrical 20C	WAS039	uS/cm	469	513	319	849
Ammoniacal Nitrogen as N	WAS036	mg/l	<0.41	<0.41	<0.41	<0.41
Chloride as Cl	WAS036	mg/l	40.3	46.7	11.2	14.2
Nitrate as N	WAS036	mg/l	4	4.8	1.2	<0.7
Nitrite as N	WAS036	mg/l	<0.08	<0.08	<0.08	<0.08
Nitrogen, Total Oxidised as N	WAS036	mg/l	4	4.8	1.2	<0.7
Phosphorus , Total as P	WAS049	mg/l	<1.20	0.27	1.48	1.08
BOD + ATU (5 day)	WAS001	mg/l	1	<1	1	2
COD (Total)	WAS040	mg/l	275	91	186	300
Fluoride as F	WAS029	mg/l	0.2	0.2	0.2	0.3
1,2,3-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<10
1,2,4-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<10
1,3,5-Trichlorobenzene	GEO47	ng/l	<10	<10	<10	<10
Aldrin	GEO47	ng/l	<4	<4	<4	<4
alpha-Endosulphan	GEO47	ng/l	<4	<4	<4	<4
alpha-HCH	GEO47	ng/l	<3	<3	<3	<3
beta-Endosulphan	GEO47	ng/l	<4	<4	<4	<4
beta-HCH	GEO47	ng/l	<3	<3	<3	<3
alpha-Chlordane	GEO47	ng/l	<3	<3	<3	<3
Dichlobenil	GEO47	ng/l	<2	<2	<2	<2
Dieldrin	GEO47	ng/l	<4	<4	<4	<4
Endrin	GEO47	ng/l	<4	<4	<4	<4
gamma-HCH	GEO47	ng/l	<2.7	<2.7	<2.7	<2.7
Heptachlor Epoxide	GEO47	ng/l	<4	<4	<4	<4
Hexachlorobenzene	GEO47	ng/l	<2	<2	<2	<2
Hexachlorobutadiene	GEO47	ng/l	<7	<7	<7	<7
Isodrin	GEO47	ng/l	<4	<4	<4	<4
o,p - DDE	GEO47	ng/l	<2	<2	<2	<2
p,p - DDE	GEO47	ng/l	<2	<2	<2	<2
o,p - TDE	GEO47	ng/l	<2	<2	<2	<2
p,p - TDE	GEO47	ng/l	<2	<2	<2	<2
o,p - DDT	GEO47	ng/l	<2	<2	<2	<2
p,p - DDT	GEO47	ng/l	<4	<4	<4	<4

Key

N/S - Not Scheduled

I/S - Insufficient Sample

To Follow - analysis incomplete (interim reports only)

C 2188219 Silkstone Environmental Ltd: Pasture House Quarry August

Laboratory Number			**20789180**	**20789181**	**20789182**	**20789183**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH3A**	**BH3B**
Sample Date/Time						
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Tecnazene	GEO47	ng/l	<10	<10	<10	<10
gamma-Chlordane	GEO47	ng/l	<4	<4	<4	<4
Triallate	GEO47	ng/l	<10	<10	<10	<10
Trifluralin	GEO47	ng/l	<30	<30	<30	<30
EH >C6 - C40	GEO35	ug/l	<10	<10	<10	14
EH >C6 - C8	GEO35	ug/l	<10	<10	<10	<10
EH >C8 - C10	GEO35	ug/l	<10	<10	<10	<10
EH >C16 - C24	GEO35	ug/l	<10	<10	<10	14
EH >C24 - C40	GEO35	ug/l	<10	<10	<10	<10
EH >C10 - C16	GEO35	ug/l	<10	<10	<10	<10
1,1,1,2-Tetrachloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,1,1-Trichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,1,2,2-Tetrachloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,1,2-Trichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,1-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2,3-Trichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2,4-Trichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2,4-Trimethylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2-Dibromo-3-chloropropane	GEO76	ug/l	<2.00	<2.00	<2.00	<2.00
1,2-Dibromoethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2-Dichloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,2-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,3,5-Trimethylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,3-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,3-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
1,4-Dichlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
2,2-Dichloropropane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
2-Chlorotoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
4-Chlorotoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Antimony, total as Sb (mg/l)	WAS076	mg/l	<0.0016	<0.0016	<0.0016	<0.0016
Arsenic, total as As (mg/l)	WAS076	mg/l	0.0062	0.0029	0.0036	0.013
Benzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Beryllium, total as Be (ug/l)	WAS076	ug/l	3.5	0.84	2.5	3.7
Boron, total as B (mg/l)	WAS076	mg/l	<0.06	0.09	<0.06	0.19
Bromobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Bromochloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Bromodichloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Bromoform	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Bromomethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00

Key

N/S - Not Scheduled

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To Follow - analysis incomplete (interim reports only)

C 2188219 Silkstone Environmental Ltd: Pasture House Quarry August

Laboratory Number			**20789180**	**20789181**	**20789182**	**20789183**
Customer Sample Ref.			**BH1A**	**BH1B**	**BH3A**	**BH3B**
Sample Date/Time						
Sample Matrix			**Ground Water**	**Ground Water**	**Ground Water**	**Ground Water**
Cadmium, total as Cd (mg/l)	WAS076	mg/l	0.0016	0.00021	0.00039	0.0012
Carbon Tetrachloride	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Chlorobenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Chloroethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Chloroform	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Chloromethane	GEO76	ug/l	<2.00	<2.00	<2.00	<2.00
Chromium, total as Cr (mg/l)	WAS076	mg/l	0.066	0.019	0.087	0.056
cis-1,2-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
cis-1,3-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Copper, total as Cu (mg/l)	WAS076	mg/l	0.1	0.02	0.11	0.16
Dibromochloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Dibromomethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Dichlorodifluoromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Dichloromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Ethyl Benzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Hexachlorobutadiene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
iso-Propylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Lead, total as Pb (mg/l)	WAS076	mg/l	0.096	0.019	0.054	0.25
m&p Xylene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
MTBE	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Naphthalene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
n-butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Nickel, total as Ni (mg/l)	WAS076	mg/l	0.083	0.022	0.094	0.075
n-propylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
o-Xylene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
p-isopropyltoluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
sec-butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Selenium, total as Se (mg/l)	WAS076	mg/l	0.0024	0.0012	0.0018	0.002
Styrene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Tellurium, total as Te (mg/l)	WAS076	mg/l	<0.00035	<0.00035	<0.00035	<0.00035
tert-Butylbenzene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Tetrachloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Titanium, total as Ti(ug/l)	WAS076	ug/l	66	97	96	19
Toluene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
trans-1,2-Dichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
trans-1,3-Dichloropropene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Trichloroethene	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Trichlorofluoromethane	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Uranium, total as U(mg/l)	WAS076	mg/l	0.0013	0.00055	0.0011	0.0018
Vinyl Chloride	GEO76	ug/l	<0.500	<0.500	<0.500	<0.500
Xylene, Total	GEO76	ug/l	<1.00	<1.00	<1.00	<1.00
Zinc, total as Zn (mg/l)	WAS076	mg/l	0.24	0.062	0.17	0.19
SVOC (W) by GC MS	SUBCON	ug/l	See Report	See Report	See Report	See Report

Key

N/S - Not Scheduled

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Appendix E

LandSim configuration and results

Calculation Settings

Number of iterations: 1001

Results calculated using sampled PDFs

Full Calculation

Clay Liner:

Unretarded values used for simulation

No Biodegradation

Unsaturated Pathway:

Retarded values used for simulation

No Biodegradation

Saturated Vertical Pathway:

No Vertical Pathway

Aquifer Pathway:

Retarded values used for simulation

No Biodegradation

Timeslices at: 30, 100, 300, 1000

Decline in Contaminant Concentration in Leachate

Calcium	Non-Volatile
c (kg/l): 0	m (kg/l): 0
Potassium	Non-Volatile
c (kg/l): 0	m (kg/l): 0
Sodium	Non-Volatile
c (kg/l): 0	m (kg/l): 0

Background Concentrations of Contaminants

Justification for Contaminant Properties

Unjustified value

All units in milligrams per litre

Phase: Phase 1

Infiltration Information

Cap design infiltration (mm/year):	SINGLE(100)
Infiltration to waste (mm/year):	SINGLE(487)
End of filling (years from start of waste deposit):	10

Justification for Specified Infiltration
Unjustified value

Duration of management control (years from the start of waste disposal): 10

Cell dimensions

Cell width (m):	80
Cell length (m):	200
Cell top area (ha):	1.8
Cell base area (ha):	1.6
Number of cells:	1
Total base area (ha):	1.6
Total top area (ha):	1.8
Head of Leachate when surface water breakout occurs (m)	SINGLE(10)
Waste porosity (fraction)	TRIANGULAR(0.639,0.64,0.642)
Final waste thickness (m):	SINGLE(10)
Field capacity (fraction):	TRIANGULAR(0.2,0.3,0.35)
Waste dry density (kg/l)	TRIANGULAR(1.58,1.59,1.6)

Justification for Landfill Geometry
Unjustified value

Source concentrations of contaminants

All units in milligrams per litre

Declining source term

Calcium	SINGLE(1200)
	Data are spot measurements of Leachate Quality
Potassium	SINGLE(296)
	Data are spot measurements of Leachate Quality
Sodium	SINGLE(10)
	Data are spot measurements of Leachate Quality

Justification for Species Concentration in Leachate

Unjustified value

Drainage Information

Fixed Head.

Head on EBS is given as (m): SINGLE(0.1)

Justification for Specified Head

Unjustified value

Barrier Information

There is no barrier

Justification for Engineered Barrier Type

Unjustified value

Coal Measures Mudstone pathway parameters

Modelled as unsaturated pathway

Pathway length (m):	UNIFORM(10,15)
Flow Model:	porous medium
Pathway moisture content (fraction):	SINGLE(0.24)
Pathway Density (kg/l):	SINGLE(1.86)

Justification for Unsat Zone Geometry
Unjustified value

Pathway hydraulic conductivity values (m/s): SINGLE(1e-007)

Justification for Unsat Zone Hydraulics Properties
Unjustified value

Pathway longitudinal dispersivity (m): SINGLE(1)

Justification for Unsat Zone Dispersion Properties
Unjustified value

Retardation parameters for Coal Measures Mudstone pathway
Modelled as unsaturated pathway
Uncertainty in Kd (l/kg):

Calcium	UNIFORM(5,30)
Potassium	SINGLE(0)
Sodium	SINGLE(0)

Justification for Kd Values by Species
Unjustified value

Aquifer Pathway Dimensions for Phase

Pathway length (m):	UNIFORM(240,440)
Pathway width (m):	SINGLE(80)

pathway parameters

No Vertical Pathway

Upper Sandstone pathway parameters

Modelled as aquifer pathway.

Mixing zone (m):	SINGLE(2)

Justification for Aquifer Geometry
Unjustified value

Pathway regional gradient (-):	SINGLE(0.05)
Pathway hydraulic conductivity values (m/s):	SINGLE(2.1e-005)
Pathway porosity (fraction):	SINGLE(0.3)

Justification for Aquifer Hydraulics Properties
Unjustified value

Pathway longitudinal dispersivity (m):	SINGLE(10)
Pathway transverse dispersivity (m):	SINGLE(1)

Justification for Aquifer Dispersion Details
Unjustified value

Retardation parameters for Upper Sandstone pathway
Modelled as aquifer pathway.
Uncertainty in Kd (l/kg):

Calcium	UNIFORM(5,30)
Potassium	SINGLE(0)
Sodium	SINGLE(0)

Justification for Aquifer Kd Values by Species
Unjustified value

Pathway Density (kg/l):	SINGLE(2.4)

Concentration of Calcium in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Concentration of Calcium in groundwater [mg/l]

At infinity

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Concentration of Potassium in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Concentration of Potassium in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Concentration of Sodium in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Concentration of Sodium in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Phase: Phase 1

Concentration of Calcium at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.70155E-014
90% of values less than 0.000404827
95% of values less than 0.0175527
99% of values less than 1.51739

Minimum 0	Maximum 7.67004	
Mean 0.0454229	Std. Dev. 0.399708	Variance 0.159767

At 100 years

01% of values less than 3.63897E-007
05% of values less than 1.02952E-005
10% of values less than 0.000146629
50% of values less than 0.458939
90% of values less than 217.775
95% of values less than 468.042
99% of values less than 917.465

Minimum 4.33952E-008	Maximum 1088.41	
Mean 68.5111	Std. Dev. 177.773	Variance 31603.3

At 300 years

01% of values less than 14.781
05% of values less than 35.1342
10% of values less than 70.7218
50% of values less than 444.316
90% of values less than 1159.87
95% of values less than 1195.02
99% of values less than 1200.58

Minimum 8.47709	Maximum 1201.33	
Mean 542.476	Std. Dev. 399.698	Variance 159758

At 1000 years

01% of values less than 1006.41
05% of values less than 1077.65
10% of values less than 1120.95
50% of values less than 1194.28
90% of values less than 1200
95% of values less than 1200
99% of values less than 1200

Minimum 970.083	Maximum 1200	
Mean 1173.86	Std. Dev. 41.8175	Variance 1748.7

Phase: Phase 1

Concentration of Calcium at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 1200
05% of values less than 1200
10% of values less than 1200
50% of values less than 1200
90% of values less than 1200
95% of values less than 1200
99% of values less than 1200

Minimum 1200	Maximum 1200	
Mean 1200	Std. Dev. 0.000173906	Variance 3.02432E-008

Phase: Phase 1

Concentration of Potassium at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 296
05% of values less than 296
10% of values less than 296
50% of values less than 296
90% of values less than 296
95% of values less than 296
99% of values less than 296

Minimum 296	Maximum 296	
Mean 296	Std. Dev. 0.000114297	Variance 1.30637E-008

At 100 years

01% of values less than 296
05% of values less than 296
10% of values less than 296
50% of values less than 296
90% of values less than 296
95% of values less than 296
99% of values less than 296.001

Minimum 295.999	Maximum 296.001	
Mean 296	Std. Dev. 0.000187081	Variance 3.49992E-008

At 300 years

01% of values less than 296
05% of values less than 296
10% of values less than 296
50% of values less than 296
90% of values less than 296
95% of values less than 296
99% of values less than 296

Minimum 296	Maximum 296	
Mean 296	Std. Dev. 1.83128E-005	Variance 3.35358E-010

At 1000 years

01% of values less than 295.999
05% of values less than 296
10% of values less than 296
50% of values less than 296
90% of values less than 296
95% of values less than 296.001
99% of values less than 296.001

Minimum 295.997	Maximum 296.003	
Mean 296	Std. Dev. 0.000347526	Variance 1.20775E-007

Phase: Phase 1

Concentration of Potassium at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 296
05% of values less than 296
10% of values less than 296
50% of values less than 296
90% of values less than 296
95% of values less than 296
99% of values less than 296

Minimum 296	Maximum 296.001	
Mean 296	Std. Dev. 4.954E-005	Variance 2.45421E-009

Phase: Phase 1

Concentration of Sodium at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 10
05% of values less than 10
10% of values less than 10
50% of values less than 10
90% of values less than 10
95% of values less than 10
99% of values less than 10

Minimum 10	Maximum 10	
Mean 10	Std. Dev. 3.87175E-006	Variance 1.49905E-011

At 100 years

01% of values less than 9.99999
05% of values less than 9.99999
10% of values less than 10
50% of values less than 10
90% of values less than 10
95% of values less than 10
99% of values less than 10

Minimum 9.99997	Maximum 10.0001	
Mean 10	Std. Dev. 6.87488E-006	Variance 4.72639E-011

At 300 years

01% of values less than 10
05% of values less than 10
10% of values less than 10
50% of values less than 10
90% of values less than 10
95% of values less than 10
99% of values less than 10

Minimum 10	Maximum 10	
Mean 10	Std. Dev. 1.72547E-007	Variance -2.97725E-014

At 1000 years

01% of values less than 9.99997
05% of values less than 9.99999
10% of values less than 10
50% of values less than 10
90% of values less than 10
95% of values less than 10
99% of values less than 10

Minimum 9.9999	Maximum 10.0001	
Mean 10	Std. Dev. 1.10733E-005	Variance 1.22618E-010

Phase: Phase 1

Concentration of Sodium at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 9.99999
05% of values less than 10
10% of values less than 10
50% of values less than 10
90% of values less than 10
95% of values less than 10
99% of values less than 10

Minimum 9.99998	Maximum 10	
Mean 10	Std. Dev. 1.79731E-006	Variance 3.23032E-012