



The Coal
Authority

Resolving the **impacts** of mining

EV00116

Nenthead (Caplecleugh) Mine Water Treatment Scheme Sites 23, 100 and 101 Feasibility



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Executive Summary

The Coal Authority (TCA) has been commissioned to identify a suitable site for the construction of a MWTS to treat minewater from Caplecleugh Adit at Nenthead as part of the WAMM programme. The Coal Authority has identified sites most likely to be suitable for siting a MWTS. Three of the sites, 16, 24, and 43, were assessed in 2017 by Aecom (*TN06, September 2017*), but were not viable due to excessive costs. A further three potential sites have been identified and assessed by TCA.

The three sites considered are:

- Site 23, consisting of fields to the west of Nenthead in close proximity to residential properties.
- Site 100, an area of grassland and woodland to the east of Nenthead.
- Site 101, an area of open grassland to the east of Nenthead and close to Nenthead Mines.

Budget cost estimates for the construction and operation of a MWTS on each of the three sites are as follows:

Comparative Costs	Site 23	Site 100	Site 101
Construction Budget Cost Estimate	£5,173,499	£5,038,118	£4,162,057
Annual Maintenance Costs	£52,362	£56,676	£56,676

NB Costs are preliminary for comparative purposes, subject to further design and analysis

Of the three sites considered Site 101 is the least cost and has a number of distinct advantages. These include good accessibility, shorter pipeline routes away from public highways, favourable land ownership, reasonable topography, availability of space, potential for partnership with Nenthead Mines Conservation Society, and fewer nearby receptors.

The site does however have concerns for archaeology and visual impact. Following a meeting with Historic England there is broad agreement that a scheme could be built whilst being sensitive to the historic features and the landscape.

Site 100 is rejected on cost but also because it will be difficult to develop due to nearby receptors, historical mining features, ecology, land ownership, topography and inappropriate landscape.

Site 23 is rejected on cost but also because it will be difficult to develop due to close proximity of nearby receptors, pipeline route in the A689 through Nenthead village, difficult access and difficult site conditions.

In conclusion Site 101 offers the best opportunity to develop a MWTS for Caplecleugh Adit.

1.0 Introduction

Historic metal mining in the Nent valley continues to impact water quality of the River Nent. Average concentrations of cadmium, lead, and zinc exceed Environmental Quality Standards and the River Nent fails to achieve good status for fish and invertebrates. The Department for Environment, Food and Rural Affairs (Defra) set up the “Water and Abandoned Metal Mines” (WAMM) Programme in 2010 to address pollution from the hundreds of metal mines across the country. The programme is being delivered as a partnership between Defra, the Coal Authority and the Environment Agency. The WAMM programme has ranked the River Nent as the lowest quality in Northumbria and one of the lowest quality rivers in England, with respect to mine water related pollution. The pollution from the River Nent contributes to pollution in the River South Tyne up to 40km downstream. Due to these impacts, the Nent Catchment has been a priority for investigation, assessment and targeted improvement measures. The Northumbria River Basin Management Plan (RBMP), published in 2015, makes recommendations to reduce pollution from abandoned mines and manage the impacts. For the Nent catchment this will require the construction of a mine water treatment scheme (MWTS) somewhere near the Caplecleugh Level Adit, Nenthead, which is one of the point source contributors to the failure of the River Nent. A MWTS will reduce the metal loading (principally lead, zinc and cadmium) of the mine water discharge from the adit by between 70% and 90%. The construction of the MWTS is planned for completion by 2019.

The Coal Authority has been commissioned to identify suitable sites for the construction of the MWTS. Three potential sites have been identified and this report considers the feasibility and outline design for a mine water treatment scheme (MWTS) at each of these three sites.

2.0 Background

2.1 Scope of the Report

The Coal Authority has undertaken an assessment of the Nent valley to identify sites most likely to be suitable for a MWTS to be constructed (the long list selection). This assessment included consideration of land availability, public opinion, and a number of environmental and constructability issues. From this initial assessment, three of the areas, Sites 16, 24, 43 were selected by the Coal Authority for further investigation. Aecom were commissioned to produce a feasibility report for the three sites. The report, TN06: Design Rationale – 3 x Shortlisted Sites, issued September 2017, demonstrated that the three sites were not viable due to excessive costs of construction and operation.

The Coal Authority have revisited the site selection process and identified three further areas, Sites 23,100 and 101, which are closer to Nenthead and have good GIS indicators. A similar exercise to TN06 has been undertaken by The Coal Authority to assess the feasibility of these three sites.

The scope of this report is to gather, review and assess the available data associated with the three shortlisted sites (as shown on FIGURE 1- Site Location Plan, Appendix B1). The report considers for each site the topography, statutory utilities, access, flooding potential, ecology, public rights of way, and heritage. A preliminary MWTS layout has been designed

for each site taking account of site boundaries, topography, geographical features, proximity to residential properties etc. The preliminary MWTS layouts are based on the Nent Hags scheme developed in 2016. The layouts schematically indicate how and where a MWTS could be accommodated within each site. Indicative construction cost estimates are provided for all three sites, and a summary discussion on the principal constraints and considerations is made.

The principal purpose of the report is to provide an indication of the scale of development in terms of cost and land take, and to identify at an early stage any major constraints that may preclude the further progress in design or procurement of the site. The costings are broad based and are provided for comparative purposes. The costings will need further more detailed build up at future stages of reporting. The findings of the report will be used in the selection of a preferred site to take forward to outline design and submission of a planning application.

2.2 Treated Mine Water Outfalls & River Nent

Caplecleugh Adit is located at the Nenthead Mines car park. At this location the River Nent is a small tributary, it is not designated main river until a location 4.6 km downstream of the adit. The discharge from the adit contributes a substantial proportion of the river flow at its discharge point. The EA is unlikely to permit discharge of treated mine water to a point any further downstream of the adit which means that treated mine water will need to be returned back, either by gravity or pumping, to the adit location, i.e. the flows will need to be pumped or gravitate back to the Caplecleugh Adit. This requirement adds to the construction costs for an additional pumping station and infrastructure and also the associated operational pumping costs.

2.3 Basis of Design

The MWTS design philosophy is based on the Nent Hags MWTS which is a vertical flow system. The main features of the design and operation are as follows:

- A capture structure at the Caplecleugh Adit will collect the untreated mine water before it enters the river.
- Flows will be transferred by gravity pipe across the river to a pumping station located in the area of the car park (specific location to be confirmed).
- A pumped rising main will transfer mine water flows to the treatment sites
- The design is based on a design flow of 10 l/s treated within 3 no. vertical flow ponds (VFPs) (treating 3.67 l/s each) and a final polishing wetland.
- The pumping stations and rising mains will therefore need to be designed with a capacity of up to 40 l/s.
- Monitoring results have indicated that the peak flow rate at the adit can be as much as 40 l/s. In the event of even higher flows, the additional flow will overflow, untreated but diluted, from the pumping station, and discharge direct to the river.
- The ground level at the pumping station is approximately 430 mAOD.
- The VFP levels at the site will be higher than this at 435 mAOD (Site 23); 530 mAOD (Site 100); and 525 mAOD (Site 101).

- The rising main design at this stage assumes a 160mm diameter rising main taking a normal pumped flow rate of 20 l/s duty/standby (with potential for up to 40l/s duty/duty) and therefore operating at 50% of the time on average. The maximum design head (static plus friction losses) is approximately 130m.
- On entering the site, the mine water will discharge into a pumping break chamber, prior to entering a balancing/distribution chamber. The flow will be split equally to discharge into three Vertical Flow Ponds VFPs (with high flows directed to the balancing pond) via underground pipework.
- Each VFP will be capable of treating 3.67 l/s, operating in parallel.
- A series of chambers will be provided to monitor and test the flow, following the mine water process through the VFPs.
- The mine water will drain via gravity to the “polishing” wetlands, which will be shallow reed beds.
- Return of the treated mine water to the river will be either by gravity or pumping.
- Site 23 will required a pumped return due to the topography of the route.
- For sites 100 and 101 the return can be by gravity pipeline.
- Once at the Nenthead Mines car park, the treated water will discharge to the river via a stone headwall, or through the existing Rampgill adit.
- An emergency overflow will be required at the MWTS to deal with excess untreated water. This is most likely to be an emergency situation arising from unusual circumstances. This emergency overflow will need to be discharged to a watercourse. It is assumed for the purposes of this feasibility report and the indicative cost plan that the emergency overflow will discharge to the nearest watercourse rather than being returned in a pipeline back to the Adit site. This will be a matter for detailed design and will need consent from EA for the discharge.

The VFP scheme is likely to generate an excess of hydrogen sulphide (H₂S), which could present an odour nuisance. Report TN07 (Doc Ref: NG-Z-2004, AECOM, 2017) describes the principles behind the treatment technology. The sites have nearby receptors and odour mitigation will be necessary to avoid an odour nuisance.

In addition, an allowance has been made in the indicative cost plan for a welfare building to house a toilet, shower, small office and kitchen facilities, however this may be combined with the odour dosing .

Drawing FIG.1- Site Location Plan, Appendix B, shows the location of the capture point, the three sites under consideration, the proposed pumped main and gravity pipeline routes.

Design Parameters	
Design Flow	Design flow based 10 l/s base flow, with a maximum 40 l/s over 24 hrs in storm scenario.
Vertical Flow Ponds	3no. Vertical Flow Ponds to treat 3.67 l/s each
Balancing Pond	1no. Balancing Pond area to hold high flows
Wetland	One wetland per scheme to provide final “polishing” prior to discharge to river/watercourse
Odour Treatment Technology	TBC
Welfare/Odour Building	1no. welfare building provided on site, located near to existing access/land boundary. Odour Treatment building to be provided downstream of VFPs and prior to discharge into Wetland.
Access and Maintenance Tracks	Access and Maintenance tracks to be 5m wide, and constructed to provide access around the full scheme for tracked plant.
Capture Structure	Manhole at the adit and wet well pumping chamber in the car park
Pumping Arrangements	Pump arrangements are required for all the three schemes. The route of the pumping main is assumed to be within the existing highway corridor, unless noted otherwise.
Return flow Arrangement	Gravity where possible, otherwise to be pumped.
Outfall	Headwall and scour protection.

2.4 General Construction Details

Two single storey, pitched roof, stone clad buildings will be required. The first, a basic welfare facility, will be sited near site entrance. The second building will house the odour dosing unit and will be located close to the VFP outlets, where odour is most likely to be generated. It may be possible to combine these into one building.

Earthworks and landforms will be constructed using earthworks no steeper than a 1:3 gradient. The ponds will be benched into the existing topography with landscaping and screening to provide a scheme that is visually sensitive. Any surplus material or material classed as waste will need to be exported off site. Perimeter fencing and a formal gated access will be provided for security. Tracks around the ponds will be suitable for use by tracked excavators.

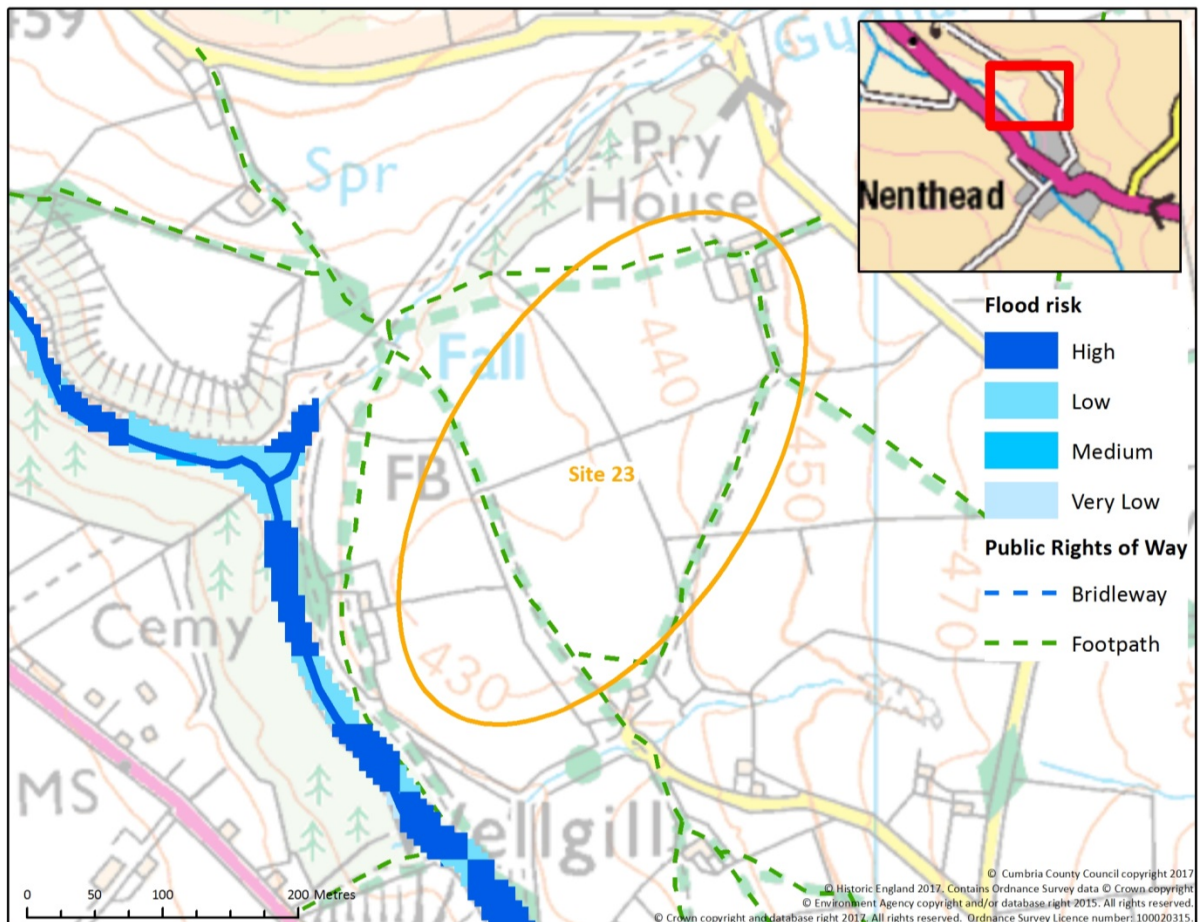
3.0 Site 23

Site 23 is located 1 km to the north-west of Nenthead. The site selection area is mostly agricultural land and farm buildings within the Nent valley. An area consisting of 2 fields has been identified as a possible plot for the MWTS. The available site is broadly rectangular in shape, bounded by Gudham Gill to the west and a farm track to the east. The site is accessed via a lane and farm access off the A689. Four residential properties lie very close to the site, Pry House 130m to the north east, Rock House 140m to the west, Strellas Cottage 100m to the south west and Wellgill Cottages immediately to the south. The site falls away to the west with gradients of 1 in 8 (12.5%).

Table 3.1 General Site Details

Name	Site 23
Location	Nenthead
Nearest postcode	CA9 3LP
OS NGR	377764 E, 544582 N
Current Land Use	Agricultural/Grassland
Land Owner	TBA

Figure 3.1 Site 23 Location and Public Access



3.1 Site Visit

Peter Terry and Andrew Brookes of TCA, visited the site and surrounding area on 9 April 2018. The weather on the day of the visit was warm and dry with dispersed clouds. Access to the site was obtained by using the public right of way that crosses the site.

The site consists of about six fields used for agricultural purposes. The landscape is undulating hillside.

A signed formal Public Right of Way (PROW) footpath gains pedestrian access to the site through the garden of Wellgill Cottages. A small track adjacent to the garden leads up to the first field.

The ground is generally quite boggy and wet under foot. The fields are divided by existing dry stone walls.

The site is surrounded by several adjacent residential properties, Strellas Cottage, Wellgill Cottages and Pry House being the closest.

Figure 3.2 View of Site 23 from the East



3.2 Existing Topographical and Level Characteristics

Topographical information has been obtained from OS mapping and field observation. The fields have gradients of between 1:6 to 1:10 sloping down from east to west. The contour level difference across the site ranges from 450mAOD to 410m AOD at Gudham Gill. The existing gated access point has an approximate road level of 425mAOD.

The two fields to the west nearest the River Nent are very steep with a crest in the middle and the west side sloping steeply down to Strellas Cottage. This area is unsuitable for siting a MWTS.

The two central fields have a central depression with moderately steep sides to the west and east. The central depression is water logged. These fields are used as a paddock. At the west end the terrain becomes very steep as the ground level falls to Gudham Gill. The soil here is very soft and fine and consequently a deep gully has been eroded by water draining off the fields. There are also numerous rabbit burrows. For these reasons a proposed MWTS layout will need to avoid this northern end of the central fields. These two fields are approached through a narrow access adjacent to Wellgill Cottages. This entrance could be upgraded to form a suitable access.

Figure 3.3 Eroded Deep Gully to Gudham Gill



The top two fields are less steep but higher up and further away with limited access and as such are not as suitable for siting the MWTS as the central two fields.

Overall the site is relatively steep and as such will require more involved earthworks and earth retaining structures and land take to accommodate longer cuttings and embankments. For this reason it is considered that the ponds and reed beds would need to be rationalised to just 2 ponds and one reed bed.

3.3 Existing Public Utilities

Electricity – Electricity North West

Overhead 11kV HV cables run across the site. An LV supply both below ground and above ground, supply Wellgill cottages. The 11kV overhead cables will need to be diverted to accommodate the MWTS. If there is sufficient capacity in the LV supply then it could be used to supply the MWTS. Otherwise the existing 11kV overhead cable could provide a supply for the site via an on site sub-station for the odour control equipment and return pumping station. The new LV mains would be laid in a designated service corridor within the proposed development site. The indicative cost plan assumes a substation will be required.

Gas – Northern Gas

Northern Gas indicated that there are no marked apparatus within the site boundary or adjacent land that will be affected by the proposals for Site 23.

Potable Water – United Utilities

United Utilities (UU) indicated that there is no marked apparatus within the site boundary or adjacent land that will be affected by the proposals for Site 23. However it is likely that there will be a potable supply to Wellgill Cottage that is not marked on UU plans. A potable water connection will be required for the site, both for construction and for the toilet and washroom site facilities. The nearest marked potable supply is at Pry House and so a supply will need to be brought across the fields to the proposed MWTS site. The indicative cost assessment does not include an allowance for reinforcement of the local water network.

Sewerage – Northumbrian Water

Northumbrian Water (NW) indicated that there is no sewerage in the area. The nearest sewer is a combined sewer at the A689. There is a sewage treatment works on the lane down to the A689 so it is possible that a connection could be laid to this works or alternatively a septic tank will be required.

Telecoms – BT Openreach

BT Openreach indicates that above ground cabling is adjacent to the site with a pole at the entrance to Wellgill Cottage. Underground cabling is in the lane running down to Strellas Cottage. No BT Openreach apparatus will need to be diverted as part of the works. A BT Openreach connection could be taken from the existing pole. The availability and speed of a broadband connection will need to be confirmed.

3.4 Access Constraints

The most likely site access route will be the development of a field track off the access lane to Wellgill Cottages. This access lane starts at the A689 and the first 500m is suitable for heavier vehicles as it serves the local sewage treatment works but is not tarmacked and would need upgrading. The junction with A689 has poor visibility to the right for emerging vehicles as the view is restricted by the bend in the road for the River Nent bridge crossing. The final 150m of the lane as it approaches the proposed site entrance provides access to residential properties only and would need to be upgraded for construction and operational vehicles. Presently there is no turning point so turning facility would need to be provided within the site.

Figure 3.4 Access Lane and Entrance to Field Track



3.5 Flooding Potential

The site is located outside a fluvial flooding zone. However, land drainage is likely to be required to minimise localised groundwater flooding in areas where paths and access will be provided. A **surface water** drainage system will be required to manage surface water run-off from the MWTS.

3.6 Ecology Constraints

Refer to BN01 – Ecology Review of Shortlisted Sites for more information.

The site is mainly grazing. Referring to MAGIC the woodland area to the north west adjacent to the Gudham Gill is identified in the National Forest Inventory as mainly coniferous. Numerous rabbit burrows were encountered just south of this woodland.

It is recommended that a Phase 1 Habitat survey be undertaken to identify ecological features within and in the environs of the site.

3.7 Existing Public Rights of Way

The Cumbria County Councils online “Definitive Map” shows that a footpath route crosses the western part of the proposed site (see fig. 3.1). Although signed the route across the fields is not well defined. This footpath links to a wider network of public rights of way, with links to the A689 and the wider valley. The public footpath will require temporary diversion during the construction phase and reinstatement upon completion.

3.8 Land Ownership

Land ownership has not been established as part of this report but it is assumed that the fields are either owned by or leased to the local farms for grazing.

3.9 Other Design Considerations

The pond layout is based on a Vertical Flow Pond (VFP) solution. Significant issues which will influence the design include:

- Odour – There are residential properties located all around the proposed MWTS site and these are potential receptors of the hydrogen sulphide odour.

The distance from the point where H₂S is most likely to be released (between the VFPs and wetland) is summarised below:

- To public footpath 60 m
- To property to the south 70 m
- To property to the northwest 160 m
- To property to the west 170 m
- To property to the east 200 m
- To A689 320 m

The siting of the odour treatment works and buildings will require consideration to minimise noise and visual impact.

- Planning / EIA – An Environmental Impact Assessment may be required as part of the planning process.
- Highways – Site traffic and installation of the rising mains would have an impact on the existing highways and approval and agreement will need to be negotiated with local highway authority.
- Landscape – The most suitable area for siting the MWTS is in the central two fields. Due to the sloping topography of the site an efficient arrangement for the ponds will be to form two ponds and site them in the central depression. Similarly due to topography and space constraints there would be a single reed bed at the lowest point of the site toward the north end. The facilities building and hardstandings will be at the site entrance. Because of the undulation of the ground the facility would not be so visible except to Wellgill Cottages and Pry House. A modest amount of screening will be necessary along the east and south boundaries. Security fencing will be required.

3.10 Indicative Proposals

The following section should be read in conjunction with FIGURE 2 – SITE 23, in Appendix B2.

3.10.1 Proposed Layout

General details regarding the layout are shown on the Site Plan and the description in section 2.0.

The site access from the lane would need to be upgraded to accommodate both construction vehicles in the interim and operational vehicles in the long term. Therefore the lane would need to be widened and constructed with a heavy duty construction. The access itself is a narrow strip of green land that will also need to be widened and constructed with a heavy duty construction. It may also be necessary to upgrade the junction with the A689 subject to discussions with the Highway Authority.

The rising main distance will be approximately 1.1 km and the water will need to be lifted from 430mAOD to 435 mAOD, a height difference of just 5m. The route of the rising main would need to be confirmed during detailed design phase, but it is assumed that it can be laid along the A689, turn up the access lane and continue along this lane to the site entrance. This is an undulating route with 2 high points along the route. The low point of the rising main will be at the junction on the A689 just before the bridge. At this point a drainage point should be provided to allow the rising main to be fully drained for maintenance purposes. The route goes through the centre of the village and will encounter existing utilities within the A689 at various locations along the route.

As discussed in Section 2.0 the site will include the two stone-clad building and a network of grasscrete access tracks to provide vehicular access around the ponds. Because of the slope of the site the ponds will need to be cut into the slope and built up on the down slope. The earthworks will be designed to balance the cut and fill and minimise the surplus material assuming design slopes of approximately 1 in 3. Treated water will be returned to the outfall by the same route as the rising main. Because the route is undulating it is likely that this return flow will also need to be pumped and so the pipe will be a rising main too and can be laid in the same trench as the incoming main. A pump station will be required on site and is likely to a wet well type design.

An emergency overflow drain would, subject to EA consent, discharge to Gudham Gill.

3.10.2 Potential Options for the Site 23 Scheme

A number of options could be considered to the scheme proposed. These include the following:

- Relocation of the southern pond away from Wellgill Cottages.
- Extend the site eastward to create more space – however the topography becomes increasingly difficult.
- Combine buildings into a single, larger building.

3.10.3 Health and Safety Considerations

The Health and Safety aspects of the construction, operation and maintenance of the site include the following key considerations:

- Junction at the A689 has poor visibility.
- Laying the rising mains in the A689 and through Nenthead will require careful traffic management and identification and protection of existing services.
- PROW access through the treatment site during construction and operation will need to be restricted and clear signage required to direct walkers.

3.11 Indicative Costs

The following table summarises the key infrastructure costs associated with Site 16 Feasibility Layout.

Table 3.2 Site 23 Indicative Cost Estimates	
Item Description	Estimated Costs
General Site Clearance (2)	£350,966
General Earthworks	£516,914
Vertical Flow Ponds	£255,465
Wetlands	£21,312
Mine water Drainage Infrastructure	£125,652
Access Tracks/Paths	£506,400
Aeration Cascades	£15,000
Pumping Arrangements	£890,696
Buildings	£100,000
Odour Dosing	£50,000
Landscaping	£204,426
Public Utility Costs – supply (6)	£31,000
Public Utility Costs – diversion	£50,000
Sub-total	£3,117,831
Site Abnormal (7)	£500,000
Preliminaries (30%) (8)	£1,085,349
Contingencies (10%)	£470,318
Total	£5,173,499

Notes on Site 23 indicative cost estimate:

1. The indicative cost estimate is based on the SPONS price book (2017) and a general overview of current market prices. Without a full detailed design and actual competitive market rates, the indicative cost estimate should be used for guidance and comparison purposes only. TCA cannot accept liability for any variation between the construction

cost estimate and the 'actual' contract value. Further breakdown of the cost estimate is given in Appendix A.

2. Existing ground conditions are unknown. An allowance of £100,000 has been made in the cost estimate for site dewatering and working in poor, water bearing ground.
3. No allowance is made for any land purchase.
4. No allowance is made for professional consultant fees, planning fees or legal fees.
5. No allowance is included for operational costs or the costs associated with the removal/replacement of compost material.
6. Public utility costs are based on experience of similar schemes only; quotes have not been obtained from utility companies at this stage. It is assumed that the only utilities diversion required is the diversion of the overhead 11kV lines.
7. Because Site 23 is very close to residents an allowance has been applied to this site for the risk of additional costs related to potential planning conditions.
8. A percentage has been applied to cover preliminaries based on a judgement on the accessibility and ease of construction for the site. For Site 23, as well as the remoteness of the area and the adverse seasonal weather conditions, we consider that the site will be more difficult to access and presents challenging ground conditions. For these reasons an allowance of 30% for preliminaries has been applied.

3.12 Site 23 Summary and Conclusions

The desk study and site visit identify the following benefits and disadvantages of site 23:

Benefits:

- No evidence of significant historical mining features such as shafts or adits.
- The site area does not include any SAM or SSSI designations.
- No features of ecological concern are apparent on the site.
- Ground likely to be soft and easily cut and filled with less risk of hard dig being encountered.
- Readily available power supply and good potential for potable water supply and telecoms.
- Construction and operational traffic approaching the site from the west (Penrith) will not need to go through the village.
- The site level is roughly equivalent to the level at the adit discharge and therefore the pumped hydraulic head will be minimal.
- The site will be partially obscured from the A689.

Disadvantages:

- The site will be very visible from a number of receptors – in particular the nearby residential properties.
- The potential for odour in close proximity to residential properties could result in considerable local objections.
- Odour mitigation in the form of a combination of hydrogen peroxide and ozone dosing, and trickle filtering are likely to be required.
- The mine water discharge will need to be pumped from the adit to the MWTS for a distance of 1.1 km.
- The pipeline routes need to be routed along or in the highway.

- Laying of the pipelines in the highway will be disruptive to traffic and residents.
- Formal agreements will need to be entered into with the Highway Authority to lay the rising mains / transfer pipes within the highway.
- The pipeline route is undulating and therefore the return pipeline will also need to be pumped requiring an additional pumping station installation at the MWTS site.
- Noise from the return pumping station will need to be assessed and noise mitigation may be required.
- The site is water logged and will require dewatering and careful handling of excavated materials to ensure workable site conditions and minimizing off-site disposal due to spoiling of site soil.
- The site is sloping requiring more cut and fill to create plateaus to accommodate the ponds.
- The ponds and reed bed sizes and shapes are compromised due to lack of suitable space.
- The access route and potential site entrance need significant upgrade to accommodate construction and operational vehicles.

3.13 Site 23 Recommendations and Further Studies

Site 23 could be used for the MWTS but has a number of disadvantages that make it more costly than sites 100 and 101. Foremost amongst these is the route of the pipework between the adit and the site and close proximity to residential receptors.

The following studies/additional works are recommended to further assess the viability of the site, and remove some elements of risk.

1. A full topographical survey of the site to confirm existing levels and features.
2. Conceptual Earthworks Strategy to confirm potential developable platform areas, cut/fill balances and landscaping / visual mitigation requirements.
3. Transportation study to evaluate the junction with the A689 and scope the upgrades required to make this junction safer for vehicles entering onto the A689.
4. Phase 1 ecology survey.
5. Ground investigation to confirm existing ground water levels and ground conditions.
6. More detailed options study to assess the most cost effective route for the pipelines.
7. Establish land ownership and potential to purchase.

4.0 Site 100

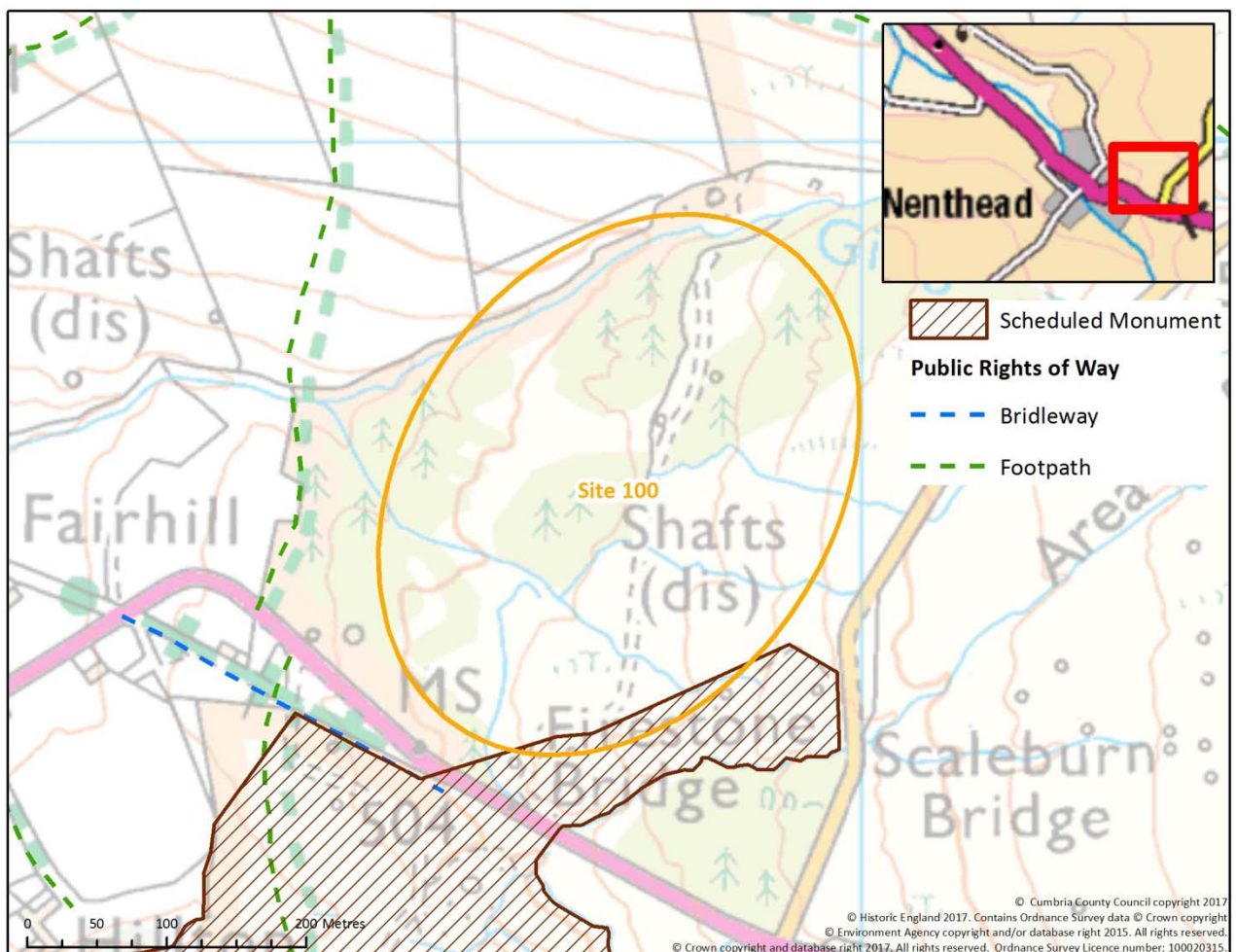
Site 100 is located 0.7km to the east of Nenthead. The site selection area is mostly moorland with some woodland to the western fringes. The eastern edge of the site is steeply sloping up to the Coalcleugh road. The southern edge is bounded by the A689. The area to the north is Site 43 which was considered in report TN06. To the west the woodland becomes increasingly dense and as such is considered to be a constraint on potential development of Site 100.

An overview of the site suggests that the central area offers best potential for siting a MWTS.

Table 4.1 General Site Details

Name	Site 100
Location	Nenthead
Nearest postcode	CA9 3PN
OS NGR	378737E 543463N
Current Land Use	Woodland/Moorland
Land Owner	Local landowner (TBD) / Weardale Estate

Figure 4.1 Site 100 Location, Designations and Public Access



4.1 Site Visit

Peter Terry and Andrew Brookes of TCA, visited the site and surrounding area on 9 April 2018. The weather on the day of the visit was warm and dry with dispersed clouds. Access to the site was obtained by using the public right of way that skirts the western edge of the site. Access to the central area was not possible and a view of it was taken from the edge of the woodland.

The site consists of moorland and woodland with only a small area adjacent to A689 used as a site for two mobile phone mast. The topography is undulating hillside.

Figure 4.2 View of Site 100 from the Coalcleugh Road



A signed formal Public Right of Way (PROW) footpath gains pedestrian access to the western edge of the site From the A689. A short gated track off the A689 gives access to masts and then traverses the site south to north but this track is indistinct and overgrown.

Three watercourses run across the site from the hillsides to the east of the Coalcleugh road. The ground is generally quite boggy and wet under foot.

There are three nearby residential receptors within a few hundred metres to the west of the site. These include Hilltop Cottage, Eastern House, Thornleigh, Granary Cottage, and Fairhill Farm. Granary Cottage is the closest at 250m from a likely position of the nearest pond outfall.

4.2 Existing Topographical and Level Characteristics

Topographical information has been obtained from OS mapping and field observation. The site is in most part relatively steep with gradients of between 1:6 to 1:10 sloping down from east to west. The contour level difference across the site ranges from 540mAOD to 480m AOD at Gillgill Burn. The existing gated access point has an approximate road level of 505mAOD at the A689.

The eastern area from the junction with the A689 and up along the Coalcleugh road is a very steep bank with gullies cut by the watercourses coming down from the east. This area is unsuitable for siting a MWTS.

There is a central area in the vicinity of the track that is less steep and could accommodate the ponds with some earthworks cutting and filling but this area is quite boggy.

The western side becomes more densely wooded and undulating and is not so suitable as the central area for siting a MWTS.

Overall the site is relatively steep and as such will require more involved earthworks and earth retaining structures and land take to accommodate longer cuttings and embankments. For this reason it is considered that the reed beds would need to be rationalised to just one reed bed.

4.3 Existing Public Utilities

Electricity – Electricity North West

The only electricity utility in the site area is an LV supply for the telecommunications masts. This supply is fed underground from the A689. Provided there is sufficient capacity in the supply it could be extended to serve the MWTS. If there is insufficient capacity there is an 11kV overhead supply on the A689.

Gas – Northern Gas

Northern Gas confirmed that there is no existing apparatus within the site boundary or adjacent land that will be affected by the proposals for Site 100.

Potable Water – United Utilities

United Utilities (UU) indicated that there are no water supply pipes within the site. There are two water pipes in the A689, a three inch water distribution main and a 150mm ductile iron trunk main. A potable water supply for the site could be obtained by connecting into the existing distribution main located within the verge of the A689.

Sewerage – Northumbrian Water

Northumbrian Water (NW) indicated that there is no sewerage in the area. The nearest sewer is a combined sewer at Thornleigh.

Telecoms – BT Openreach

BT Openreach indicated that above ground cabling is located in the adjacent A689 corridor. It services the masts and is located within the northern verge. Underground cabling runs from the pole adjacent to the access gate up to the masts. This supply could be extended to serve the MWTS. However the availability and speed of a broadband connection will need to be confirmed.

4.4 Access Constraints

The most likely site access will be the access off the A689 that serves the masts. This is a gated access and is suitable for heavier vehicles. However the gate would need to be relocated further up the track to allow vehicles to turn onto the access before stopping to open the gate. The track is just a stone track and would need upgrading to tarmac. The junction with A689 has good visibility but traffic is likely to be travelling at around 60mph. Presently there is no turning point so turning facility would need to be provided within the site.

Figure 4.3 Existing Gated Access to Site 100 Serving the Masts



4.5 Flooding Potential

The site is located outside a fluvial flooding zone. However, land drainage is likely to be required to minimise localised groundwater flooding in areas where paths and access will be provided. A surface water drainage system will be required to manage surface water run-off from the MWTS.

4.6 Mining Features

The area has historically been used for lead mining and there appears to be a number of mine shafts in the area. Peter Jackson of the Nenthead Mines Conservation Society has advised that there are a lot of underground mine workings in this area. The south east corner of the site is part of the Scheduled Ancient Monument designation.

4.7 Ecology Constraints

Refer to BN01 – Ecology Review of Shortlisted Sites for more information.

Apart from the masts and the PROW there is no human activity in this area and the woodland is very well established. Referring to MAGIC the woodland areas are included in the National Forest Inventory.

It is likely that Red Squirrels are present in the wood as well as many bird species. On the occasion of the site visit grouse was observed and a deer was seen crossing the moorland and going into the wood. The site is suitable habitat for both amphibians and reptiles.

Figure 4.4 View Illustrating Varied Ecology



It is recommended that a phase 1 habitat survey be undertaken to identify ecological features within the site.

4.8 Existing Public Rights of Way

The Cumbria County Councils online "Definitive Map" shows that a footpath route crosses the western part of the proposed site (refer to figure 4.1). Although signed the route through the woods is not well defined. This footpath links to a wider network of public rights of way, with links to the A689 and the wider valley. The public footpath will not be affected by the proposed location of the MWTS.

4.9 Land Ownership

Land ownership has not been established as part of this report and no approach has been made to any land owners. However it is understood from local knowledge that the western part is owned by a local landowner and the eastern part is owned by the Weardale Estate. We have been advised that the local landowner would not be willing to sell any land.

4.10 Other Design Considerations

The pond layout is based on a Vertical Flow Pond (VFP) solution. Significant issues which will influence the design include:

- Odour – There are residential properties located to the west of the proposed MWTS site and these are potential receptors of the hydrogen sulphide odour.

The distance from the point where H₂S is most likely to be released (between the VFPs and wetland) is summarised below:

- To public footpath 190 m west
- To property to the west, Granary Cottage, 240m
- To property to the west, Fairhill Farm, 320m
- To property to the west, Thornleigh, 340m
- To A689, 140 m south

The siting of the odour treatment works and buildings will require consideration to minimise noise and visual impact.

- Planning / EIA – An Environmental Impact Assessment may be required as part of the planning process.
- Mining Features – historic mining features will influence the layout of the MWTS. Some of these features will need to be capped or filled. An archaeology watching brief may be required.
- Watercourses – A number of watercourses traverse the site and will need to be engineered or diverted around the MWTS features.

- Highways – Site traffic and installation of the rising mains would have an impact on the existing highways and approval and agreement will need to be negotiated with local highway authority.
- Landscape – The most suitable area for siting the MWTS is in the central area where the sloping ground is less onerous. Due to the sloping topography of the site an efficient arrangement for the ponds will be to form three ponds and site them parallel to the contours and between the watercourses. Similarly due to topography and space constraints there would be a single reed bed at the lowest point of the site. The facilities building and hardstandings will be at the site entrance. Because of the undulation of the ground and presence of the woodland the facility would be less visible and easier to obscure. Security fencing will be required.

4.11 Indicative Proposals

The following section should be read in conjunction with FIGURE 3 – SITE 100, Appendix B3.

4.11.1 Proposed Layout

General details regarding the layout are shown on the Site Plan and the description in section 2.0.

Agreement would need to be negotiated with the landowners and mast operators to share the access from the A689. The site access would need to be upgraded to accommodate both construction vehicles in the interim and operational vehicles in the long term. Therefore the track would need to be widened and constructed with a heavy duty construction. The access gate will need to be moved to create space for vehicles to turn in and constructed with a heavy duty construction. It may also be necessary to upgrade the junction with the A689 subject to discussions with the Highway Authority.

The rising main distance will be approximately 0.8 km and the water will need to be lifted from 430mAOD to 530mAOD, a head difference of 100m. The route of the rising main would need to be confirmed during detailed design phase, but it is assumed that it can be laid up the access track to the mine museum, through to the quarry track, and then in the verge of the quarry track to the A689 where it will cross the road and enter the site.

There will be two stone-clad buildings to accommodate welfare and odour control, and a network of grasscrete access tracks to provide vehicular access around the ponds. Because of the slope of the site the ponds will need to be cut into the slope and built up on the down slope. The earthworks will be designed to balance the cut and fill and minimise the surplus material assuming design slopes of approximately 1 in 3.

Treated water will be returned to the outfall by the same route as the rising main. This will be a small diameter gravity pipe with chambers at regular intervals and changes in direction.

An emergency overflow drain would, subject to EA consent, discharge to Gillgill Burn.

4.11.2 Health and Safety Considerations

The Health and Safety aspects of the construction, operation and maintenance of the site include the following key considerations:

- Junction at the A689 has good visibility but it is relatively fast section of road.

4.12 Indicative Costs

The following table summarises the key infrastructure costs associated with Site 100 Feasibility Layout.

Table 4.2 Site 100 Indicative Cost Estimates	
Item Description	Estimated Costs
General Site Clearance (2) (9) (10)	£868,340
General Earthworks (11)	£509,080
Vertical Flow Ponds	£255,465
Wetlands	£21,312
Mine water Drainage Infrastructure	£125,652
Access Tracks/Paths	£507,784
Aeration Cascades	£15,000
Pumping Arrangements	£466,845
Buildings	£100,000
Odour Dosing	£50,000
Landscaping	£213,609
Public Utility Costs – supply (6)	£31,000
Public Utility Costs – diversion	£0
Sub-total	£3,164,085
Site Abnormal (7)	£500,000
Preliminaries (25%) (8)	£916,021
Contingencies (10%)	£458,011
Total	£5,038,118

Notes on Site 100 indicative cost estimate:

1. The indicative cost estimate is based on the SPONS price book (2017) and a general overview of current market prices. Without a full detailed design and actual competitive market rates, the indicative cost estimate should be used for guidance and comparison purposes only. TCA cannot accept liability for any variation between the construction cost estimate and the 'actual' contract value. Further breakdown of the cost estimate is given in Appendix A.
2. Existing ground conditions are unknown. An allowance of £200,000 has been made in the cost estimate for site dewatering and working in poor, water bearing ground.
3. No allowance is made for any land purchase.

4. No allowance is made for professional consultant fees, planning fees or legal fees.
5. No allowance is included for operational costs or the costs associated with the removal/replacement of compost material.
6. Public utility costs are based on experience of similar schemes only; quotes have not been obtained from utility companies at this stage.
7. Because Site 100 is in an ecologically sensitive area and also has a number of historical mine features an amount for "site abnormalities" has been applied to this site to make an allowance for the risk of additional costs related to ecology and preservation of mining heritage.
8. A percentage has been applied to cover preliminaries based on a judgement on the accessibility and ease of construction for the site. For Site 100, as well as the remoteness of the area and the adverse seasonal weather conditions, we consider that the site will presents challenging ground conditions. For these reasons an allowance of 25% for preliminaries has been applied.
9. An allowance of £50,000 has been made for watercourse diversions.
10. An allowance of £100,000 has been included for stabilising mine features such as adits or shafts.
11. Due to the presence of historical mining features an allowance of £300,000 has been made for archaeology during the works.

4.13 Site 100 Summary and Conclusions

The desk study and site visit identify the following benefits and disadvantages of site 100:

Benefits:

- The site area does not include any SAM or SSSI designations.
- Readily available power supply and good potential for potable water supply and telecoms.
- The site will be partially obscured from the A689.
- The access off the A689 is suitable provided that shared access can be negotiated.
- The pipeline routes are mainly along tracks rather than in the highway

Disadvantages:

- The use of the site may be obstructed by local landowners.
- A number of features of ecological concern are apparent on the site.
- Presence of significant historical mining features such as shafts or adits.
- The site is sloping requiring more cut and fill to create plateaus to accommodate the ponds.
- The ponds and reed bed sizes and shapes are compromised due to lack of suitable space.
- The site is water logged and will require dewatering and careful handling of excavated materials to ensure workable site conditions and minimizing off-site disposal due to spoiling of site soil.
- The mine water discharge will need to be pumped from the adit to the MWTS for a distance of 0.8 km.
- The potential for odour in close proximity to residential properties could result in considerable local objections.

- Odour mitigation in the form of a combination of hydrogen peroxide and ozone dosing, and trickle filtering are likely to be required.
- The site entrance needs to be upgraded to accommodate construction and operational vehicles.

4.14 Site 100 Recommendations and Further Studies

Site 100 could be used for the MWTS but has a number of significant disadvantages that make it more costly than site 101. Foremost amongst these is the ownership of the land, the ecology of the site, the presence of mine workings and the water logged ground.

The following studies/additional works are recommended to further assess the viability of the site, and remove some elements of risk.

1. Establish land ownership and potential to purchase.
2. Phase 1 ecology survey
3. A desk study on mining activity in the site area.
4. A full topographical survey of the site to confirm existing levels and features.
5. Conceptual Earthworks Strategy to confirm potential developable platform areas, cut/fill balances and landscaping / visual mitigation requirements.
6. Ground investigation to confirm existing ground water levels and ground conditions.
7. Transportation study to evaluate the junction with the A689 and scope the upgrades required to make this junction safer for vehicles entering onto the A689.

5.0 Site 101

Site 101 is located 0.9km to the south east of Nenthead. The site selection area is mostly grassland and post-industrial. The western edge of the site is steeply sloping down to the mine museum. The northern edge is bounded by the A689. The area to the east is open countryside. The southern edge is the quarry track with the Smallcleugh Mine SSSI beyond.

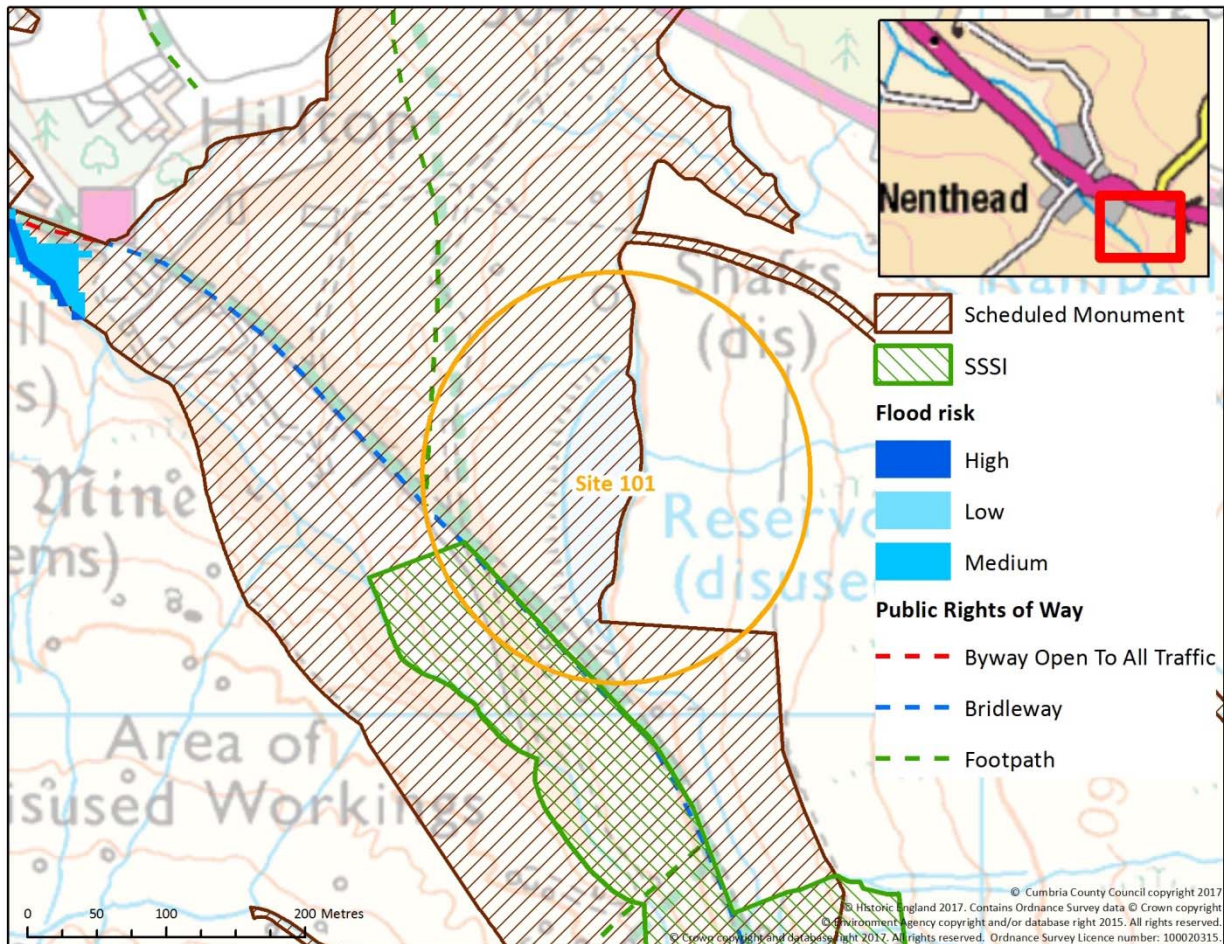
A predominant feature of the site is the Handsome Mea reservoir.

An overview of the site suggests that the area to the east and west of the reservoir offers best potential for siting a MWTS.

Table 5.1 General Site Details

Name	Site 101
Location	Nenthead
Nearest postcode	CA9 3NR
OS NGR	378591E 543232N
Current Land Use	Grassland
Land Owner	Cumbria District Council

Figure 5.1 Site 101 Location, Designations and Public Access



5.1 Site Visit

Peter Terry and Andrew Brookes of TCA, accompanied by Hugh Potter (EA) and Peter Jackson (NMCS) visited the site and surrounding area on 9 April 2018. The weather on the day of the visit was warm and dry with dispersed clouds. Access to the site was obtained by using the bridleway that becomes the quarry road up from the Nenthead Mines Museum.

The site consists of grassland to the east of the reservoir and post-industrial landscape to the west of the reservoir. The area is open country and not used for agriculture or livestock grazing. A quarry track skirts the western and southern edges and is in regular use.

Vehicular access is by the quarry track which has a junction with the A689 east of Nenthead. A formal Public Right of Way (PROW) footpath crosses the site from north to south and a bridleway comes up from the mine museum and joins the quarry track which continues up to Flinty Fells.

Figure 5.2 View of Site 101 from Handsome Mea Reservoir



Two pipelines traverse the site from the reservoir down to the hydro power station at the mine centre. There are a number of historical mine features such as leats, shafts, crown holes, adits and tips. A predominant feature is the old course of the chimney flue, a long stone built derelict flue structure that runs at ground level up the hillside. This feature is a Scheduled Ancient Monument SAM, as is a large part of the western half of the site.

The site is sloping and undulating and the grassland areas are boggy.

Nearby receptors within a five hundred metres of the site, to the west, include Mill Cottage, Hilltop Cottages, Nenthead House, Eastern House, Thornleigh, and Granary Cottage.

5.2 Existing Topographical and Level Characteristics

Topographical information has been obtained from OS mapping and field observation. The site is sloping with gradients of between 1:6 to 1:10 sloping down from east to west. The contour level difference across the site ranges from 510mAOD to 480m AOD. The existing reservoir is at approximately 495m AOD.

The area to the west nearest the mine museum has been worked and re-shaped by mining activity and is very undulating and is not so suitable for siting a MWTS.

5.3 Existing Public Utilities

Electricity – Electricity North West

ENW have indicated that there are no cables in the actual site area. There is an 11kV overhead supply at the A689 that crosses the site entrance. The nearest LV supply is at the Mill Cottage. Provided there is sufficient capacity in the supply it could be extended to serve the MWTS. If there is insufficient capacity a supply would have to be taken from the 11kV overhead supply on the A689. The indicative cost plan assumes the latter.

Gas – Northern Gas

Northern Gas confirmed that there is no existing apparatus within the site boundary or adjacent land that will be affected by the proposals for Site 101.

Potable Water – United Utilities

United Utilities (UU) indicated that there are no water supply pipes within the site. There are two water pipes in the A689, a three inch water distribution main and a 150mm ductile iron trunk main. A potable water supply for the site could be obtained by connecting into the existing distribution main located within the verge of the A689.

Sewerage – Northumbrian Water

Northumbrian Water (NW) indicated that there is no sewerage in the area. The nearest sewer is a combined sewer at Hilltop Cottages.

Telecoms – BT Openreach

BT Openreach indicated that above ground cabling is located in the A689. It services the masts and is located within the northern verge. Above ground cabling is also located at Mill Cottage and the mine museum. This supply could be extended to serve the MWTS. However the availability and speed of a broadband connection will need to be confirmed.

5.4 Access Constraints

Figure 5.3 Quarry Access Track



The most likely site access will be the access off the A689 that serves the quarry road. This is a gated access and is suitable for heavier vehicles. The junction with A689 has good visibility but traffic is likely to be travelling at around 60mph.

5.5 Flooding Potential

The site is located outside a fluvial flooding zone. However, land drainage is likely to be required to minimise localised groundwater flooding in areas where paths and access will be provided. A surface water drainage system will be required to manage surface water run-off from the MWTS.

5.6 Mining Features

The area has historically been used for lead mining and there appears to be a number of mine shafts, adits and leats in the area. The mineworkings are mainly to the west of the site.

A large part of the site is scheduled under the Ancient Monuments and Archaeological Areas Act 1979. For further information refer to Historic England:

<https://historicengland.org.uk/listing/the-list/list-entry/1015858>

The Smallcleugh Mine SSSI is important because the site has surface and underground exposures of flat type orebodies in limestone and significant mineral are present.

Figure 5.4 Examples of Leats



A meeting was held with Andrew Davidson, Inspector of Ancient Monuments, Historic England, on 18th April 2018 to discuss the impact of the proposed MWTS on historic mining features. From Historic England position the feasibility plan is broadly acceptable assuming appropriate measures to preserve archaeology will be put in place (to be agreed with Historic England in later stages of design) and assuming Nenthead Mines Conservation Society are also in agreement. The scheme design will be designed to conserve archaeology wherever possible. The access road route is preferred from the North side as the archaeology in this area is of less value than the south side of the reservoir. Pipeline construction may need an archaeological watching brief and buildings should be visually sympathetic to surrounding architecture and area. There is a strong preference for ponds to be located outside the ancient monument. The reedbed is acceptable in the ancient monument, as shown, due to the smaller and less visually intrusive nature. Drainage

improvements to the mines site are welcomed as a way of reducing erosion of heritage. Consideration should be given to restoration/improvement of historic leats in any drainage scheme. Acceptable methods for reducing erosion of mining spoil include retaining walls (with local stone and appearance if re-building old wall or visually non-intrusive engineering for a new wall), vegetation of slopes (where possible) and timber barriers.

The proximity to Nenthead Mines Museum affords an opportunity to partner with the museum to offer a visitor experience that includes the MWTS. This would require purpose made pedestrian access to parts of the MWTS with information boards and guard railing and perhaps other educational displays and experiences.

5.7 Ecology Constraints

Refer to BN01 – Ecology Review of Shortlisted Sites for more information.

Referring to MAGIC the area to the west of the reservoir is Priority Habitat Inventory for England Calaminarian Grassland. The area to the east is non priority grassland. Breeding grounds for birds include lapwing, curlew, snipe and black grouse.

The Smallcleugh Mine is designated SSSI because of its geological interest and is selected as the largest and most detailed example of limestone flat-type mineralisation in the country, and is the only site for the minerals melanterite and epsomite.

On the occasion of the site visit grouse was observed. The site is suitable habitat for both amphibians and reptiles.

It is recommended that a Phase 1 ecology survey be undertaken to identify ecological features within the site.

5.8 Existing Public Rights of Way

The Cumbria County Councils online “Definitive Map” shows that a footpath route crosses the proposed site from north to south (refer to figure 5.1). The public footpath may need temporary diversion during the construction of the MWTS.

5.9 Land Ownership

The site is understood to be in the ownership of Cumbria County Council and there are discussions ongoing about the possibility of transferring the ownership to NMCS.

5.10 Other Design Considerations

The pond layout is based on a Vertical Flow Pond (VFP) solution. Significant issues which will influence the design include:

- Odour – There are residential properties located to the west of the proposed MWTS site and these are potential receptors of the hydrogen sulphide odour.

The distance from the point where H₂S is most likely to be released (between the VFPs and wetland) is summarised below:

- To public footpath – on the proposed MWTS boundary
- To property to the west, Mill Cottage, 380m
- To property to the west, Hilltop Cottages, 390m
- To property to the west, Granary Cottage, 430m
- To A689, 230 m north

The siting of the odour treatment works and buildings will require consideration to minimise noise and visual impact.

- Planning / EIA – An Environmental Impact Assessment may be required as part of the planning process.
- Mining Features – historic mining features will influence the layout of the MWTS. Some of these features will need to be preserved protected or recorded and others may need to be capped or filled.
- Pipelines – Two pipelines traverse the site and will need to be avoided or diverted around the the MWTS features.
- Highways – Pipelines will be in private land and will not need to be laid in highway.
- Landscape – The most suitable area for siting the MWTS is in the area east and west of the reservoir where the sloping ground is less onerous.
- Materials – The site is adjacent to a quarry and there could be opportunity to use locally quarried materials in the works. This could include using stone blocks or gabions to form vertical sides to the ponds thus reducing land take up, extent of service tracks and pipework.

5.11 Indicative Proposals

The following section should be read in conjunction with FIGURE 4 – SITE 101, Appendix B4.

5.11.1 Proposed Layout

General details regarding the layout are shown on the Site Plan and the description in section 2.0.

Agreement would need to be negotiated with the landowners and quarry operators to share the access from the A689.

The rising main distance will be approximately 0.8 km and the water will need to be lifted from 430mAOD to 530 mAOD, a head difference of 100m. The route of the rising main

would need to be confirmed during detailed design phase, but it is assumed that it can be laid up the access track to the mine museum, through to the quarry track, and then in the verge of the quarry track to the MWTS entrance.

The proposed layout of the MWTS has been designed to bring the scheme as far down the hillside as possible for three reasons:

- Reduce the rising main length and hydraulic head.
- Bring the MWTS nearer to the present mine museum to enhance the potential for the MWTS to be part of a visitor educational experience.
- Minimise the visual impact by siting the MWTS lower on the hillside.

There is however a potential concern that the layout places the reed beds within the Scheduled Ancient Monument area. This has been discussed with Historic England with an understanding that the impact could be acceptable.

There will be two stone-clad buildings to accommodate welfare and odour control, and a network of grasscrete access tracks to provide vehicular access around the ponds. Because of the slope of the site the ponds will need to be cut into the slope and built up on the down slope. The earthworks will be designed to balance the cut and fill and minimise the surplus material assuming design slopes of approximately 1 in 3.

As mentioned in 5.10 locally sourced stone could be used to form the pond sides.

Treated water will be returned to the outfall by the same route as the rising main. This will be a small diameter gravity pipe with chambers at regular intervals and changes in direction.

An emergency overflow drain would, subject to EA consent, discharge to Handsome Mea reservoir.

There may be an option to agree a discharge of treated water to the reservoir outfall pipe that runs down to the River Nent.

5.11.2 Potential Options for the Site 101 Scheme

A number of options could be considered to the scheme proposed. These include the following:

- Relocation of the reed beds out of the SAM area.
- Use the existing pipelines to return flow to the river.
- Use power from the hydroelectric plant.
- Create a visitor educational experience.
- Use locally sourced stone to build pond walls and service tracks.

5.11.3 Health and Safety Considerations

The Health and Safety aspects of the construction, operation and maintenance of the MWTS that are particular to Site 101 include:

- The existing mine workings could present a hazard and all shafts would need to be identified and cordoned off at commencement of the works.
- Traffic using the quarry road.

5.12 Indicative Costs

The following table summarises the key infrastructure costs associated with Site 101 Feasibility Layout.

Table 5.2 Site 101 Indicative Cost Estimates	
Item Description	Estimated Costs
General Site Clearance (2) (9) (10)	£484,348
General Earthworks (11)	£269,853
Vertical Flow Ponds	£255,465
Wetlands	£21,312
Mine water Drainage Infrastructure	£125,652
Access Tracks/Paths	£541,282
Aeration Cascades	£15,000
Pumping Arrangements	£463,312
Buildings	£100,000
Odour Dosing	£50,000
Landscaping	£270,850
Public Utility Costs – supply (6)	£56,000
Public Utility Costs – diversion	£0
Sub-total	£2,653,073
Site Abnormals (7)	£500,000
Preliminaries (20%) (8)	£630,615
Contingencies (10%)	£378,369
Total	£4,162,057

Notes on Site 101 indicative cost estimate:

1. The indicative cost estimate is based on the SPONS price book (2017) and a general overview of current market prices. Without a full detailed design and actual competitive market rates, the indicative cost estimate should be used for guidance and comparison purposes only. TCA cannot accept liability for any variation between the construction cost estimate and the 'actual' contract value. Further breakdown of the cost estimate is given in Appendix A.
2. Existing ground conditions are unknown. An allowance has been made in the cost estimate for working in poor, water bearing ground.
3. No allowance is made for any land purchase.

4. No allowance is made for professional consultant fees, planning fees or legal fees.
5. No allowance is included for operational costs or the costs associated with the removal/replacement of compost material.
6. Public utility costs are based on experience of similar schemes only; quotes have not been obtained from utility companies at this stage.
7. Because Site 101 has a number of historical mine features an amount for "site abnormalities" has been applied to this site to make an allowance for the risk of additional costs related to preservation of mining heritage.
8. A percentage has been applied to cover preliminaries based on a judgement on the accessibility and ease of construction for the site. For Site 101, as well as the remoteness of the area and the adverse seasonal weather conditions, we consider that the site will present challenging ground conditions. For these reasons an allowance of 20% for preliminaries has been applied.
9. An allowance of £100,000 has been included for stabilising mine features such as adits or shafts.
10. Due to the presence of historical mining features an allowance of £300,000 has been made for archaeology during the works.

5.13 Site 101 Summary and Conclusions

The desk study and site visit identify the following benefits and disadvantages of site 101:

Benefits:

- The site has plenty of room to accommodate the works.
- Landowners are likely to be favourable to the scheme.
- Readily available power supply and good potential for potable water supply and telecoms.
- Access off the A689 is suitable.
- The pipeline routes are along tracks and avoid the highway.
- The site location has the potential to add visitor educational experience to the existing mine museum.
- There is potential for mutual benefit for the MWTS and the mine museum.
- The ponds are more likely to fit the landscape given that there is already a body of water on the site.
- Potential to use locally sourced stone.

Disadvantages:

- The site will be visible.
- The site is a potential habitat for Calaminarian Grassland.
- Presence of significant historical mining features such as shafts or adits.
- The site is sloping requiring some cut and fill to create plateaus to accommodate the ponds.
- The mine water discharge will need to be pumped from the adit to the MWTS for a distance of 0.8 km and a head of 100m.
- The potential for odour in close proximity to residential properties could result in local objections.
- Odour mitigation in the form of a combination of hydrogen peroxide and ozone dosing, and trickle filtering are likely to be required.

5.14 Site 101 Recommendations and Further Studies

Site 101 has good potential for use for the MWTS and has a number of significant advantages that make it more cost effective than sites 23 and 100. Foremost amongst these advantages are the size of the site, the ownership of the land, the route for the pipework, and the potential for partnership with the mine museum.

The following studies/additional works are recommended to further assess the viability of the site, and remove some elements of risk.

1. Phase 1 ecology survey
2. A desk study on mining activity in the site area.
3. A full topographical survey of the site to confirm existing levels and features.
4. Conceptual Earthworks Strategy to confirm potential developable platform areas, cut/fill balances and landscaping / visual mitigation requirements.
5. Ground investigation to confirm existing ground water levels and ground conditions.

6.0 Nenthead Mines Area

The following sections 6.1–6.3 have been extracted from the AECOM report TN06 Chapter 5:

6.1 Capture Structure and Pumping Station

Works within the Nenthead Mines area will be common to all sites. The work will include the capture of the flows from the Caplecleugh adit, transfer to the pumping station and the pumping station itself. There will also need to be an outfall to the Nent for the clean water flowing back from the treatment sites. This will need to include a cascade to dissipate the energy from the site. It is proposed that the gravity transfer pipe crosses the Nent at the location of the existing footbridge, and a new bridge may need to be constructed, subject to assessment of the constructability of the route. The pumping station will be located immediately adjacent to the turning head, and will require a control cabinet, and a below ground pumping station. The pumping station may need to be fenced to prevent access. The outfall for clean water will be on the east side of the Nent, approximately opposite the Caplecleugh adit, this will be subject to confirmation on the specific constraints in the area.

6.2 Existing Public Rights of Way

There are a number of existing public rights of way within the area of the capture point. In particular there is a Byway Open to All Traffic (BOAT) running through the Nenthead Mines car park and leading to a bridleway leading to the Nenthead Mines area. A footpath (not identified on the Definitive Map as a PROW) exists on the western bank of the Nent between Overwater and the footbridge. Whilst not defined as a PROW consideration should be made to maintaining access along this route during construction.

6.3 Scheduled Ancient Monument

Some of the works at Nenthead will need to be located within the Scheduled Ancient Monument (SAM), list entry number 10158582 – “Lead mines, ore works and smeltmill at Nenthead”. In particular the capture point and the transfer from the adit to the pumping station will need to be within the boundary. The design of the works will need to minimise extent within SAM boundary, and take the designation of the area into consideration. In particular it is recommended that the pumping station is sited out of the extents of the SAM.

6.4 Health and Safety Considerations

The Health and Safety aspects of the construction, operation and maintenance of the capture structure and pumping station include the following:

- Public access at the Nenthead mines area during construction should be restricted by providing a clear, fenced off area. A temporary bridge crossing of the Nent and/or footpath diversion may be required to take people away from the working area.
- Deep excavations to form the pumping stations.
- Construction of the capture structure in the steep banks of the river – this could be avoided by building the capture structure to the side of the adit.

7.0 Operating Costs

An appraisal of the relative merits of each site must include the long term operating costs. The potential operating costs for each of the three sites has been estimated to identify the relative OPEX costs associated with a 25 year life cycle.

The operating costs for each site are broadly similar. The main variable will be the electricity costs for pumping from the adit to the MWTS site.

The operational cost estimate is based upon a number of assumptions and is subject to further study and detail estimating. The following limitations and exclusions apply:

- The estimate excludes any costs associated with normal wear and tear of basic site infrastructure such as catch pit covers, drainage, fencing etc;
- The odour dosing (Hydrogen Peroxide) costs are based on the business case for Nent Haggs.
- Reactive Media Removal/Replacement costs are based on the business case for Nent Haggs.
- Pumping costs are based on a preliminary assessment of a pump set-up and operating curve and an approximate cost of electricity. This estimate therefore provides a relative cost for comparison rather than an accurate prediction of the actual costs.

7.1 Regular Operating Costs

The main costs associated with running the MWTS are the same for any of the three sites. The costs used for the Nent Hags business case are presented here:

Item	£/annum
Monthly Flow Monitoring	£10,400
Site Management	£6,500
Water Sampling	£11,000
Council Business Rates	£5,000
Mine water Discharge Consents	£1,700
Odour Dosing	£8,500
Total	£43,100

From to time to time some elements of the MWTS will need replacing. The pumps may need replacing due to wear and tear. The reactive media will need replacing due to exhaustion of its reactive properties.

Pumps

Due to the heavy metals content of the water the pumps may need to be replaced on a regular cycle. The Nents Head project cost plan has assumed a 5 year replacement cycle for the pumps at a cost of £10,000 every 5 years. Site 23 requires a return flow pumping station but because the water will have been treated it is assumed the pump replacement for the return pumps will be on a 10 year cycle.

Reactive Media

The compost will need to be changed every 10 years. TN06 suggested a cost for removal and disposal of the used compost of £2,625,000 but recent experience at Force Crag suggest this figure should be substantially reduced to £150,000 every 20 years.

7.2 Pumping Costs

Refer to Table 7.2. Electricity costs are based on two pumps (duty/duty) on a three phase power supply. The design flow rate will be based on an average flow of 10l/s over a 24 hour period. A preliminary assessment would suggest a 160mm diameter rising main with a velocity of 1.5m/s at a flow of 20l/s operating 50% of the time. The actual design will depend on the pump rating, pump efficiency and friction losses. Head losses in a 160mm plastic rising main are approximately 2.8m per 100m. Based on a combined pump and motor efficiency of 80% and a price for electricity of £0.10kW/hr the following running costs apply for each site:

Table 7.2 Pump Running Costs	Sites		
Item Description	23*	100	101
Head Difference (Adit to MWTS) (m)	5	100	100
Rising Main Length (m)	1300	800	800
Friction Head Loss (m)	38	28	28
Total Operating Head Difference (m)	43	128	128
Power Demand (kW/h)	5	15	15
Annual electricity cost	£9,262	£13,576	£13,576
* Site 23 requires two pumping stations			

7.3 Net Present Cost

Based on the following:

- Recommended UK Public Service discount rate of 3.5%.
- 25 year Operating Period.
- CAPEX includes design and planning costs as well as procurement.
- CAPEX includes an allowance for ground investigations of £150,000.
- CAPEX includes an allowance for the planning application process of £130,000.
- CAPEX includes design fees at 10% or contract works cost.
- OPEX excludes pump and reactive media replacement costs.

Table 7.3 Net Present Cost	Sites		
Item Description	23	100	101
OPEX (Operating and Pumping only)	£M 0.94	£M 1.01	£M 1.01
OPEX + CAPEX	£M 6.83	£M 6.61	£M 5.68

8.0 Conclusions

Of the three sites considered site 101 is the least cost and has a number of distinct advantages which include:

- Accessibility
- Pipeline routes
- Land ownership
- Topography
- Availability of space
- Potential for partnership with NMCS
- Fewer nearby receptors

The site does however have concerns for archaeology, ecology and visual impact. Following a meeting with Historic England there is broad agreement that the scheme can be built whilst being sensitive to the historic features and landscape. A Phase 1 ecology survey will be required to establish the baseline ecological concerns and provide information to support an EIA if required. Visually the site can be seen from a distance but the ponds and reed beds fit the landscape given that there is already a body of water on the site.

Site 100 has a number of significant issues including mining features, ecology, land ownership, topography and inappropriate landscape.

Site 23 has the distinct disadvantages of nearby receptors and having to lay the pipelines in the A689 through Nenthead village. In addition the access is difficult and topography constrains the MWTS layout.

Table 8.1 Comparative Costs	Sites		
	23	100	101
Construction Budget Cost Estimate	£5,173,499	£5,038,118	£4,162,057
Annual Maintenance Costs	£52,362	£56,676	£56,676

Table 8.2 Site Comparisons

Item	Site 23 Status	Site 100 Status	Site 101 Status	Comments
Mine water delivery and return	<p>Pumped delivery and pumped return required.</p> <p>Two pumping stations required.</p> <p>Pipeline route is along A689 and through the village.</p>	<p>Pumped delivery, 100m static head, gravity return.</p> <p>Pipeline has to cross A689 and through SAM.</p>	<p>Pumped delivery, 100m static head, gravity return.</p> <p>Pipeline through SAM.</p>	<p>Emergency overflow required and assumed to discharge to local watercourse.</p>
Treatment Layout	<p>Constrained by steep site.</p>	<p>Constrained by steep site and ecology.</p> <p>Within ecologically active area.</p> <p>Presence of mining features.</p>	<p>Presence of mining features</p>	<p>Site 101 has ample space whereas sites 23 and 100 are constrained.</p>
Odour Impact	<p>Houses and PROW in very close proximity.</p> <p>Potential for there to be strong objection despite odour treatment.</p>	<p>Houses and PROW in nearby.</p> <p>Potential for there to be strong objection despite odour treatment.</p>	<p>Houses and PROW in nearby.</p> <p>Potential for there to be objection despite odour treatment.</p>	<p>Odour treatment will be necessary but site 101 has the lowest potential for impact.</p>
Earthworks	<p>Difficult site conditions.</p> <p>Sloping wet site will require dewatering, land drainage and</p>	<p>Difficult site conditions.</p> <p>Sloping wet site will require dewatering, land drainage and</p>	<p>Sloping site may require retaining structures.</p> <p>Mining features will require</p>	<p>All sites are sloping but Site 101 has more space to accommodate longer earthworks profiles and the</p>

Table 8.2 Site Comparisons

Item	Site 23 Status	Site 100 Status	Site 101 Status	Comments
	retaining structures.	retaining structures. Potential for unforeseen mining features.	archaeological watching brief.	opportunity to use locally sourced stone.
Ecology	Low perceived ecological interest.	High perceived ecological interest. Amphibians and Red squirrels are likely to be a concern.	Moderate perceived ecological interest. Calaminarian grass could be a concern.	Phase 1 ecology survey required.
Highways/Access	Poor visibility. Highway authority approved junction required. Narrow shared lane needs upgrade.	Existing access available subject to landowner consent.	Existing access available. Access route needs extending over SAM and will require protection of mining archaeology.	
Health and Safety Design considerations	Pipeline construction in A689 and through Nenthead.	Sloping and wet site. Mining features.	Mining features.	
Landownership	Uncertain and likely to be local landowners.	Uncertain but likely to be a local landowner and the Weardale Estate.	Cumbria County Council and likely to be transferred to NMCS.	

Appendices:

Appendix A	BASIS OF INDICATIVE COST ESTIMATE	
Appendix B1	FIGURE 1 - Site Location Plan	EV00116-FIG.1
Appendix B2	FIGURE 2 - Site 23	EV00116-FIG.2
Appendix B3	FIGURE 3 - Site 100	EV00116-FIG.3
Appendix B4	FIGURE 4 - Site 101	EV00116-FIG.4

Appendix A - Basis of Indicative Cost Estimate

The feasibility report includes a high level assessment of the indicative costs for each of the three sites. These indicative costs are for comparison purposes only so that the least cost, best value site can be identified. The indicative costs are broken down into various elements of the construction works so that high cost items can be identified. To build the indicative costs estimates a very preliminary layout of each site has been proposed and used to assess quantities for different work items. These layouts are based on the constraints known at this stage but are subject to the necessary further study, survey and design development. The costs rates are also based on high level assessments and have not been fully costed at a detailed level. Therefore it should be recognised that the actual out turn costs of construction will be at variance to these indicative cost estimates.

The following tables provide a summary of the basis of the indicative cost estimate. The estimate adopts the same methodology as used in TN06 so that the estimated site costs can be compared with the sites considered in TN06. In preparing the rates for each item a comparison and check has been made with TN06. Where there is broad agreement with the rates used in TN06 these rates have been used.

The quantities for the different work items have been measured from the preliminary layout drawings. Earthworks volumes have been calculated based on a preliminary design of the site profiles taking account of the topography. The VFPs and reed beds have been positioned to suit the topography and cut into the slopes. A steeper site generates greater earthworks cut and fill quantities. An allowance has also been made for off-site disposal especially for sites where the soil is wet or there is little room to incorporate excess material.

Contract preliminaries have been applied to the indicative cost estimates according to the perceived challenges that each site represents. All contracts have a proportion of cost associated with contractors' preliminaries but we consider that these sites will have higher preliminary costs than usual. The factors affecting the likely preliminaries include remoteness of the site, accessibility, seasonal working, ecology, mining heritage and public relations.

The contingencies are set at a flat rate of 10% and represent an allowance for unforeseen circumstances and contract variations.

The indicative cost estimates do not include:

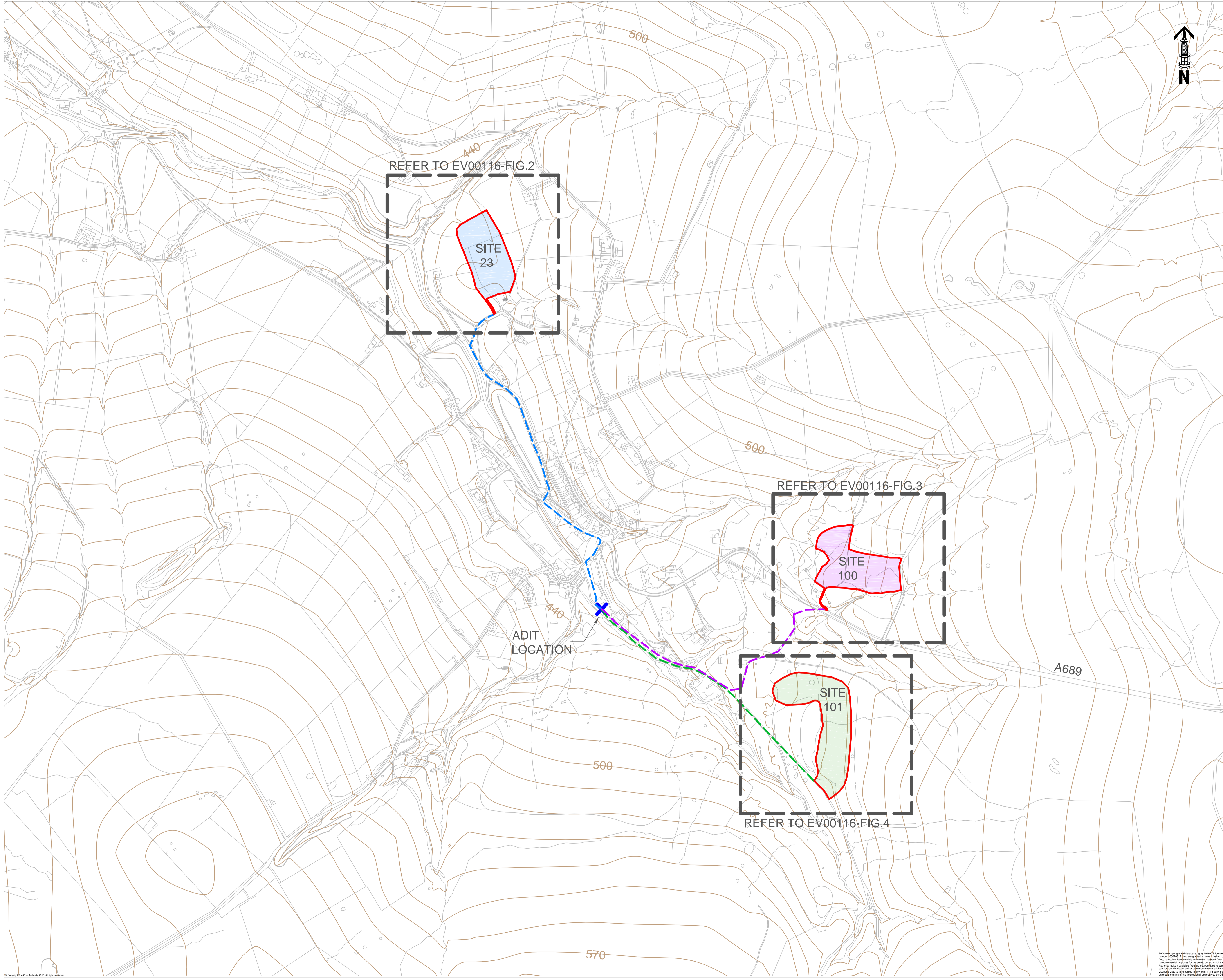
- Utilities supply or diversion where no budget estimate has been provided.
- Costs for diversion of rights of way.
- Costs associated with land purchase.
- Professional fees, permits, consents, planning application fees.
- S106 contributions (except in the case of Site 23 where there is more likelihood that a S106 contribution will be required).
- Operational costs.

Basis of Design Costs				
Item No.	Task	Description	Unit	Rate
1 General Site Clearance				
1.1	Topsoil Strip	Excavate topsoil maximum depth 0.25m	m ²	£3.20
1.2	General Site Clearance	Clear general site vegetation (not including trees or invasive species)	m ²	£0.13
1.3	Felling of Trees	Fell Trees on site 600mm girth, grub up roots, all by machine, removal to tip	No.	£345.00
2 General Earthworks				
2.1	General Excavation	Excavate material 1.0-2.0m depth, firm sand or gravel soils	m ³	£6.06
2.2	Vertical Flow Ponds Excavation	Excavate material 2.-5.0m depth, firm sand or gravel soils	m ³	£10.07
2.3	Reed Beds Excavation	Excavate material 0.5-1.00m depth, firm sand or gravel soils	m ³	£4.01
2.4	Access Roads Excavation	Excavate material 0.5-1.00m depth, firm sand or gravel soils	m ³	£4.01
2.5	Disposal of Excavated Material	Removal of excavated material, 15km distance using 20t tipper	m ³	£24.35
3 Vertical Flow Ponds				
3.1	Pond Liner/Geotextile	HDPE geomembrane liner (with geotextile protection layer) laid over the plan area of vertical ponds.	m ²	£6.56
3.2	Reactive Compost Media	PAS 100 Compost media	m ²	£8.08
3.3	Drainage Layer (Stone)	200mm thick, well graded free draining granular fill material, compacted on the base of each VFP.	m ²	£31.49

Basis of Design Costs				
Item No.	Task	Description	Unit	Rate
3.4	Drainage Layer (Pipework)	100mm perforated uPVC plastic pipe.	m	£20.70
4 Reed Beds				
4.1	Wetland Liner/Geotextile	HDPE geomembrane liner (with geotextile protection layer) laid over the plan area of reed beds.	m ²	£6.56
4.2	Topsoil Spread	300mm thick excavated topsoil to form layer of planting medium with wetland	m ²	£2.37
4.3	Reeds/Vegetation	Selected reed planting to wetlands.	m ²	£3.67
5 Mine Water Drainage Infrastructure				
5.1	PVC Drainage Pipe	225mm pipe in trench 1.50-2.00m depth	m	£82.72
5.2	Catchpits/Manholes	475mm Polypropylene chamber	no	£610.00
5.3	Headwalls/Discharge Structures	Bagwork headwall/discharge structure to discharge mine water flow into VFps/existing watercourse.	no	£1,032.00
5.4	Penstocks/Flow Control Structures	Penstocks/flow control to be retrofitted withing proposed catchpits/manholes to distribute mine water flow.	no	£561.84
6 Access Tracks/Paths				
6.1	Access Tracks Construction	5.00m wide reinforced concrete grassed track.	m ²	£90.00
6.2	Access Track Edging	Precast concrete edging	m	£29.00

Basis of Design Costs				
Item No.	Task	Description	Unit	Rate
7 Aeration Cascade				
7.1	Aeration Cascade	Concrete aeration cascade	no	£15,000.00
8 Pumping Arrangements				
8.1	Rising Main (within highway)	Twin rising main within highway	m	£550.00
8.2	Rising Main (within verge/tracks)	Twin rising main within verge/tracks	m	£175.00
8.3	Rising Main (within fields)	Twin rising main within fields	m	£98.00
8.4	Package Pumping Station	Package pumping station for 10l/s	no	£130,000.00
8.5	Emergency Overflow	225mm pipe in trench 1.50-2.00m depth	m	£67.76
8.6	Return Pipework for Treated Minewater	225mm pipe in trench 1.50-2.00m depth	m	£67.76
8.7	Works Associated with the Adit	General civil works on the adit	no	£100,000.00
9 On-site buildings				
9.1	Welfare Building	Traditional Style stone building	m ²	£2,000.00
9.2	Odour Dosing Building	Traditional Style stone building	m ²	£2,000.00

Basis of Design Costs				
Item No.	Task	Description	Unit	Rate
10 Odour Dosing Kit				
10.1	Odour Dosing Kit	Odour dosing kit		£50,000.00
11 Landscaping				
11.1	Grass Seeding	General grass seeded area 35/m ²	m ²	£0.96
11.2	Tree/Hedge screening	General hedge/tree screening	m	£81.00
11.3	Security Fence	Cleft oak rail fence four rails	m	£24.00
11.4	Topsoil Spread	Topsoil spread	m ²	£2.20



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- KEY**
- SITE 23 PROPOSED PUMPING ROUTE
 - SITE 101 PROPOSED PUMPING ROUTE
 - SITE 100 PROPOSED PUMPING ROUTE
 - SITE 23
 - SITE 101
 - SITE 100

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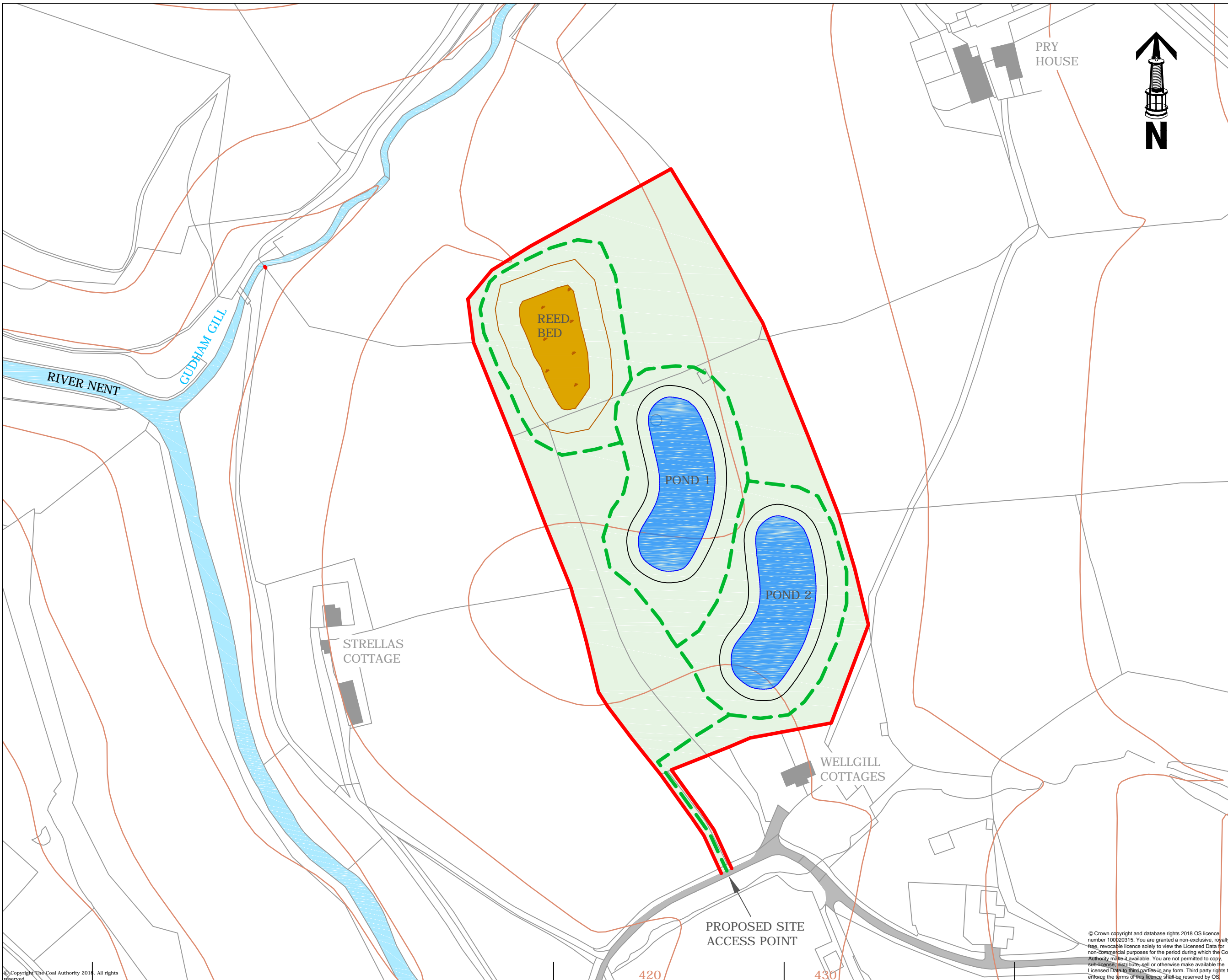
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FIGURE 1 - SITE LOCATION PLAN

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Size	A1	Reviewed	P Terry

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EV00116-FIG.1	R1

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- SITE BOUNDARY
- ACCESS TRACKS
- PONDS
- TREATMENT SITE AREA
- REED BEDS

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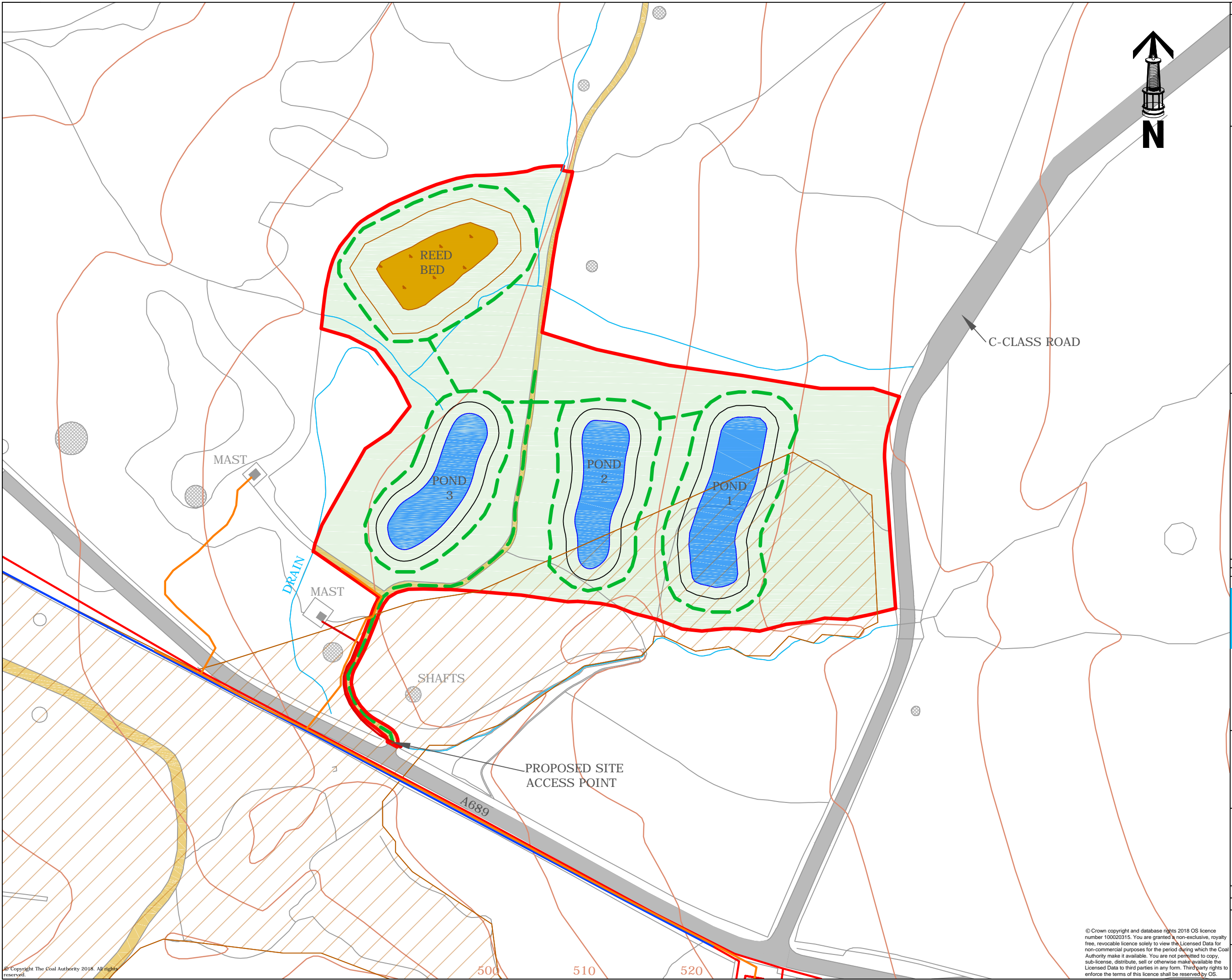
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FIGURE 2 - SITE 23

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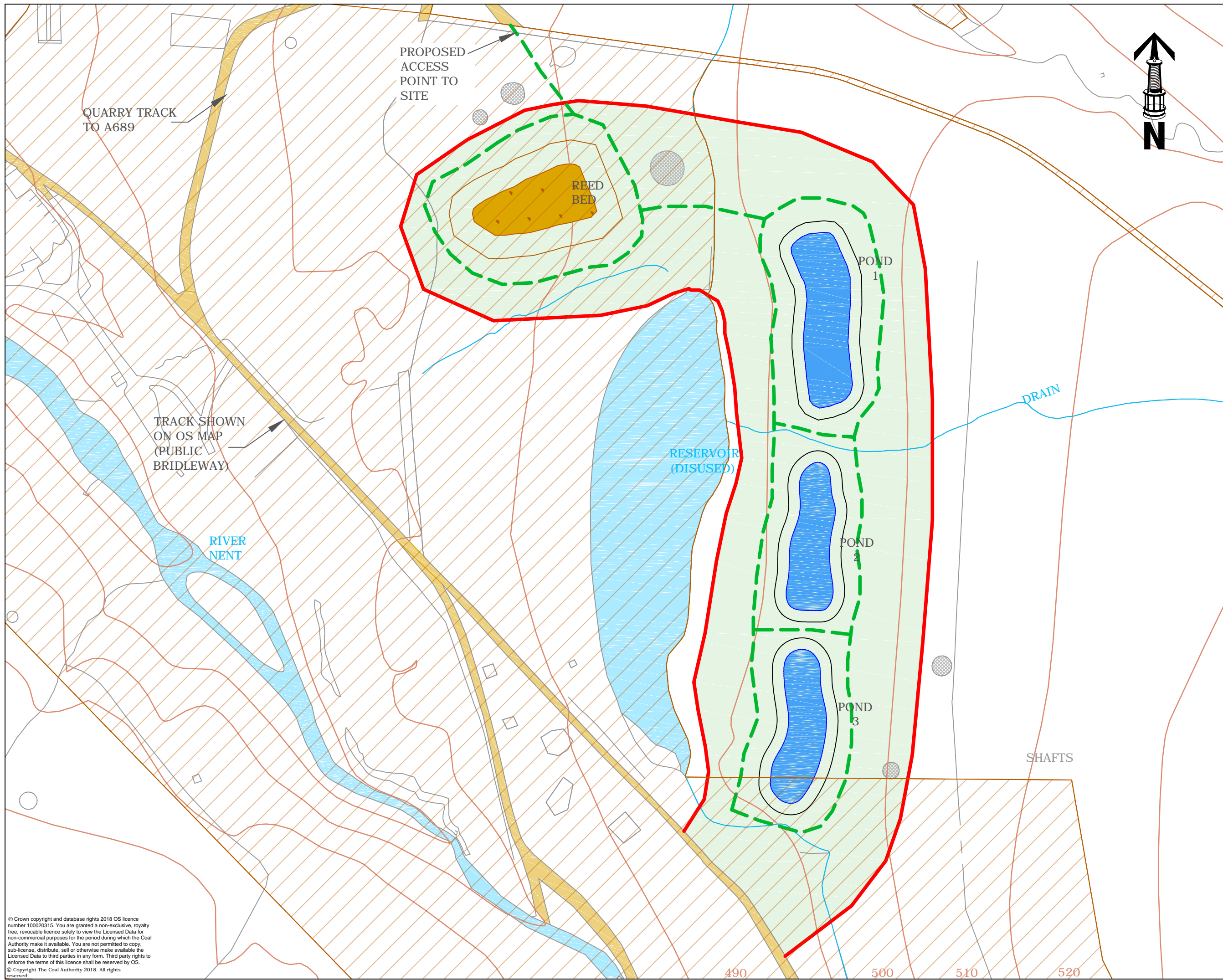
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FIGURE 3 - SITE 100

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FIGURE 4 - SITE 101

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