

# **Hendon Cemetery and Milesplit Hill Cemetery**

**London Borough of Barnet**

**Tier One**

**Hydrogeological Risk Assessments**

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## Executive Summary

This report is a desk-based qualitative hydrogeological risk assessment of the existing Hendon Cemetery and the proposed new cemetery at Milesplit Hill. It is based upon information from a number of sources, including a geological report specifically produced by the British Geological Survey.

The Vulnerability Ranking given in this desk-based assessment to both sites is midway between Low and Moderate, mainly as a result of:

- The presence of watercourses within Hendon Cemetery
- The proximity of the site at Milesplit Hill to a Groundwater Source Protection Zone 2
- The absence of protective superficial deposits at either site

In mitigation of the potential risk of contamination to the groundwater deep beneath both sites is the protection provided by the thickness of the confining and impermeable London Clay. This is considered to be 70m thick beneath Hendon Cemetery and 42m thick beneath the Milesplit Hill site.

The average annual demand for body burials, as opposed to ashes, at Hendon Cemetery is 319. It is assumed that this demand would be shared equally with the Milesplit Hill site once developed as a cemetery.

In view of the vulnerability factors and consequent ranking scores, but primarily due to the high demand for burial, both sites are considered to pose a high level of potential risk to groundwater. The Environment Agency's published view included within this report is that

*Proposals for new cemetery developments for greater than 100 burials per year are considered to be high risk even in a lower sensitivity groundwater scenario. Such proposals will only be agreed by the Environment Agency where a developer can demonstrate through detailed risk assessment that, given the site specific setting and the engineering methods proposed, groundwater pollution will be avoided.*

## Recommendations

The Environment Agency's standard requirements for cemeteries include a prohibition on burials within 30m of any watercourse. Whilst burials have historically taken place within this distance of watercourses at Hendon Cemetery, this practice should not be repeated unless specific approval is obtained from the Environment Agency for burials within 10m of the watercourse, due to the clay ground.

Detailed site investigations should be undertaken by a company with specialist understanding of cemeteries\* to establish the extent to which the clay offers protection to groundwater and surrounding areas from any potential contamination from burials.

\*Based upon my experience of their work, I can recommend TGMS Ltd, whose Managing Director is Dr. Richard Earl.

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## Introduction

The London Borough of Barnet commissioned this desk-based hydrogeological risk assessment of the existing Hendon Cemetery and the proposed new cemetery at Milesplit Hill.

Hendon Cemetery opened in 1899 and occupies 17 hectares (42 acres). There is limited virgin ground remaining for burials, but it is planned to optimise space for new burials through the re-use of graves.

In contrast, the site at Milesplit Hill was originally designated as an extension to the adjacent Mill Hill Cemetery, but has not yet been developed for cemetery use.

This report is an initial desk-based hydrogeological risk assessment of the suitability of the selected sites for use for the burial of bodies. The sites are located relatively close to each other.

It includes information extracted from various sources, including a detailed geological report commissioned from the British Geological Survey (BGS), attached in full to this report, and from the web sites of the BGS and Environment Agency (EA) and [www.gov.uk](http://www.gov.uk). Quotations from such sources are in *italics*.

The report first considers each of the sites' hydrogeological vulnerability and then the potential level of risk of contamination of groundwater and surface water from future burials.

## Environment Agency Guidance

Since 14<sup>th</sup> March 2017, the Environment Agency's guidance on groundwater protection and controlling the risks posed by cemeteries has been published on [www.gov.uk](http://www.gov.uk). This guidance includes:

### **1. The Environment Agency's Approach to Groundwater Protection** – last updated February 2018

*This document updates Groundwater protection: Principles and practice (GP3). It contains position statements which provide information about the Environment Agency's approach to managing and protecting groundwater. They detail how the Environment Agency delivers government policy for groundwater and adopts a risk-based approach where legislation allows. Many of the approaches set out in the position statements are not statutory but may be included in, or referenced by, statutory guidance and legislation.*

#### **L. Cemetery developments**

*This section contains the position statements on the development of new cemeteries or the extension or redevelopment of existing cemeteries. For further information see the guidance for cemeteries and burials.*

*Burials are covered by the requirements of EPR<sup>1</sup> as they can discharge hazardous substances and non-hazardous pollutants to groundwater.*

*For individual burials that are spaced out over time, the risks to groundwater are likely to be low and the de minimis exclusion in EPR applies.*

*Large numbers of burials in a short time, or the cumulative effects of many individual burials, may cause or have the potential to cause groundwater pollution. In general, the shorter the time over which burials occur and the higher the number of burials, the greater the risk of groundwater pollution. In these cases the Environment Agency will, where appropriate, use its powers under EPR to control or prohibit the burials.*

*The European Commission has indicated that, for ethical reasons, human corpses cannot be defined as waste. As a consequence, the Waste Framework Directive 2008/98/EC which defines waste, and basic waste management principles, does not apply, and burials are not controlled by waste legislation in England. The Environment Agency can therefore only control groundwater pollution from burials as a consultee on planning applications, or through environmental permitting and water resources legislation where risks of pollution are greatest.*

#### **L1 - Locating cemeteries close to a water supply used for human consumption**

*The Environment Agency will normally object to the locating of any new cemetery or the extension of any existing cemetery, within SPZ1, or 250 metres from a well, borehole or spring used to supply water that is used for human consumption, whichever is the greater distance.*

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<sup>1</sup> The Environmental Permitting (England and Wales) Regulations 2010 (EPR)

## **L2 - Mass casualty emergencies**

*The Environment Agency will normally object to or may refuse to permit new or existing cemeteries planned for use in mass casualty emergencies if they are in SPZ1 or within 250 metres of an abstraction point, whichever is the greater distance. Where there is a risk of disease transmission into groundwater the Environment Agency will extend its objection to SPZ2.*

## **L3 - Cemeteries: protecting groundwater in highly sensitive locations**

*The Environment Agency will apply a risk-based approach to assessing the suitability of sites for cemeteries outside of the zones noted in position statements L1 and L2. A high priority is placed on protecting groundwater within principal aquifers and groundwater catchments used for drinking water supply, and new larger cemetery developments in such areas might not be appropriate. Proposals for new cemetery developments for greater than 100 burials per year are considered to be high risk even in a lower sensitivity groundwater scenario. Such proposals will only be agreed by the Environment Agency where a developer can demonstrate through detailed risk assessment that, given the site specific setting and the engineering methods proposed, groundwater pollution will be avoided.*

*Note that all cemetery developments and burials must maintain an unsaturated zone below the level of the base of the grave(s). The Environment Agency will work with the local authorities to identify alternative site and burial options where necessary. <sup>2</sup>*

## **2. Cemeteries and burials: prevent groundwater pollution – last updated 28<sup>th</sup> February 2018**

*Burials must not pollute groundwater. Groundwater can be at risk of pollution from burials where the numbers are sufficient and if the site is in a sensitive or vulnerable area. Measures to prevent or limit pollution must be appropriately considered, given the sensitivity and risks posed.*

*A burial site must be:*

- *outside a source protection zone 1 (SPZ1)*
- *at least 250 metres from any well, borehole or spring supplying water for human consumption or used in food production – for example at farm dairies*
- *at least 30 metres from any spring or watercourse not used for human consumption or not used in food production*
- *at least 10 metres from any field drain, including dry ditches*

*All graves must:*

- *have at least 1 metre clearance between the base of the grave and the top of the water table – they shouldn't have any standing water in them when dug*
- *not be dug in bedrock or areas susceptible to groundwater flooding*
- *be deep enough so at least 1 metre of soil will cover the top of the coffin, body or animal carcass*

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<sup>2</sup> The Environment Agency's Approach to Groundwater Protection. March 2017 page 39

*Always allow for any potential rise in the water table, including seasonal variations and extreme rainfall.*

*The Environment Agency can take action if large numbers of burials, either as a single event or over a period of time, affect or could affect groundwater quality.*

*Burials can result in the discharge of hazardous substances and non-hazardous pollutants to groundwater. They are therefore covered by the requirements of the Groundwater Daughter Directive 2006/118/EC as implemented by the Environmental Permitting Regulations.*

*The Environment Agency may serve a works notice under section 161A of the Water Resources Act 1991 and the Anti-Pollution Works Regulations 1999 to prevent or seek remedial action for pollution of controlled waters.*

*In addition to the requirements set out in this guide, you may need to monitor groundwater before burying animal or human remains. Find out what you need to monitor in the cemeteries and burials groundwater risk assessment guidance.*

### ***Burials below the water table***

*Burials must not cause pollution and therefore shouldn't take place below the water table. Burials below the water table limit the capacity for attenuation and there must be no direct input of hazardous substances to groundwater. Therefore, some sites with existing planning permission, such as existing cemeteries, may need some form of intervention to control groundwater levels. For example, artificial drainage and abstraction for removal.*

*You must collect any artificially drained groundwater, treat it as contaminated, and dispose of it as foul water. You'll need an environmental permit to carry out these actions unless you have permission to discharge to mains foul drainage. Contact your local sewerage provider in these cases.*

*Until there is more information about the effect of any new method for managing burials close to, or below, the water table, the Environment Agency will want to see:*

- *a hydrogeological assessment of present and future risks*
- *plans for continued checks of the site including long-term monitoring*

*For human burials, this includes the use of sealed caskets.*

### ***New cemeteries and extensions***

*Any new cemetery or extension to an existing site, including grave plot reuse and 'lift and deepen' methods, must:*

- *comply with minimum groundwater protection requirements*
- *pose no unacceptable risk to groundwater used for drinking water and food production purposes*

*As a minimum you must do a tier 1 risk assessment to evaluate the potential harm to groundwater from pollution. Local councils control new cemetery and extension applications through planning laws, and the Environment Agency is a statutory consultee for potential groundwater pollution. The*

*Town and Country Planning Act and Regulations (various dates) have provisions allowing the control of development and land use, including cemeteries. Planning conditions may be set to protect groundwater. The Environment Agency considers sites with the potential for 100 burials a year or more to be high risk. These sites will need detailed evidence to show both:*

- *sufficient depth to the water table or that natural formations offer protection*
- *proposed engineering and management methods to prevent unacceptable groundwater pollution*

*You may also have to carry out regular monitoring to ensure the risk of groundwater pollution stays acceptable. How often, and what checks, depends on:*

- *cemetery size and rates of use*
- *results of the risk assessment*
- *hydrogeological characteristics*
- *ongoing results of the monitoring*

*The Environment Agency expects you to limit your cemetery's environmental impact, such as phasing burials to reduce the concentration of substances and organisms.*

### **3. Cemeteries and burials: groundwater risk assessments – last updated 21<sup>st</sup> August 2017**

#### **Source, pathway and receptor**

*You should use a source-pathway-receptor approach to follow this guide's principles.*

*For groundwater risk assessments relating to burials the:*

- *source is the buried human or animal remains*
- *pathway is the subsoil or other medium through which substances from the source permeate and travel*
- *receptor is the groundwater*

*Groundwater receptors can include:*

- *any boreholes, wells and springs used for drinking supplies*
- *groundwater-dependent ecosystems (such as wetlands) or other identified conservation sites that may be at risk (such as a Site of Special Scientific Interest)*

*To assess the risk at a site you will need a realistic estimate of the yearly maximum number of burials that take place or will take place, and whether these involve human or animal remains. You must ensure any subsurface investigation of the soil and rock is at least 1 metre below the base of the grave.*

*You should use site specific hydrogeological data.*

#### **Tier 1 risk assessment: risk screening**

*For a tier 1 assessment, you need to do a desk study and a qualitative risk assessment. Each risk is ranked using a scoring system to prioritise those of most concern. The overall risk of the proposal can then be assessed as low, medium or high. For high and medium risks, you need to do a more detailed tier 2 or 3 risk assessment.*

## Risk Assessment

The first step in considering this undeveloped area for use for burial is to assess and score a number of factors against a groundwater vulnerability ranking chart, illustrated below:

### Groundwater Vulnerability Ranking Chart

Ranking	Very Low	Low	Moderate	High	Very High
Drift type	Clay	Silt	Silty sand	Sand / gravel	Absent
Drift thickness	>5m	>3 – 5m	3m	0 – 3m	Absent
Depth to water table	>25m	11 – 25m	10m	5 – 9m	< 5m
Flow mechanism	Intergranular				Fissured
Aquifer	Non-aquifer		Minor aquifer		Major aquifer
Abstraction and Source Protection Zone	Outside Zone 111	Within Zone 111	Close to boundary of Zones 11 & 111	Within Zone 11	Within Zone 1 or <250m from private source
Watercourses and springs	>100m	>70 <100m	>50 <70m	>30m <50m	<30m
Drains	>100m	>40 <100m	30 – 40m	>10 <30m	<10m

Figure 1: Groundwater Vulnerability Ranking Chart

A scoring scheme is used to provide a comparison mechanism:

Vulnerability	Element score	Total score (Range)
Very low	1 – 2	8 – 16
Low	3 – 4	24 – 32
Moderate	5 – 6	40 – 48
High	7 – 8	56 – 64
Very high	9 – 10	72 – 80

Figure 2: Scoring scheme

Using this system, a total score (range) for vulnerability ranking can be obtained for the site:

Low vulnerability	8 – 32
Moderate vulnerability	32 – 56
High Vulnerability	56 – 80

Figure 3: Vulnerability ranking scores

The vulnerability ranking is then considered in the light of burial rates and an overall level of risk projected.

## Site Locations

The aerial views below in Figures 4 and 5 show the approximate boundaries of the existing and proposed cemeteries outlined in red:



Figure 4: Aerial view of Hendon Cemetery



Figure 5: Aerial view of the site at Milesplit Hill

The Location Plan shown at Figure 6 below supported the planning application for the Milesplit Hill site and shows the extent of the site more clearly than the aerial image above.



Figure 6: Milesplit Hill site location plan

The following are extracts from the BGS report:

**Setting:**

**Site 1**, Hendon Cemetery, 523899, 190842 is situated at 50 – 60 m above OD with the ground surface sloping towards the east. Two small streams drain from the site eastwards into Dollis Brook, which is located 400 m east of Site 1.

**Site 2**, Mill Hill Cemetery, 523143, 192078, is situated at 75 – 85 m above OD with the potential development site (situated to the north) situated at an elevation of between 85 – 100 m above OD. The ground surface slopes towards the south. The nearest significant stream/river, Folly Brook, is located 1.3 km north of the site and Dollis Brook is located 1.5 km southeast of the site. Small, local drainage ditches are present starting 300 m northwest, but sinking downslope, 100 m southwest, of the site.

**Artificial ground:**

*No artificial ground has been recorded on either sites, though both have been developed (Site 1, between 1896 and 1920, and Site 2\*, post 1938, based on historic OS maps), therefore you can expect to find disturbed ground to about 2m for the burial plots together with thin made ground for the roadways and minor landscaping. There are some small buildings including a chapel and there are likely to be some utility services.*

**N.B.** the BGS comments\* concerning Site 2 appear to refer to the existing Mill Hill Cemetery, rather than to the adjacent undeveloped land, which is the subject of this report.

**Superficial deposits:**

*The Dollis Hill Gravel Member is mapped over the very southern part of Site 1\*.*

*It is typically composed of gravel, sand and clay in part, with occasional laminated silty beds. The deposits were laid-down over a million years ago when the ancestral course of the River Thames flowed to the north of its present route. Locally the deposits may contain lenses of silt, clay or peat. Nearby boreholes (TQ28NW 248, located 1 km southeast of Site 1 and TQ28NW 334, located 1 km south of Site 1) suggest that the deposit varies between 1 m and 5.5 m thick. Potential peat horizons in the sands and gravels may give rise to localised compressible ground conditions when the ground surface is loaded.*

**N.B.** the BGS comments\* concerning Site 1 appear to refer to land to the south of the cemetery owned by Hendon Golf Club. See note at Figure 7 below.

*No other superficial deposits have been mapped across the sites here but there may be a thin patchy layer of Head. Head is a Quaternary deposit comprising soft ochreous brown clay or sandy clay, and formed by the local reworking (under the influence of gravity) of weathered bedrock. It is unlikely to be more than a metre thick if present.*

**Rockhead depth:**

*Bedrock is mapped at outcrop and rockhead is therefore expected to be at or near the surface but may be concealed by thin topsoil. The exception to this is in the very south of Site 1, where 1 – 5.5 m of the Superficial Dollis Hill Gravel Member overlies the London Clay Formation. Boreholes TQ29SW 126 and TQ29SW 127, located immediately southeast of site 1, and TQ29SW 175, located 700 m southwest of Site 2, show topsoil depths of 0.2 – 0.3 m. Borehole TQ29SW 183, located 450 m north of Site 1 and 850 m southeast of Site 2, records made ground, associated with urban development, to a depth of 2.5 m.*

**Bedrock:**

*The bedrock is the London Clay Formation of Eocene age with an estimated thickness here of 40 – 60 m. It typically comprises stiff, poorly laminated, blue-grey, silty clay where fresh at depth, weathering to a soft to firm brown clay near the surface where oxidised. It may contain some fine sand as thin beds, partings or pockets, together with a few thin beds of shells. At the base there may be a thin pebble bed of black rounded flint pebbles.*

*In Borehole TQ29SW 183, located 450 m north of **Site 1** and 850 m southeast of **Site 2**, records show that the London Clay Formation is 42 m thick and rests on 9 m of the Lambeth Group. Beneath the Lambeth Group, 6 m of the Thanet Sand Formation is recorded, resting on the Chalk Group which is 101.5 m thick to the base of the borehole.*

*Two shallow boreholes (TQ29SW 126 and TQ29SW 127) are located immediately southeast of **Site 1** and record firm to stiff, brown locally mottled, thinly laminated fissured clay to depths of 8.5m below. There is a borehole located within **Site 2**, however no records are available.*

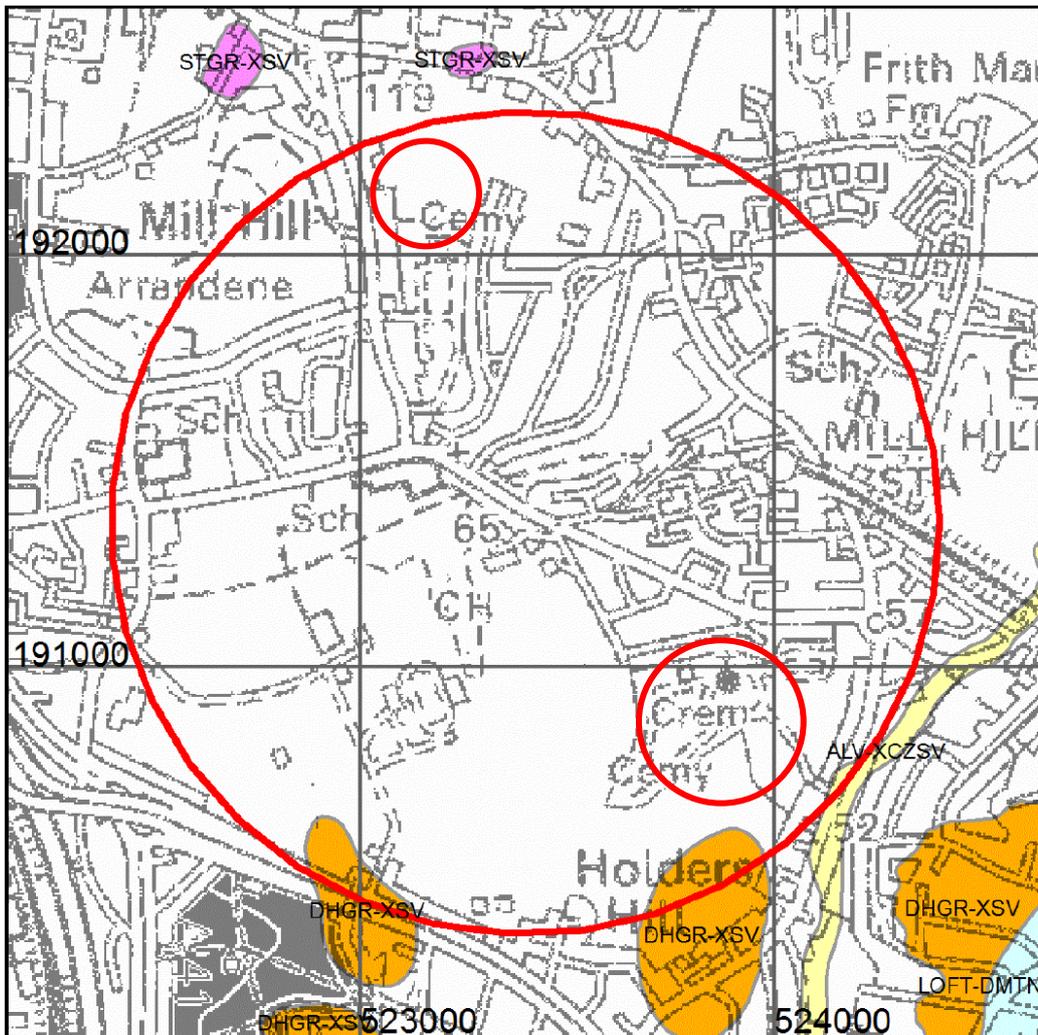
*At **Site 1** the thickness of the London Clay Formation is likely to be of similar thickness, 42m, to the thickness recorded in borehole TQ29SW 183.*

*At **Site 2** the London Clay Formation is likely to be slightly thicker than in the borehole TQ29SW 183, 60 - 70 m thick, as the site is located at a slightly higher elevation.*

*The London Clay Formation is highly-susceptible to shrink-swell behaviour in response to changes in moisture content. Thin sand layers in the London Clay Formation may be prone to running sand conditions depending on the height of the local water table.*

## Site Geology - Superficial Deposits (Drift)

The map below from the BGS report illustrates superficial deposits within the area. I have inserted two smaller red circles to indicate the approximate locations of Hendon Cemetery and the proposed site at Milespit Hill.



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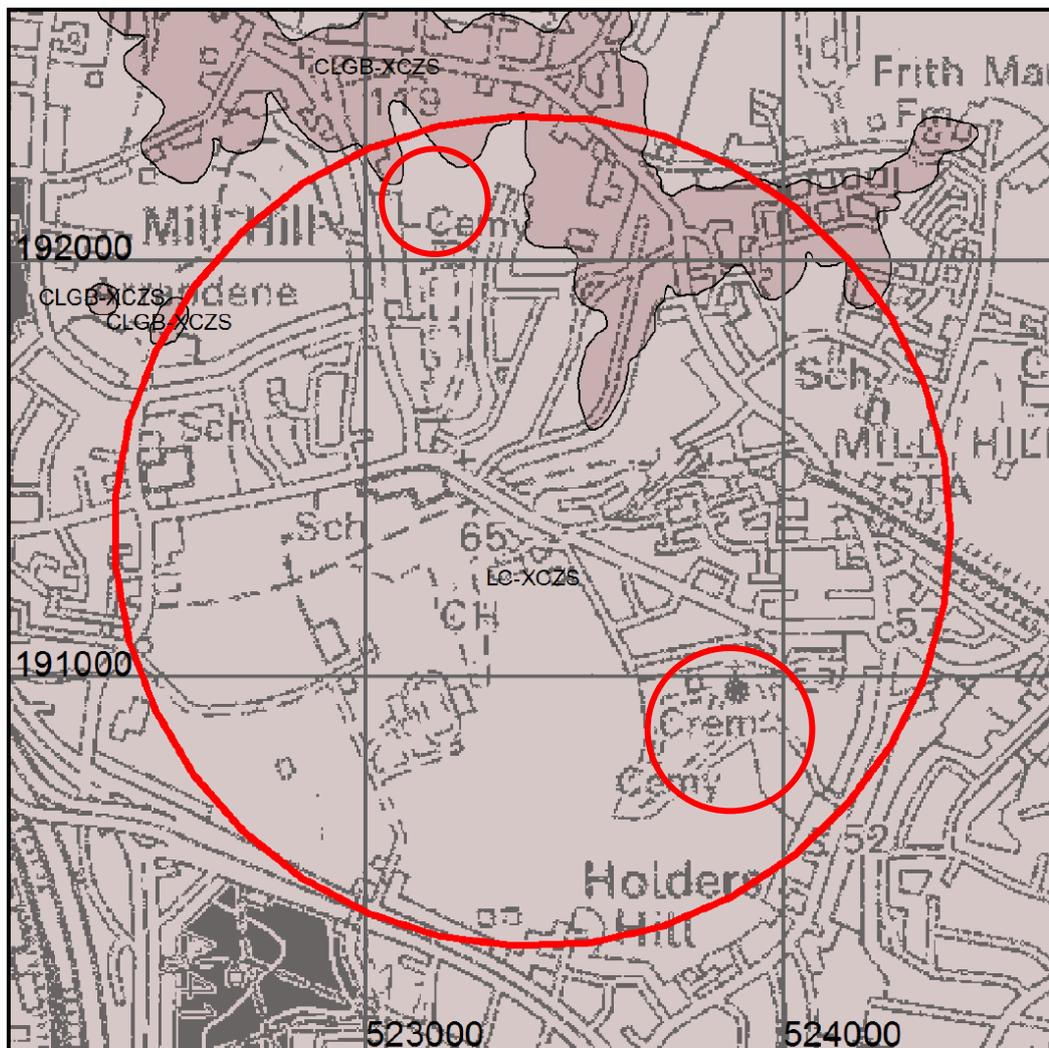
Map colour	Computer Code	Name of geological unit	Composition
	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
	LOFT-DMTN	LOWESTOFT FORMATION	DIAMICTON
	DHGR-XSV	DOLLIS HILL GRAVEL MEMBER	SAND AND GRAVEL
	STGR-XSV	STANMORE GRAVEL FORMATION	SAND AND GRAVEL

Figure 7: Map and Key showing superficial deposits

It is apparent from this map that neither site is overlain by superficial deposits. The Dollis Hill Gravel Member lies over land to the south of Hendon Cemetery, owned by Hendon Golf Club.

## Site Geology - Bedrock (Solid) Geology

The map below from the BGS report illustrates bedrock deposits within the area. I have inserted two smaller red circles to indicate the approximate locations of Hendon Cemetery and the proposed site at Milesplit Hill.



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Map colour	Computer Code	Name of geological unit	Rock type
	CLGB-XCZS	CLAYGATE MEMBER	CLAY, SILT AND SAND
	LC-XCZS	LONDON CLAY FORMATION	CLAY, SILT AND SAND

Figure 8: Bedrock geology

It appears from the map that both sites lie over London Clay, with Claygate Member beyond the northern boundary of the Milesplit Hill site.

## Groundwater Source Protection Zones (GSPZs)

Figure 9 below, extracted from [www.data.gov.uk](http://www.data.gov.uk), illustrates that Hendon Cemetery lies well outside any Groundwater Source Protection Zone. The Milesplit Hill site lies just outside and to the south of GSPZs 1 and 11. Figure 10, extracted from [www.magic.defra.gov.uk](http://www.magic.defra.gov.uk), provides greater clarity:

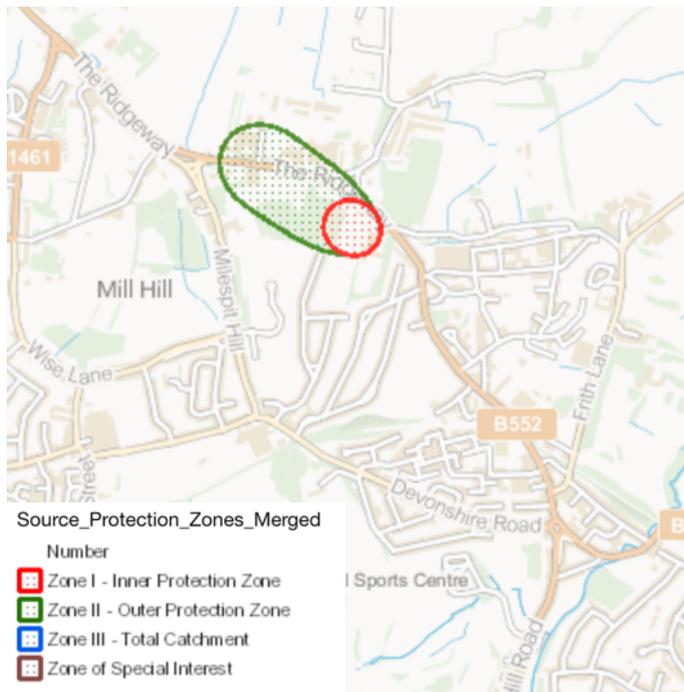


Figure 9: Groundwater Source Protection Zones



Figure 10: GSPZs to the immediate north of the site at Milesplit Hill (shown in blue)

# Aquifers

## Bedrock

The map below at Figure 11, extracted from [www.magic.defra.gov.uk](http://www.magic.defra.gov.uk), indicates the locations in the vicinity of the two sites of 'Secondary A' bedrock aquifers (formerly referred to as a Minor Aquifers). These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

It is not possible to view these at a closer magnification on the [www.magic.defra.gov.uk](http://www.magic.defra.gov.uk) web site. However, I have inserted two red circles to indicate the approximate locations of Hendon Cemetery and the proposed site at Milespit Hill.

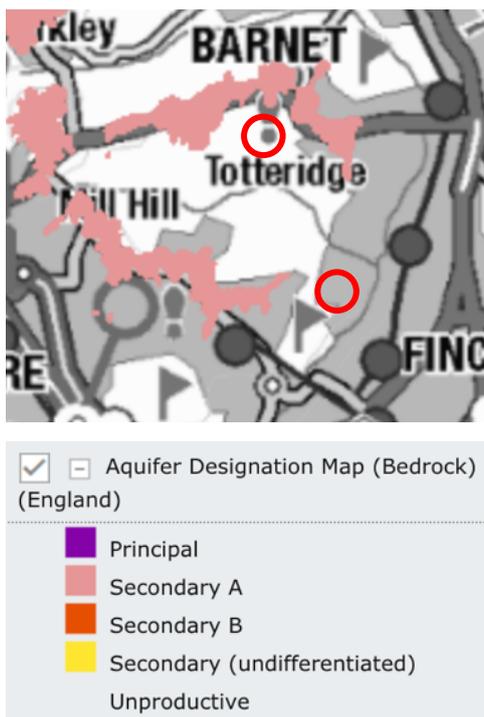


Figure 11: Bedrock aquifer designation map

Neither site lies over a bedrock aquifer.

## Superficial

The map below at Figure 12, extracted from [www.magic.defra.gov.uk](http://www.magic.defra.gov.uk), indicates the locations in the vicinity of the two sites of superficial aquifers. I have inserted two red circles to indicate the approximate locations of Hendon Cemetery and the proposed site at Milesplit Hill.

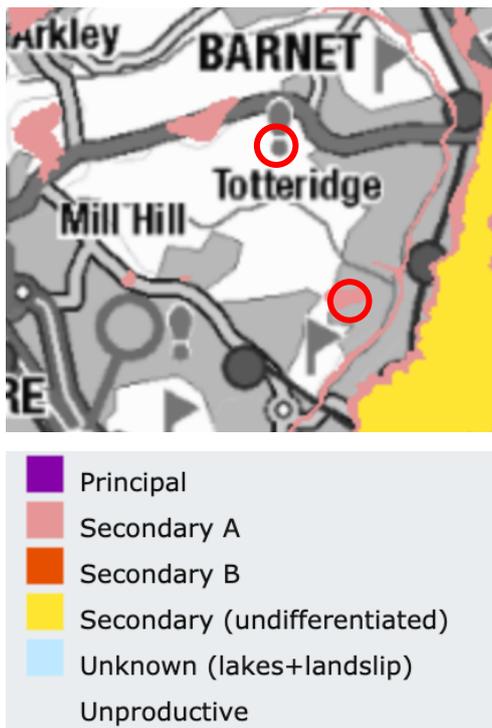
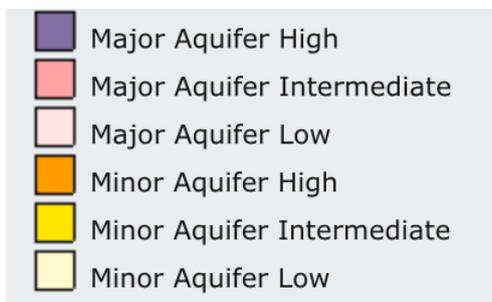


Figure 12: Superficial aquifer designation map

Neither site lies over a superficial aquifer.

## Groundwater vulnerability

The map below at Figure 13, extracted from [www.magic.defra.gov.uk](http://www.magic.defra.gov.uk), indicates the locations in the vicinity of the two sites of areas of groundwater vulnerability. I have inserted two red circles to indicate the approximate locations of Hendon Cemetery and the proposed site at Milespit Hill.



Neither site lies over an area of groundwater vulnerability.

## Boreholes

The BGS report refers to borehole records in the vicinity of the two sites. The aerial views below, extracted from the BGS web site, illustrate the locations of key boreholes.



*Figure 13: Boreholes within Hendon Cemetery*

Borehole TQ29SW126 was sunk to 8.5m below ground level on 29/6/1989 and the log reveals that no groundwater was struck.

Borehole TQ29SW127 was sunk to 8.5m below ground level on 30/6/1989 and the log reveals that no groundwater was struck.

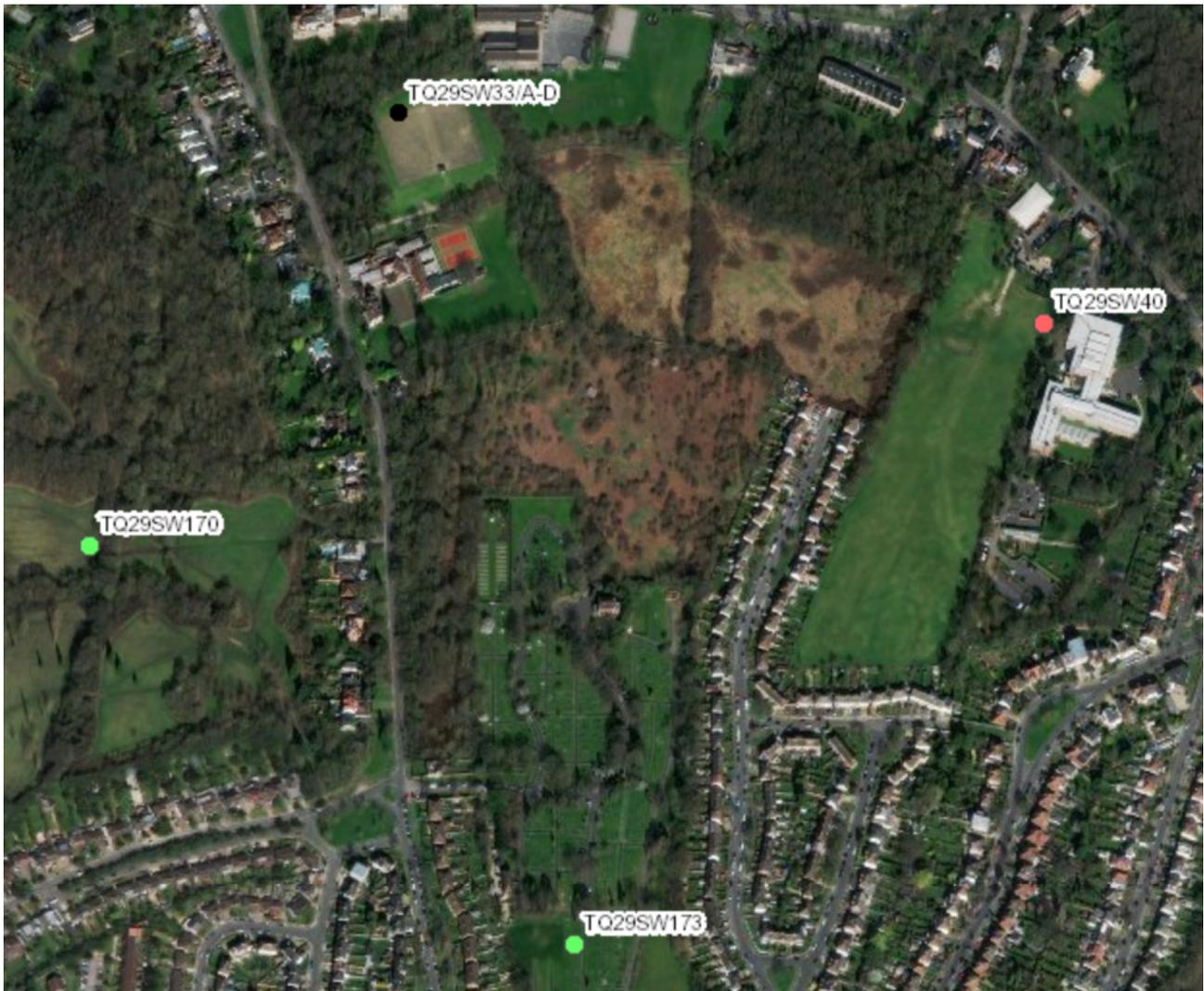


Figure 14: Boreholes in the vicinity of the Milespit Hill site

One of the nearest boreholes is TQ29SW173, within the existing Mill Hill Cemetery. Unfortunately, as noted in the BGS report, the borehole record is not available.

TQ29SW40 was sunk on 4/5/1990 to a depth of 150m below ground level. The borehole log records rest water level at 106m below ground level. This groundwater was found in the chalk underneath approximately 90m depth of London Clay.

# Flood risk

The map extract in Figure 15 below, extracted from [www.gov.uk](http://www.gov.uk), illustrates flood risk at Hendon Cemetery, with Figure 16 showing lower risk at the Milesplit Hill site.

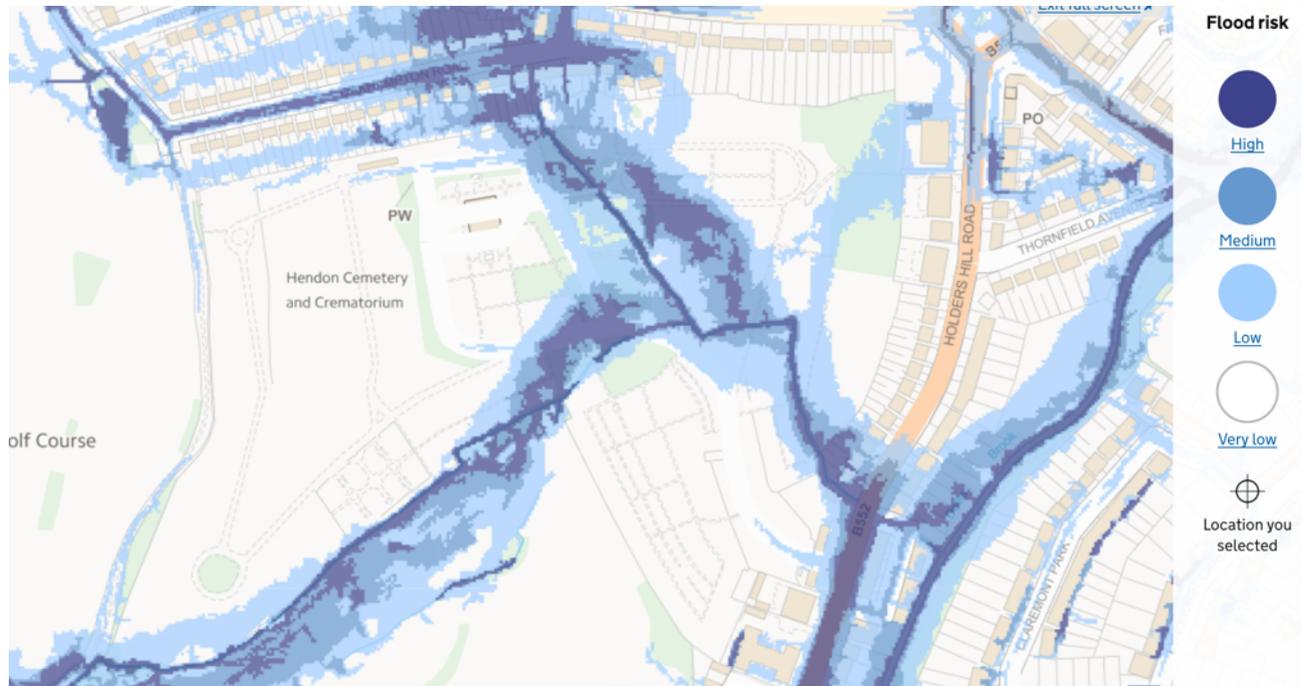


Figure 15: Flood risk at Hendon Cemetery

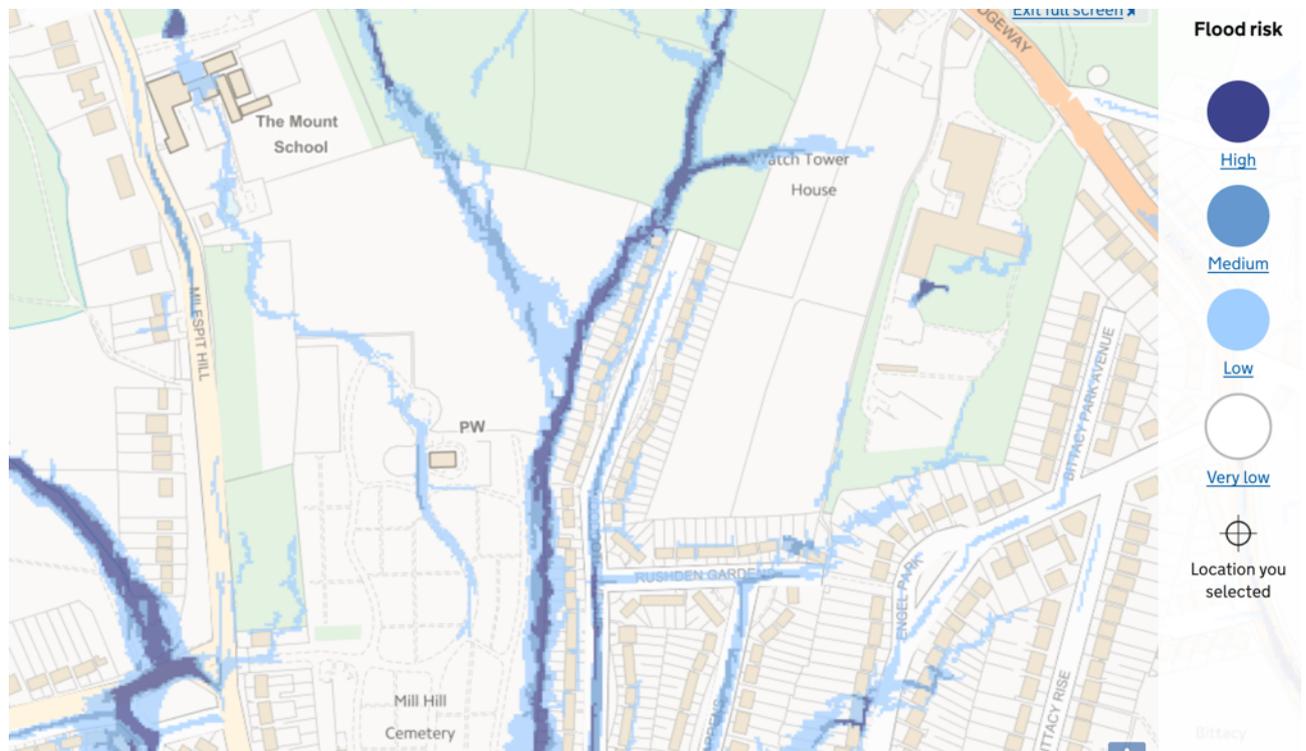


Figure 16: Flood risk at Milesplit Hill

## Hydrogeology of the site

Geological unit	Groundwater potential	Water level and strikes	Quality	*Environment Agency Groundwater vulnerability classification
Dollis Hill Gravel Member	Variably permeable with intergranular flow (only present at Site 1)	Thin perched aquifer with near surface water	Vulnerable to surface contamination	Secondary aquifer with medium vulnerability
London Clay Formation	Low permeability fissured clay. Some water might be present in upper weathered horizons and in sandy beds, where present	Small amount of perched water may be present in upper weathered horizons. Some water could be encountered in sandy beds and could rise above where struck	Any water present is likely to be hard with high sulphate concentration	Unproductive strata. However some groundwater flow may still occur in the upper weathered, or more permeable, horizons and this should be taken into consideration when considering persistent pollutants

Figure 17: Hydrogeology of the site – table in BGS report

As noted previously in this report, the Dollis Hill Gravel is mapped outside to the south of Hendon Cemetery. The extensive experience of the excavation of graves at Hendon Cemetery reveals no encounters with perched water tables or water in sandy beds: the ground is heavy clay.

*The London Clay Formation, which is present at surface across the majority of Site 1 and all of Site 2, is a low permeability aquitard that is likely to only contain limited quantities of groundwater in the upper more weathered layers and/or in sandier horizons. Boreholes TQ29SW 126 and 127, south-east of Site 1, both penetrated 8.5 m of London Clay Formation and were dry.*

*The regionally important Chalk aquifer is present at depth below both sites, but due to the thickness of London Clay (42 m, 60-70 m, respectively) the cemeteries are not likely to impact upon it.*

## Site Vulnerability Assessment

The tables below illustrate the key features ascertained from the points examined above.

### Site 1 Hendon Cemetery

Criteria	Comment
Superficial Deposits: Type	Absent
Superficial Deposits: Thickness	Absent
Depth to Water Table	> 25m in Chalk below London Clay
Flow Mechanism	Potential intergranular flow within upper weathered horizons of the very low permeability London Clay, which is an aquiclude.
Aquifer	Non aquifer
Abstraction and Source Protection Zone (SPZ)	Outside any SPZ
Watercourses and springs	Two streams join within the site and flow out to Dollis Brook. Some of the site lies within 30m of a watercourse, whilst much of the site lies within 70m of a watercourse.
Land Drains	None known

Figure 18: Site vulnerability assessment factors at Hendon Cemetery

### Site 2 Milesplit Hill

Criteria	Comment
Superficial Deposits: Type	Absent
Superficial Deposits: Thickness	Absent
Depth to Water Table	> 25m in Chalk below London Clay
Flow Mechanism	Potential intergranular flow within upper weathered horizons of the very low permeability London Clay, which is an aquiclude.
Aquifer	Non aquifer
Abstraction and Source Protection Zone (SPZ)	Outside any SPZ
Watercourses and springs	Two streams join within the site and flow out to Dollis Brook. Some of the site lies within 30m of a watercourse, whilst much of the site lies within 70m of a watercourse
Land Drains	None known

Figure 19: Site vulnerability assessment factors at Milesplit Hill

## Site Vulnerability Assessment Score Sheets

### Site 1 Hendon Cemetery

Factor	Site Characteristics	Ranking	Ranking Scores		
Drift type	Absent	Very High	9	-	10
Drift thickness	Absent	Very High	9	-	10
Depth to water table	> 25m	Very Low	1	-	2
Flow mechanism	Intergranular	Very Low	1	-	2
Aquifer	Non-aquifer	Very Low	1	-	2
Abstraction and SPZ	Outside Zone 3	Very Low	1	-	2
Watercourses and springs	< 30m to >100m	Moderate	5	-	6
Land Drains	None present	Very Low	1	-	2
<b>Total (range)</b>			<b>28</b>	-	<b>36</b>

Figure 20: Hendon Cemetery site vulnerability score sheet

### Site 2 Milesplit Hill

Factor	Site Characteristics	Ranking	Ranking Scores		
Drift type	Absent	Very High	9	-	10
Drift thickness	Absent	Very High	9	-	10
Depth to water table	> 25m	Very Low	1	-	2
Flow mechanism	Intergranular	Very Low	1	-	2
Aquifer	Non-aquifer	Very Low	1	-	2
Abstraction and SPZ	Just outside Zone 2	Moderate	5	-	6
Watercourses and springs	>100m	Very Low	1	-	2
Land Drains	None present	Very Low	1	-	2
<b>Total (range)</b>			<b>28</b>	-	<b>36</b>

Figure 21: Milesplit Hill site vulnerability score sheet

## vulnerability Ranking

### Sites 1 and 2

Vulnerability	Element score	Total score (Range)	Actual score
Very low	1 to 2	8 to 16	<b>28 to 36</b>
Low	3 to 4	24 to 32	
Moderate	5 to 6	40 to 48	
High	7 to 8	56 to 64	
Very high	9 to 10	72 to 80	

Figure 22: Vulnerability ranking of both sites

The range of vulnerability score of **28 to 36** falls midway between Low and Moderate vulnerability.  
**Level of Risk**

The Milesplit Hill is not yet developed for cemetery use. The number of body burials, as opposed to ashes, at Hendon Cemetery during the last three years is tabulated in Figure 23 below.

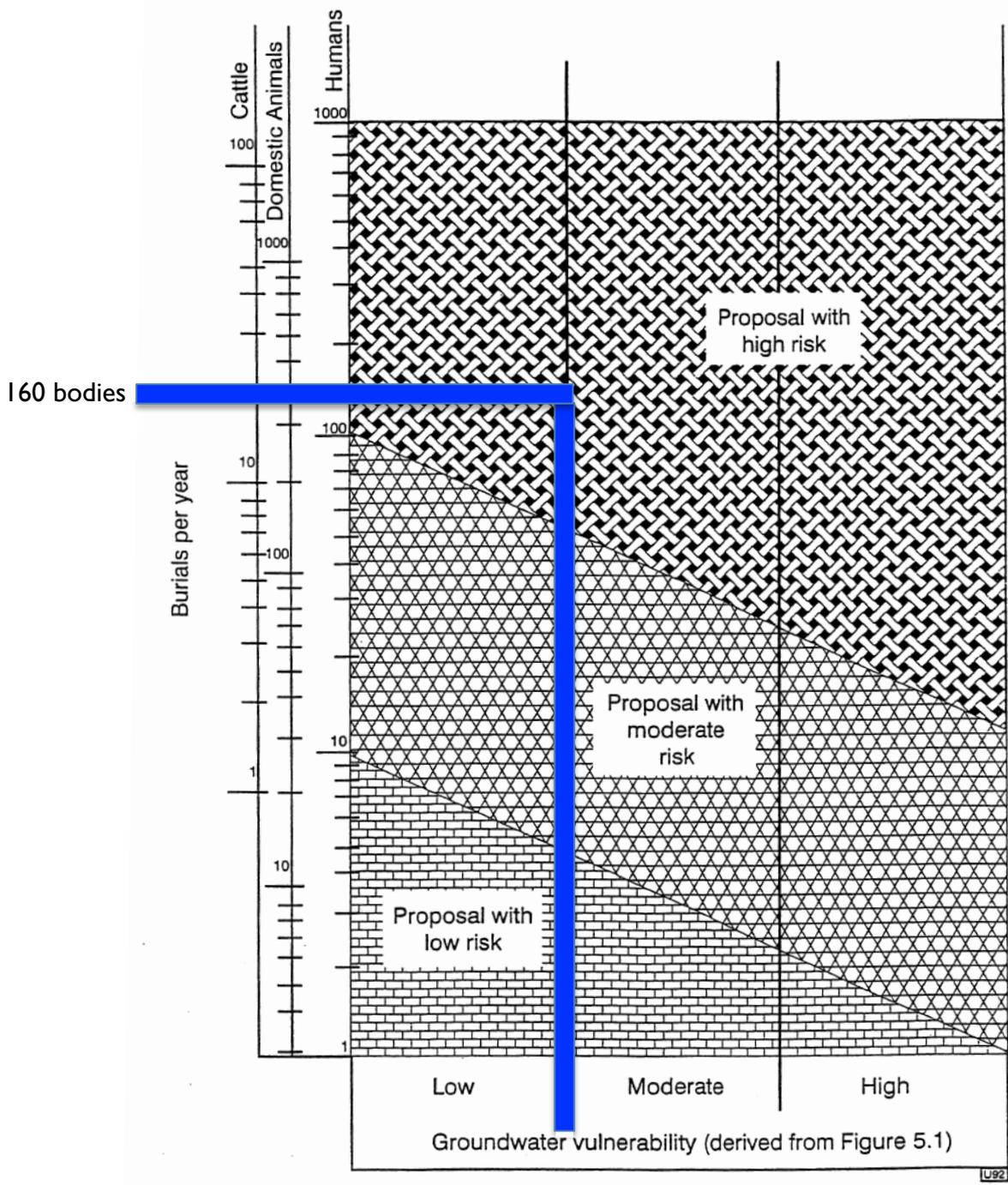
<b>Year</b>	<b>New</b>	<b>Reopen</b>	<b>Totals</b>
2016	209	114	<b>323</b>
2017	198	81	<b>279</b>
2018	251	103	<b>354</b>
<b>Average</b>	<b>219</b>	<b>99</b>	<b>319</b>

*Figure 23: Body burials at Hendon Cemetery 2016 to 2018*

It is difficult to accurately predict the impact that the opening of the new Milesplit Hill site will have upon demand for burial at Hendon Cemetery. At this stage, an assumption that both sites will share 50% of burials seems reasonable, due to their close proximity.

Using the relationship between vulnerability, burial rates and the level of risk, as shown in the diagram overleaf (note the different scales for animals and humans), the appropriate level of risk assessment of these two sites is High, even with numbers of burials shared equally between the two sites.

# Schematic relationship between burial rates, vulnerability class and level of risk



**Figure 5.2 Schematic relationship between burial rates, vulnerability class and level of risk**

Figure 24: Schematic relationship between burial rates, vulnerability class and level of risk