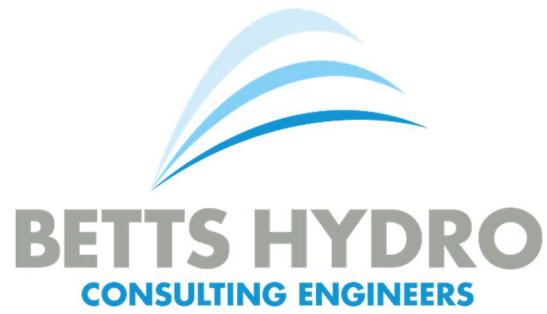




**PITCH DEVELOPMENT  
RADCLIFFE MOOR ROAD, BURY**

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**HYDROLOGICAL ASSESSMENT**

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For

Westchurch Homes

**MAY 2022**

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**PITCH DEVELOPMENT  
RADCLIFFE MOOR ROAD, BURY  
HYDROLOGICAL ASSESSMENT**

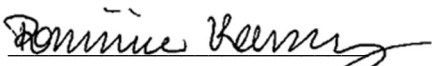
**Document Tracking Sheet**

**Document Reference:** HYD633 Hydrological Assessment  
**Revision:** 1.2  
**Date of Issue:** 11<sup>th</sup> May 2022  
**Report Status:** DRAFT

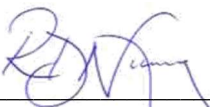
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**Revision History:**

| Rev.: | Date:      | Status: | Prepared by: | Checked by: | Issued by: |
|-------|------------|---------|--------------|-------------|------------|
| 1.2   | 11/05/2022 | DRAFT   | RDN          | DK          | RDN        |
| 1.1   | 09/05/2022 | DRAFT   | RDN          | DK          | RDN        |
| 1.0   | 06/05/2022 | DRAFT   | RDN          | DK          | RDN        |
| 0     | 05/05/2022 | DRAFT   | RDN          | DK          | RDN        |



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## EXECUTIVE SUMMARY

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This Hydrological Assessment has been commissioned by Westchurch Homes to support a planning application for the development of the site off Radcliffe Moor Road, Bury for a series of football playing pitches and a changing facility and carpark.

Intrusive investigations to a depth of 30m did not encounter any artesian water and encountered the rockhead at 7-9m below ground level. One spring was identified on site which is on the southern boundary and adjacent to the fishing ponds. This spring overtops from the site and is a source of water for the ponds and will not be changed.

The proposed SW drainage strategy is designed to mimic the existing drainage arrangement. There is no formalised connection into the adjacent land and this will continue. The new drainage will introduce pipework and filtration via granular construction materials, swales and reed beds at attenuated greenfield runoff rates that will allow groundwater recharge, evaporation and overtopping as exists presently.

Earthworks operations will stand a safe distance away from the existing waterbodies to ensure that there is no impact on water or associated waterbody structures

It is demonstrated within the report that none of the proposed works or longer-term development implications will place a burden onto the adjacent waterbodies. On the contrary, there are benefits that can be secured post-development including long-term maintenance access, improvement of water quality and control of chemical applications that will protect the long-term future of the ponds and lodges adjacent to the site.

This report has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate and will have no adverse impact on neighbouring land uses.

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## Specialist Software

-  Microdrainage (v.14.1) – Calculation of Greenfield run-off rates IH124/ICP-SUDS/ADAS345, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.
-  Flood Estimation Handbook FEH– Determination of Catchment Descriptors and depths of rainfall.

## Abbreviations & Acronyms

|             |                                       |
|-------------|---------------------------------------|
| <b>AEP</b>  | Annual Exceedance Probability         |
| <b>BGS</b>  | British Geological Survey             |
| <b>BMBC</b> | Bury Metropolitan Borough Council     |
| <b>CC</b>   | Climate Change                        |
| <b>CSAI</b> | Cranfield Soil and Agrifood Institute |
| <b>EA</b>   | Environment Agency                    |
| <b>FEH</b>  | Flood Estimation Handbook             |
| <b>FRA</b>  | Flood Risk Assessment                 |
| <b>LLFA</b> | Lead Local Flood Authority            |
| <b>LPA</b>  | Local Planning Authority              |
| <b>mAOD</b> | Metres Above Ordnance Datum           |
| <b>NGR</b>  | National Grid Reference               |
| <b>NPPF</b> | National Planning Policy Framework    |
| <b>OS</b>   | Ordnance Survey                       |
| <b>PFRA</b> | Preliminary Flood Risk Assessment     |
| <b>PPG</b>  | Planning Practice Guidance            |
| <b>QSE</b>  | Quick Storage Estimate                |
| <b>QBAR</b> | Mean Annual Flood                     |
| <b>SfA</b>  | Sewers for Adoption                   |
| <b>SFRA</b> | Strategic Flood Risk Assessment       |
| <b>SuDS</b> | Sustainable Drainage Systems          |
| <b>TWL</b>  | Top Water Level                       |
| <b>UU</b>   | United Utilities                      |

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## 1.0 INTRODUCTION

---

### 1.1 Development Proposals

- 1.1.1 The site is part of a wider project that includes the relocation of Wyresdale FC from its present home off Inverbeg Drive, Bolton to new, modern state of the art facilities off Radcliffe Moor Road in Bury.
- 1.1.2 A full planning application – Application Ref. 67658 was made by Westchurch Homes in October 2021 for;

*“Change of use of the land for use as outdoor sports pitches including engineering operations to form 4 pitches, the construction of a clubhouse, ancillary storage structures, creation of access from Radcliffe Moor Road, parking, landscaping, drainage and associated works”.*

### 1.2 Site and Planning Context

- 1.2.1 The application is supported by a Planning Statement Ref: 62622/01/SPM/RHT 19961179v3 dated July 2021 by Lichfields.

The Site comprises of two roughly rectangular parcels of land and extends to approximately 6.2ha (15.3 acres) and slopes gradually from north to south. The Site's existing use is as agricultural land comprising open grazing fields classed Grade 4 (poor quality) in terms of Agricultural Land Classification by Natural England<sup>1</sup>.

### 1.3 Consultation

- 1.3.1 The preparation of this report has been undertaken in consultation with Bury Metropolitan Borough Council (BMBC). Representations have been made by Graham Schoon (Countryside Officer), Benjamin Medlock (Planning Officer) as well as anecdotal feedback from LLFA. Stillwater Associates who are Panel Engineers on behalf of the Council have been and will continue to be consulted on the proposals.

Consultation responses are within **Appendix A**.

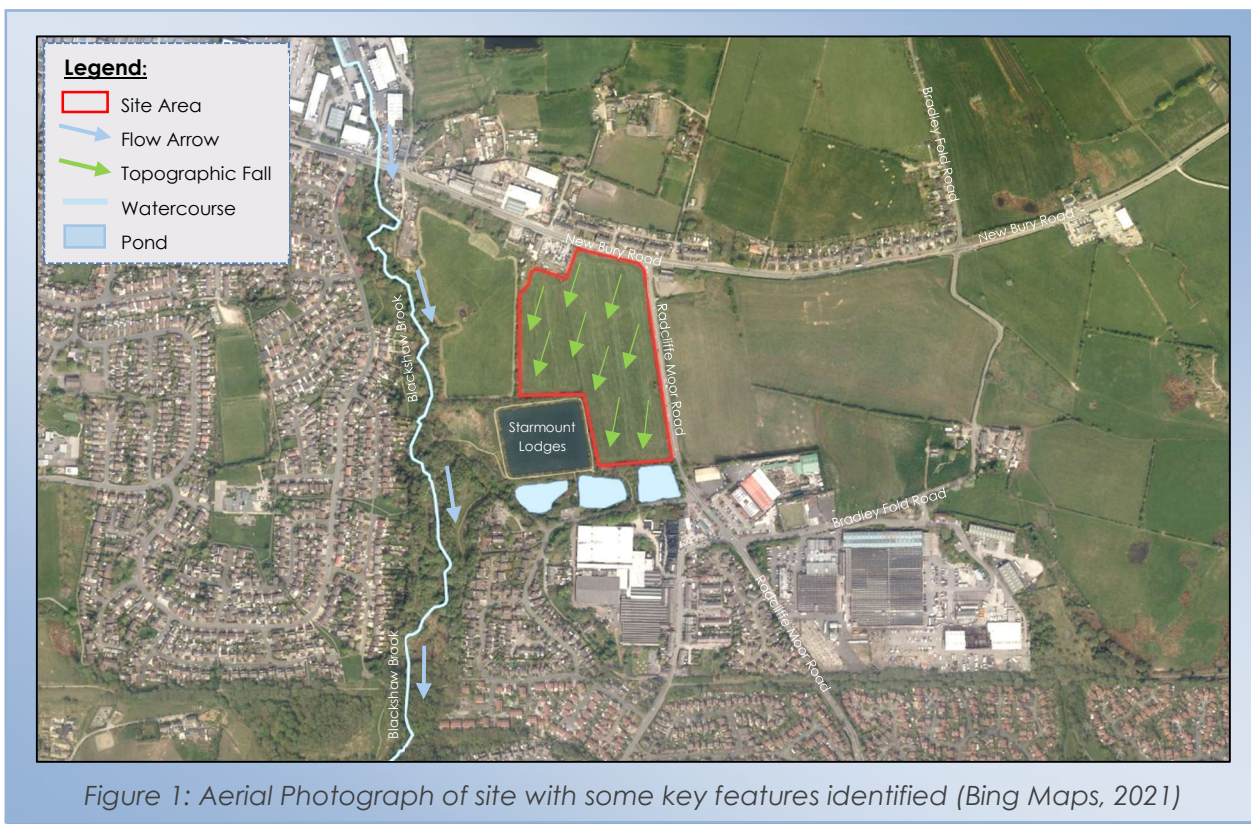
### 1.4 Objection

- 1.4.1 BMBC have formally objected to the Planning Application on matters relating to the hydrology, protection of the adjacent reservoir, water quality and we will endeavour to address these points raised within this report and supporting information. The details of the objection are set out in full in section 3.

## 2.0 EXISTING SITE LOCATION

### 2.1 Location

- 2.1.1 The development site is located off Radcliffe Moor Road in Bury. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 375544, N: 409104 and the nearest postcode is BL2 6QB. A location plan is included in **Appendix B**.
- 2.1.2 The site covers 3.85ha, with Bury New Road to the north and Radcliffe Moor Road to the east. To the south of site is Starmount Lodge Reservoir and fishing lakes, and to the west is agricultural grazing land, with Blackshaw Brook beyond, as illustrated in Figure 1.



### 2.3 Topography

- 2.3.1 A topographic survey has been undertaken and included within **Appendix C**. Existing ground levels fall from at high point ~117.40mAOD in the northeast corner (adjacent to Bury New Road) to ~99.50mAOD in the southwest (adjacent to the reservoir's northern embankment) and to ~101.15mAOD to the south (fishing ponds), as shown in Figure 2 overleaf.



Figure 2 – existing ground level contours (from LiDAR) overlaid on an aerial image

## 2.2 Existing and Historical Land Use

2.2.1 The site is currently undeveloped and comprises of low-density vegetation, with trees and shrubs along the field boundaries. Historically the site was utilised for agricultural purposes and no other historical uses have been identified during this assessment, however the Ground Investigation has identified a number of historic uses including a former well, a pumping pit (for drainage of coal mines), possible mound of made / reworked ground (eastern parcel) and former houses along the boundary edge. The suspected approximate locations are shown in figure 3 which is an extract from the Betts Geo-Environmental Ground Investigation Report, 2021.



Figure 3 – suspected approximate locations of historical features (Note the red-edge is shown beyond application site as part of a wider study area)

- 2.2.2 It is understood that the reservoir to the south of site was constructed for the Bradley Fold Print Works to be used as processing water.
- 2.2.3 It was confirmed during the site walk-over that the reservoir is not used for abstraction and is linked to the middle lodge by a high-level overflow channel shown in photograph 1 overleaf.
- 2.2.4 There is also a drain-down valve from the reservoir to the lower lodge which was installed relatively recently, shown in photograph 2 overleaf, however it is understood that following installation this would not function, most likely due to corrosion in the upstream pipework.



*Photographs 1 and 2 – showing the high-level overflow and low-level drain-down valve*

## 3.0 BMBC OBJECTION DETAILS

---

### 3.1 Matters of objection

3.1.1 The objection is stated in full below and then subsequently summarised for ease.

*"Further to our meeting yesterday I am writing to formally object to Planning Application No.6758.*

*The Council owns the adjoining land to the south of the application site.*

*The area is public open space and has a large raised reservoir and three smaller lodges. The angling on the reservoir and lodges is managed by Radcliffe Angling Society on behalf of the Council. The reservoir and two of the lodges are used for angling. The third lodge is managed as a wildlife area. Over the last few years, the Council has invested in the angling facilities on site and have provided the anglers with a classroom to facilitate their coaching programme which aims to encourage juniors and others to take up angling and the wider community to engage with the sport.*

*Maintaining water quality/quantity is fundamental to the health of all waterbodies and any alteration or interruption to the water supply caused by the proposed development would be highly detrimental to the fishery.*

*The continuing success of Radcliffe Angling Society depends on maintaining the good water quality/quantity within the lodges to sustain a productive healthy fishery.*

*Introduction of fertilisers through the drainage system from the proposed development would increase the nutrient levels in the water which is likely to trigger excessive aquatic weed growth rendering the water unfishable. There is a further risk of blue green algal blooms that are hazardous to public health and can trigger fish kills due to oxygen deficiency.*

*The Council has had experience of other waters that it owns becoming eutrophic following disruptions to water supplies or introduction of nutrients. Repairing the damaged caused has proved to be difficult, expensive and has taken several years.*

#### *Water supply to the reservoir.*

- The proposed development does not ensure that the quantity and quality of the water feeding the reservoir is not reduced.*
- The water supply to the raised reservoir is believed to originate from springs within the confines of the reservoir that are connected to an aquifer(s) within the application site. There is a risk that the proposed excavation works will sever the water supply and lead to the reservoir drying out.*
- There is a risk that the proposed excavation works may lead to the aquifer becoming contaminated with water from the abandoned mine workings, and/or from the fertilizers and herbicides used to maintain the pitches, and/or surface water drainage from the carpark.*

*There is no site investigation information, design details, risk assessments or method statements demonstrating how the above risks might be managed.*

Reservoir Safety.

*The reservoir is classified as high risk under the Flood and Water Management Act, 2010 as there is a risk of death should it breach.*

- *As proposed increased standing water or water flows along the toe of the east and north dam increases the risk that the dam may become unstable and breach.*
- *Carrying out excavation works in close proximity to the toe of the north and east embankment may cause the dam to become unstable and breach.*
- *Increased flows of water or an increase in water level into and through the three lower lodges may cause the adjoining south dam to become unstable and breach.*

*There is no site investigation information, design details, risk assessments or method statements demonstrating how the above risks might be managed.*

*The development as proposed in the application does not demonstrate how the safety and stability of the reservoir structure will be maintained both during and after the construction phase.*

Water supply to the three lower lodges.

*The lodges are supplied from a spring/stream entering the eastern lodge on the north side where they adjoin the application site. There is also a supply from the reservoir spillway entering the middle lodge.*

- *The proposed development does not ensure that the quantity and quality of the water feeding the lodges is not reduced.*
- *If the water quality/quantity from raised reservoir is reduced (see above) this would in turn contaminate the two lower lodges.*
- *There is a risk that the springs/stream may become contaminated with water from the abandoned mine workings, and/or from the fertilizers and herbicides used to maintain the pitches, and/or surface water drainage from the car park.*
- *There is no assessment of the suitability, condition, or capacity for the existing drainage system from the lodges to Blackshaw Brook.*

*There is no site investigation information, design details, risk assessments or method statements demonstrating how the above risks might be managed."*

3.1.2 Summary of the key points of the objection which are all addressed in this document:

- 1) Water quantity and quality being discharged to the fishing lodges
- 2) Risk of nutrient enrichment to the fishing lodges
- 3) Water quantity and quality entering the reservoir
- 4) Risk of contamination or nutrient enrichment to the reservoir
- 5) Reservoir safety

## 4.0 GEOLOGY

---

### 4.1 Geology and Soils

- 4.1.1 The British Geological Survey describes the bedrock geology and superficial deposits as follows: -

BGS Bedrock geology

The 1:50 000 scale bedrock geology description: Cannel Rock (south Lancashire) - Sandstone. Sedimentary Bedrock formed approximately 318 to 319 million years ago in the Carboniferous Period.

BGS superficial deposits

The 1:50 000 scale superficial deposits description: Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period.

- 4.1.2 The British Geological Survey describes the bedrock geology and superficial deposits as follows: -

Cranfield Soil and Agrifood Institute Soilscales viewer description

Soilscale 17: *Slowly permeable seasonally wet acid loamy and clayey soils*

Texture: *Loamy and clayey*

Drainage: *Impeded drainage*

Drains to: *Stream network*

- 4.1.3 The Agronomist (PSD Agronomy, 2021) provides the following characterisation of the soils: -

*The Soil Survey of England & Wales indicated the site would probably comprise the Brickfield 3 Association. The Association consists predominantly of loamy and clayey surface water gley soils. The parent material is a greyish till or Head derived from Carboniferous and other Palaeozoic sandstone and shales. The loamy textures are due to the preponderance of sandstone in the drift.*

*The main soils are seasonally waterlogged (Wetness Class IV) but with satisfactory agricultural drainage, may be in Wetness Class III where annual rainfall is less than about 900mm. They have slowly permeably loamy and clayey subsurface arisings which cause surface waterlogging. Surplus winter rainfall mainly moves away laterally at shallow depth and underdrainage is essential.*

*Much of the Association is under permanent grass for livestock and grass growth in spring is often retarded by cold, wet land.*

- 4.1.4 As part of the Ground Investigation work the risk from former mining was assessed. 7 boreholes were drilled to up to 30m on the site in the location of the proposed clubhouse. Three holes were drilled to 30m depth and a further 4 shallow holes to prove rockhead depth and search for the outcrop of the Trencherbone Mine. The Cannel Rock was encountered in every hole and there was no evidence of any coal or old mineworkings, therefore a Low Risk to the proposed development.

## 5.0 HYDROLOGY

### 5.1 Hydrology

- 5.1.1 There are no observable watercourses crossing the site and the nearest Main River is Blackshaw Brook approximately 150m to the east of site.
- 5.2.2 The flood risk to the site from Blackshaw Brook is 'very low' based on the proximity to site and the surrounding topography. This is further supported by the Governments fluvial/tidal flood risk mapping, which shows the site at little to no risk of flooding from Blackshaw Brook.
- 5.2.3 Initial consultation with the EA, BMBC and UU also failed to highlight any historical flooding directly to the site or the surrounding area. This is further supported by the review of Bury Metropolitan Borough Council's Strategic Flood Risk Assessment, which does not identify the site location to be at flood risk from fluvial sources.
- 5.2.4 The UK Centre for Ecology and Hydrology maps identify the site as being within the catchment of Blackshaw Brook.

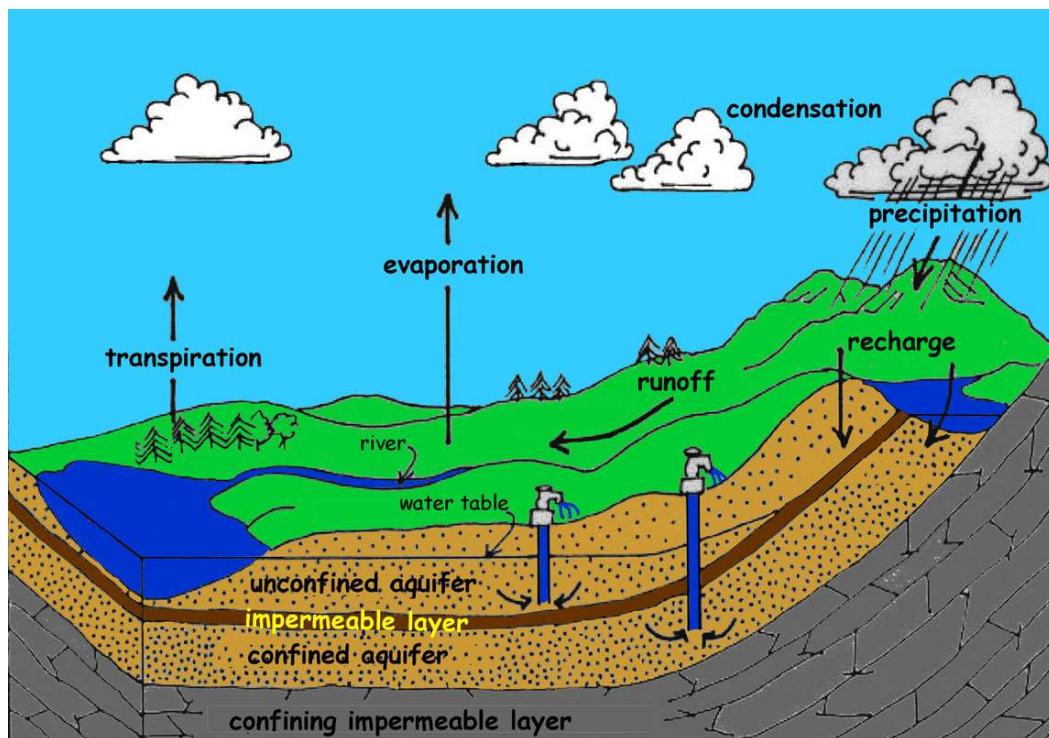


Figure 4 – Water Cycle (Summit to the Sea, 2002)

## 6.0 HYDROGEOLOGY

### 6.1 Hydrogeology

- 6.1.1 The Superficial deposits of the Glacial Till are classed as a Secondary Aquifer – Undifferentiated.
- 6.1.2 The bedrock deposits of the Sandstone and Pennine Coal Measure are classed as a Secondary A Aquifer – High Permeability.

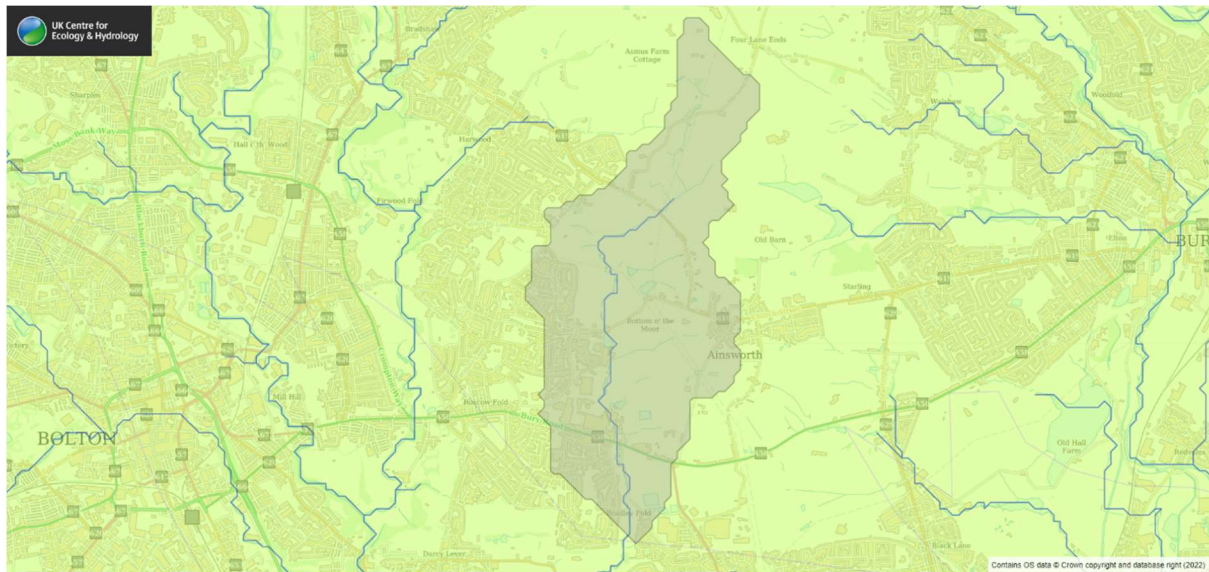


Figure 5 – FEH catchment plan showing BGS Hydrogeology, (UK Centre for Ecology & Hydrology, 2022)

- 6.1.3 The Centre for Ecology and Hydrology mapping data shows the site is underlain by a 'moderately productive aquifer 2B (fissured)', see figure 5.
- 6.1.4 The site does not lie within Groundwater Source Protection Zone as defined by the Environment Agency.
- 6.1.5 There are no current licenced groundwater water abstractions within 250m of site although there are four (4 No) historic licenses.

### 6.2 Groundwater

- 6.2.1 The Groundwater Vulnerability Maps show the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a single square kilometre. The map has five risk categories (High, Medium-High, Medium, Medium-Low and Low) based on the likelihood of a pollutant reaching the groundwater (i.e. the vulnerability), the types of aquifer present and the potential impact (i.e. the aquifer designation status). The simplified Groundwater Vulnerability Map indicates the risk to be 'medium-low'.

### 6.3 Source Protection Zones

6.3.1 Source Protection Zones (SPZs) are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction. This is part of an initial screening process in assessing impacts to groundwater resources. Zones around location sites are defined by groundwater travel time to an abstraction. This is determined through applying Environment Agency groundwater flow models run at the location of abstractions, inputting parameters such as flow direction, geology type, rainfall and hydrological boundaries. SPZs provide a visual representation of the increased risks as you get closer to the abstraction.

6.3.2 The site does not sit within a Source Protection Zone.

6.3.3 In terms of groundwater and aquifer risk the Betts Geo-Environmental Ground Investigation Report, 2021 confirms that 'no significant contamination sources have been identified within the soils onsite and given the presence of low permeability soils, the risk to groundwaters and the aquifer from site is considered very low.'

### 6.4 Starmount Lodge Reservoir

6.4.1 The reservoir is elevated relative to the surrounding ground and is understood to be fed by artesian water from the aquifer beneath (the Secondary A Aquifer with High Permeability within the bedrock deposits of the Sandstone and Pennine Coal Measure).

6.4.2 Photographs 3 and 4 below show the relative elevation of the reservoir compared to the significantly lower level on the northern side of the reservoir. Photograph 3 is looking east standing on footpath that runs along the top of the northern embankment. Photograph 4 is looking south at the northern embankment.



*Photographs 3 and 4 – showing the relative elevation of the reservoir's northern embankment compared to site.*

6.4.3 Comments have been received from Stillwater Associates who provide the Council with advice regarding reservoirs. Stillwater Associates comments are as follows: -

*We have the following reservoir safety related comments in relation to the proposed development:*

- 1. The proposed works should not impact the reservoir embankment structure adversely. Therefore there should not be any filling / excavation on the embankment or within 5m of the toe of the embankment. A 5m buffer around the toe of the embankment should also be maintained to allow for adequate inspection of the embankment and maintenance.*
- 2. Any additional surface water generated from the proposed works shall be drained sufficiently around the reservoir and not impound / pond up against the embankments, particular on the north side of the reservoir.*
- 3. As the reservoir is spring fed any changes to the springs / groundwater level / aquifers could change the flows into the reservoir (increase or decrease). Your submission should include an assessment of possible changes to the inflows entering the reservoir.*
- 4. As two of the ponds to the south of the reservoir are located adjacent to the reservoir embankment toe, any potential change in the water level within the ponds from additional flows entering the ponds from the development is to be assessed. If any changes in the pond level are possible the impact of these on the stability of the reservoir embankment is to be assessed.*

*We will leave the council to comment on possible quality issues in the reservoir and downstream ponds as this is outside our area of expertise.*

- 6.4.4 We respect the requirement for an offset/easement from the reservoir embankment and agree to the 5m offset from the toe. This is incorporated into the proposals.
- 6.4.5 Appropriate drainage systems will prevent surface water generated by the development proposals from ponding at the toe of the embankment.
- 6.4.6 There should be no impact on the aquifer feeding the reservoir as the ground investigation works encountered no groundwater at the depths of excavation proposed. It is understood the aquifer is within the Sandstone bedrock and is >7m deep.
- 6.4.7 There should be no increase in the water levels within any of the fishing lodges as the flows from site are being attenuated and there is a very limited amount of impermeable area (the building roof only).

## **6.5 Spring on the southern boundary**

- 6.5.1 There is a spring observable near the southern boundary with flow leaving the site discharging into the upper and middle lodges. This is understood to be from the Secondary Aquifer within the Glacial Till layer (superficial deposits).
- 6.5.2 This spring water provides a baseflow through the fishing lakes and must be maintained.



*Photograph 5 – Spring location on the southern boundary feeding the lodges*

- 6.5.3 It was a dry day when the most recent site walk-over was undertaken and there was an observable flow from the spring at the location in photograph 5 above.

## **6.6 Existing Surface Water Runoff**

- 6.6.1 The ground conditions and topography are such that rainfall landing on the site will runoff from northeast to the southwest towards the fishing lakes and reservoir (Starmount Lodges).
- 6.6.2 At present the topography and ground conditions would indicate that some infiltration will occur over time, but this will be dependent on the saturation of the ground when rainfall occurs. When there has been an extended period of rainfall then the ground is likely to be saturated and the ability for further water to infiltrate is reduced resulting in surface water runoff, both on the surface (observable) and within the surface soils.
- 6.6.3 Existing hedgerows will intercept runoff enabling root uptake will reduce the rate and volume of runoff leaving the site, also they will also help slow the flow and allow more time for infiltration to occur, albeit limited due to the soil type.
- 6.6.4 The site levels mean that the existing catchment of the site can be considered split in two with a proportion of surface water runoff from the eastern parcel going to the southern boundary adjacent to the upper fishing ponds (eastern-most). This area had standing water and the adjacent ground was locally saturated underfoot. Levels are such that surface water runoff combines with spring water at this boundary location before discharging informally into the fishing ponds.
- 6.6.5 The surface water runoff from the western parcel should fall to the southern boundary adjacent to the reservoir, however there was no evidence of any saturation of ground at the low point or along the boundary, which was anticipated due to the reservoir embankment being raised relative to site.

- 6.6.6 Investigation in the form of a walk-over further to the west of site along the northern edge of the reservoir down towards Blackshaw Brook found more saturated ground and some small areas of standing water.
- 6.6.7 There is a reasonable likelihood that some surface water runoff from the site may be being intercepted by the 'bedding and surround' of the Gas Main, which is likely to be granular and may offer an easier flow path. This corridor may inadvertently be intercepting some surface water runoff from the land to the north of the Gas Main which is why there is no ponding or saturation of the ground adjacent to the northern toe of the reservoir embankment. The routing of the Gas Main corresponds with the saturated ground further west.
- 6.6.8 It is reasonable to assume that there may also have been a toe drain installed during the construction of the reservoir to avoid any standing water in this location as the reservoir is elevated relative to the site and the ground falls to this location.

## 7.0 DEVELOPMENT PROPOSALS

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### 7.1 Summary

- 7.1.1 It is proposed in the surface water drainage strategy to mimic the existing hydrology as closely as possible. Perforated pitch drainage pipes will be installed at 5m centres beneath the pitches and will be attenuated to greenfield flow rates at source.
- 7.1.2 The clubhouse and carpark drainage will be attenuated to greenfield runoff rates. The drainage will pass through a piped network either directly into the groundwater, or via the pipes into the swale and reed bed area.
- 7.1.3 There is no positive connection to be made into any pond, watercourse, waterbody or pipe. As a consequence of this strategy, no off-site works associated with the surface water drainage, nor is there any requirement for a legal easement necessary.
- 7.1.4 Water will collect in the swale and reed bed and will evaporate, filter into the groundwater or will overtop in times of heavy rainfall into the pond network to the south.
- 7.1.5 The introduction of reed bed from will improve water quality prior to any hydraulic continuity with the adjacent waterbodies.

### 7.2 Levels alterations

- 7.2.1 There are no proposals on the site that should impact on the sandstone aquifer which is understood to be at >7m deep.
- 7.2.2 Although earthworks and regrading of the site will take place to generate suitable development platforms there are no deep excavations proposed as levels are, in the main, being built-up.
- 7.2.3 The developer has produced a range of cross-sections through the development land indicating a rockhead profile based on the ground investigation works and deep boreholes (>30m deep).
- 7.2.4 Any levels alterations adjacent to the reservoir embankment are of critical importance to avoid any risk to the existing structure. There are two boundaries of the site that follow the toe of the existing reservoir embankment. Where these boundaries meet there is little retaining, however following the northern reservoir embankment west this embankment becomes more elevated as the land on the development site falls away. This is similar along the eastern reservoir embankment as you head south the embankment becomes more elevated as the land on the development site falls away but to a lesser extent.
- 7.2.5 Pitch 2 (u13/u14 pitch) is adjacent to the northern reservoir embankment. There are no proposals for any levels alterations within 3 metres of the toe of the embankment. This will avoid any increase in loading, any undermining or instability and will also mean that

if an existing land drain runs along the toe of the embankment then it will remain undisturbed to minimise the risk of any standing water at the toe of the embankment.

- 7.2.6 There should be no adverse impact on the northern embankment toe, see figure 6 overleaf which is an extract from Section A-AA drawing in Appendix D.

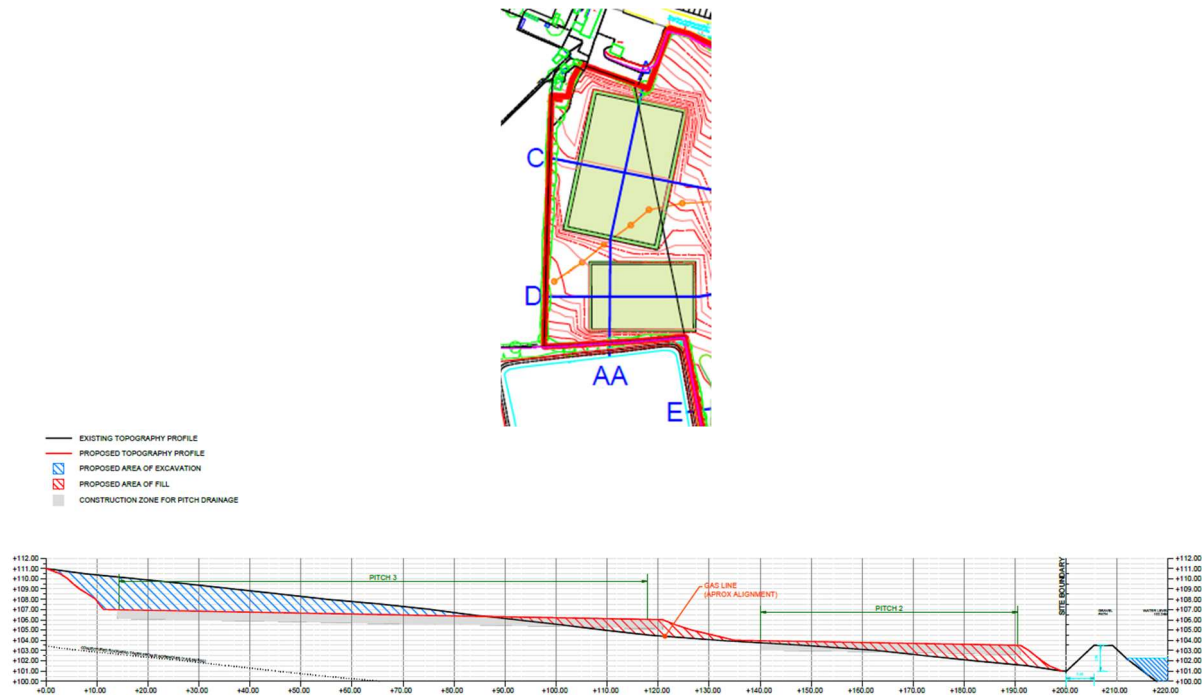


Figure 6 – Extract of cross-section A-AA, Westchurch Homes

- 7.2.7 Pitch 1 (full size) is adjacent to the eastern reservoir embankment. There are no proposals for any levels alterations within 3 metres of the toe of the embankment. This will avoid any increase in loading, any undermining or instability and will also mean that if an existing land drain runs along the toe of the embankment then it will remain undisturbed to minimise the risk of any standing water at the toe of the embankment.
- 7.2.8 There is some standing water at present in the southern corner near the middle lodge, however the introduction of the swale and reed beds should improve this situation.
- 7.2.9 The swale is a relatively shallow feature at <1.2 metres deep, it will have a side slope gradient of no steeper than 1:3. The offset distance from the toe of the embankment will vary as the feature is proposed to be non-linear, however it will be set at least 3m from the toe of the embankment.
- 7.2.10 The swale will be a conveyance/attenuation type for part and a wet swale for part to offer a range of benefits. The swale will connect into a series of reed beds which provide a range of water quality improvement measures but should also assist in controlling the location of any standing water which should reduce the amount of standing water at the toe as currently observed.
- 7.2.11 TBA are preparing a Landscape Management Plan and an updated landscaping drawing for the reed bed/swale area with the 5m stand-off shown.

7.2.11 There is an extract shown below in figure 7, from cross-section E-EE through the proposed swale which helps to demonstrate the relative position of the drainage feature and the reservoir embankment and it is clear that there is no impact on the plane of influence.

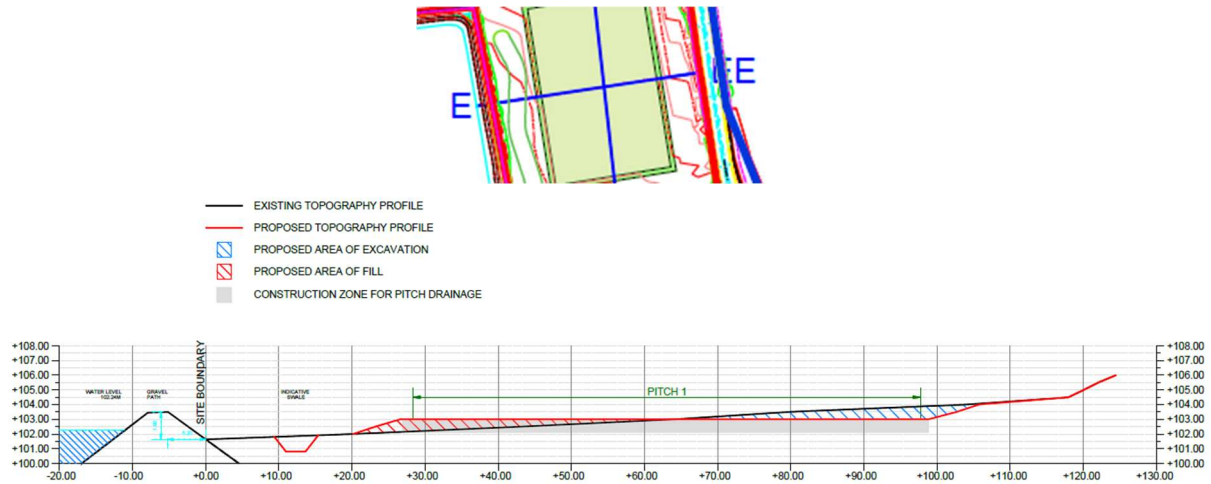


Figure 7 – Extract of swale cross-section E-EE, Westchurch Homes

7.2.12 There is an extract shown below in figure 8, from a cross-section through the proposed pitch 1 and the location of the spring which helps to demonstrate the relative position of the drainage feature and the lodge and it is clear that there is no significant change in levels in this location.

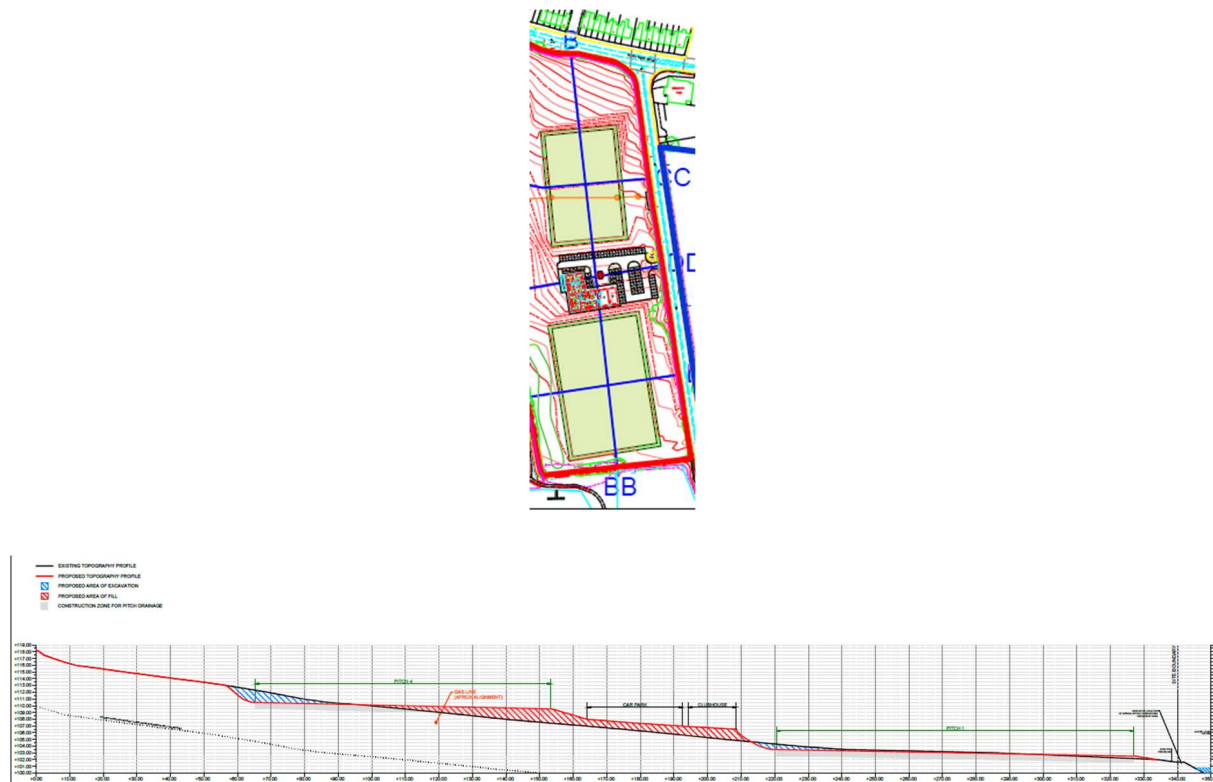


Figure 8 – Extract of cross-section B-BB, Westchurch Homes

### **7.3 Surface water management**

- 7.3.1 The proposed pitches will, to all intents and purposes be level and will therefore necessitate some levels alterations, however this will be kept to a minimum with pitches set at different levels (terracing) and no retaining is proposed.
- 7.3.2 The key principle is to try and mimic the existing hydrology both in terms of the runoff generated by the surface and the flow from the spring. The proposed drainage management strategy indicates that runoff runoff will continue to discharge to the lodge to the south of pitch one.

### **7.4 Surface water discharge hierarchy**

- 7.4.1 There are three methods that have been reviewed for the management and discharge of surface water. These may be applied individually or collectively to form a complete strategy and should be applied in the order of priority listed below: -

-  Discharge via infiltration
-  Discharge to waterbody
-  Discharge to public sewer network

- 7.4.2 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water system onsite. The ground conditions are not favourable for infiltration to occur but slowing the flow and allowing as much time as possible for infiltration to occur or other natural losses is appropriate.
- 7.4.3 At present the majority of surface water runoff goes south overland and in the surface strata to the eastern and highest fishing lodge. This is in the approximate location where the spring is observable from the water within the glacial till layer. It is proposed that the current situation be mimicked as much as possible.
- 7.4.4 No surface water runoff is proposed to discharge to the public sewer network.

### **7.5 Surface water discharge rate**

- 7.5.1 The majority of the development proposals are permeable surfacing, such as the pitches and the permeable car parking area. The only area of impermeable proposed is the roof area for the clubhouse.
- 7.5.2 In accordance with the SuDS Manual (CIRIA) and the Non-Technical Standards for SuDS (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable.
- 7.5.3 To mimic the existing greenfield runoff rate the runoff from the area of impermeable should be restricted (the roof of the building). In addition, the car park will drain much more quickly than the current surface layers due to the high void ratio within the

proposed sub-base. The attenuation of flow from the car park can be contained within the sub-base for the key design storm events and the small roof area can be contained separately after it has passed through a raingarden.

- 7.5.4 The greenfield runoff rate generated by the site is calculated to be 11.3 l/s/ha based on the FEH Statistical method. Based on the proposed development area of 2.97ha the development existing runoff rate, and proposed restricted rate is 33.7 l/s. This results in almost nil stormwater storage requirement even in the 1 in 100 year plus 40% Climate Change event for the majority of the development as the proposals are almost entirely permeable surface. The building roof area which is approximately 786 sq.m will be attenuated to 0.9 l/s which generates an approximate storage requirement of 52 cu.m in the 100yrRP+40%CCA event which will be contained within a rain garden and a length of swale.
- 7.5.5 The outlet orifice diameter for this low rate will be very small, to minimise the risk of blockage this outlet will be within a manhole that has a spill weir, catchpit and a granular filter medium before a terram wrapped pipe outlet constrained by an orifice plate.
- 7.5.6 The permeable car park will also have an orifice outlet restrictor as the car park will drain more quickly than the existing surface layers do. The car park area which is approximately 1,714 sq.m will be attenuated to 1.9 l/s which generates an approximate storage requirement of 113 cu.m in the 100yrRP+40%CCA event which will be contained within the granular subbase.
- 7.5.7 In addition to the stormwater storage within the car park sub-base and the raingarden there will also be storage within the swale and the reedbeds.

## **7.6 Climate Change**

- 7.6.1 There are indications that the climate in the UK is changing significantly, and it is widely believed that the nature of climate change will vary greatly by region. Current opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall. It is believed that the impact of climate change means there is likely to be a long-term increase in the average sea levels, with an expectation that sea levels will rise gradually. An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact.
- 7.6.2 In view of the future uncertainties surrounding Climate Change and the likely increase in rainfall intensity and duration and its impact upon the surface water drainage system it should be accounted for within the design of all new developments.
- 7.6.3 The updated Climate Change projections estimate changes to rainfall intensity and based on the design life of the development (100yrs) the "total potential change figures for the 2080's" have been selected; with the Upper End Estimate being 40% and the Central Change Factor of 20%.

## 7.7 Pitch Drainage

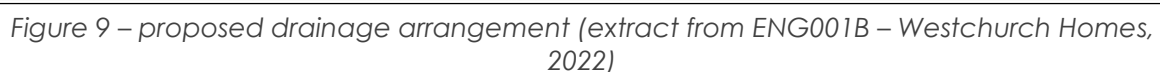
7.7.1 The runoff will be intercepted by the pitch drainage systems before flowing through a swale system and in turn a reed bed system. This is shown on the appended drainage drawing (ref. ENG001B, Westchurch Homes, 2022), an extract of this drawing is shown overleaf in Figure 9.

7.7.2 Review of the Agronomist's Report by PSD Agronomy, 2021 identifies that: -

- *Soil type, pitch usage levels and pitch standards required dictate that as a minimum a pipe/slit drainage system will be required for each pitch.*
- *Drainage of the grass areas between the pitches will be necessary to ensure access for the spectators and for the areas to be appropriately maintained.*
- *Irrigation is not considered essential but would be useful for reestablishment of worn areas in spring/early summer.*
- *Topsoil depth of 200-220mm is sufficient to surface the pitches.*

7.7.3 The Agronomist summarises that: -

- *Excess winter rainfall is high and will need to be removed by an efficient drainage system given the presence of the impermeable clay subsoil. Deterioration of the topsoil structural condition especially at the surface, would be expected given it would be at field capacity for much of the football season. Supplementing the pipe drainage system with sand slits to bypass the deteriorated topsoil must be considered as a component of the works along with sand amelioration of the topsoil or heavy sand topdressing to improve its natural drainage properties. The sand will also firm-up the surface reducing susceptibility to divoting.*
- *The need to irrigate to enable the sward to recover following renovations at the end of the soccer season in spring is assessed as not being essential but useful according to historical weather data. Nevertheless, a late summer sowing would normally be preferred for establishment of the pitches if the project timescales permitted.*
- *Overall, the analysis results indicate the topsoil to be fine textured and therefore it will possess behavioural characteristics which will require any future pipe drainage to be supplemented by surface drainage systems such as slit drainage, sand grooves and/or sand amelioration.*



The works include the following:

- Trimming /grading the already spread plateau topsoil to the required level.
- Type 5 Pitch pipe drainage – main drain, lateral drain at 5m centres, inspection chambers and cut-of drains.
- Final grading/trimming, cultivations, fertilising and seeding.
- Disposal of pipe drain arisings on-site within the earth works plan.

- 12 months establishment and maintenance – mowing, 4 no. fertilisers, overseeding as required, stone picking, 1 x herbicide and 1 x fungicide.
- Gravel slits at 1m centres following sward establishment.
- Slit arisings disposed off-site to the Contractor's tip.
- 3 no. sand topdressings, vertidrainage and drag matting.
- Preparation and seeding of peripheral areas; excludes the landscape planting illustrated on the proposed layout drawing.

#### **Option 2:**

The works include the following:

- Trimming /grading the already spread plateau topsoil to the required level.
- Type 5 Pitch drains – main drains, lateral drains at 3m centres, inspection chambers and cut-of drains.
- Installation of Koro slit drains at 500mm centres.
- Final grading/trimming, cultivations, fertilising and seeding.
- Disposal of pipe and Koro slit drain arisings on-site within the earth works plan.
- 12 months establishment and maintenance – mowing, 4 no. fertilisers, overseeding as required, stone picking, 1 x herbicide and 1 x fungicide.
- 3 no. sand topdressings, vertidrainage and drag matting.
- Preparation and seeding of peripheral areas; excludes the landscape planting illustrated on the proposed layout drawing.

#### **Option 3:**

The works are as per Option 1 plus the amelioration of the topsoil with a 50mm thick sand layer prior to seeding. This option would allow the reduction in the sand topdressings and vertidrainings from 3 to 2 during the establishment period.

#### **Option 4:**

The works are as per Option 2 plus sand amelioration of the topsoil with a 50mm thick sand layer prior to installation of Koro top drains. Again, the sand topdressing/vertidrainage operations in the establishment period can be reduced to 2.

- 7.7.4 Pitch Construction - A specialist contractor will be appointed to undertake the topsoil strip, earthworks, pitch drainage and pitch construction (including an initial 12 months maintenance period) in accordance with the Agronomist specification to achieve a Sport England type 5 standard of pitch.

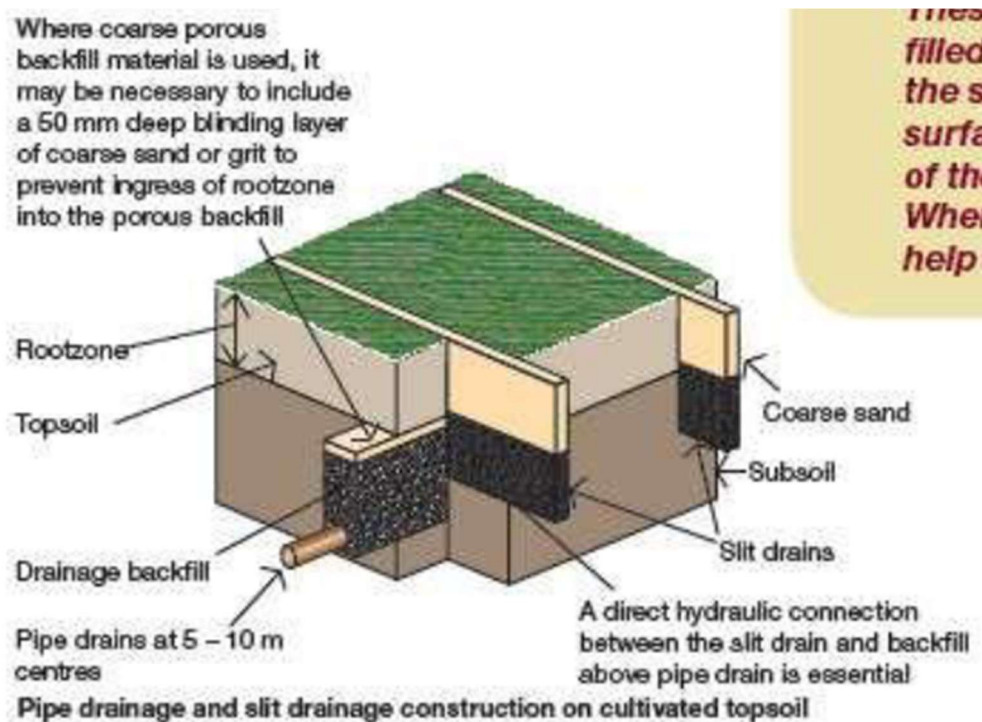


Figure 10 – Pitch drainage, Type 5: Pipe drained with slit drains

## 7.8 PH and Nutrient enrichment

- 7.8.1 The Agronomist has undertaken lab testing to establish the soil PH and nutrient status. In summary the soil is deficient in phosphorus and borderline in potassium which will require correcting to ensure the development of a healthy sward following cultivation and seeding.
- 7.8.2 It was identified that; the preferred pH range for a mineral soil to sustain a perennial ryegrass dominant sward is 6.0-6.5. The test result was 5.3 and therefore falls below the preferred range. Incorporation of a suitable lime material during future improvement works will be required to raise the pH to within its preferred range.
- 7.8.3 The extractable levels of nutrient reflect the availability of that nutrient to the growing plant. General guidelines indicate the preferred range for nutrients is in the index range of 2.0 to 4.0. Both the phosphorus and potassium levels are low and below the lower limit of the preferred range. The magnesium level is satisfactory being around the midpoint of the preferred range. However, both the phosphorus and potassium content of the topsoil will require to be raised to a satisfactory level during future pitch development works especially if the topsoil is sand ameliorated. This can be achieved by incorporating a suitable base fertiliser (e.g., 0% N: 20% P205: 20% K2O).
- 7.8.4 General pitch maintenance and management are set out within the Agronomist Report. Controls for the frequency of application and specification of fertiliser can be applied through planning conditions where necessary.

## 7.9 Raingarden, Swales and Reed Beds

- 7.9.1 The building roof area can pass through small raingardens to improve water quality and removes particulates; this also helps to deal with the first 5mm of rainfall. They take up very little space but provide an additional range of benefits and improve biodiversity.

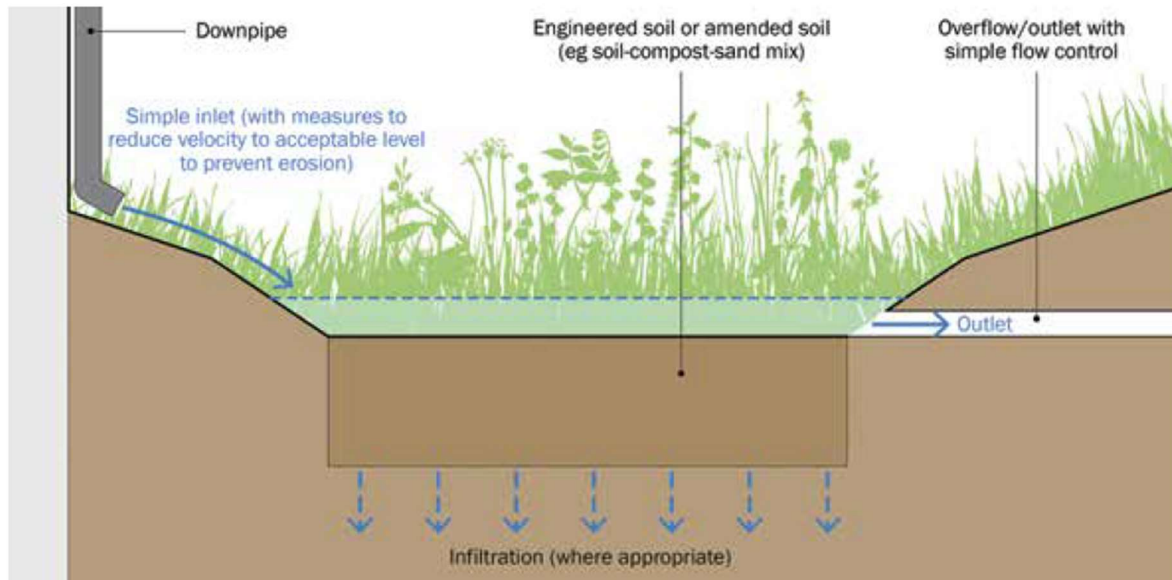


Figure 11 – Typical rain garden (CIRIA, 2015)

### Conveyance and attenuation swale

- 7.9.2 The conveyance swale is a shallow vegetated channel, these are particularly effective at collecting and conveying surface water runoff from the drained area to another stage of the SUDS management 'train'. They provide both treatment and attenuation.

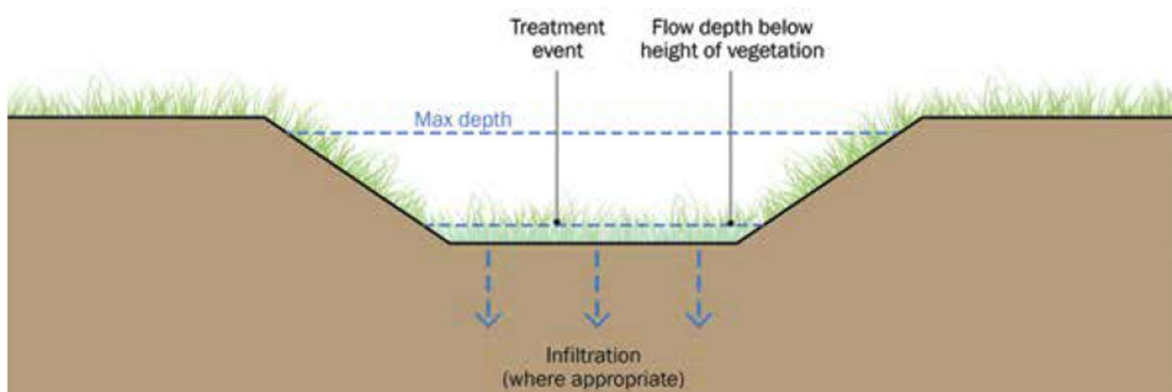


Figure 12 – Typical conveyance/attenuation swale (CIRIA, 2015)

### Wet swale

- 7.9.3 The conveyance swale will connect into a wet swale with some wetland planting before connecting into a reedbed area. The conveyance swale provides pre-treatment before the wet swale.

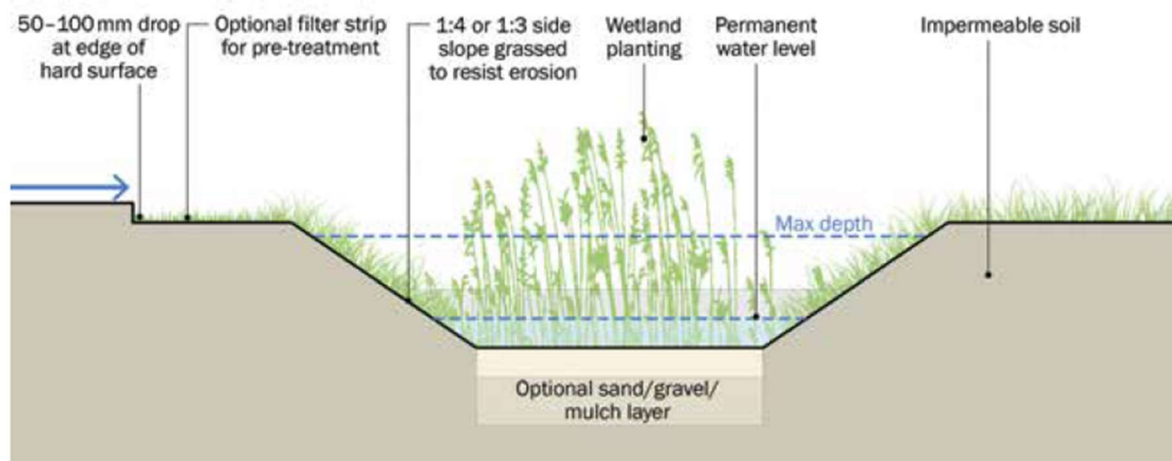


Figure 13 – Typical wet swale (CIRIA, 2015)

#### Reed Beds

- 7.9.4 The wet swale will connect into a reed bed. A reed bed is a wastewater treatment system that use growing wetland plants as the active component in getting effluent clean enough to discharge back into the receiving environment. Alternately called treatment wetlands, constructed wetlands or reed bed treatment systems, they have the potential to be low-cost, zero energy input, low-tech, high-efficiency systems that can be used to help protect streams and rivers from almost any source of effluent or dirty water. A typical example of the type of system proposed is shown below in Photograph 6.



Photograph 6 – Reed beds (lowimpact.org, 2022)

- 7.9.5 The runoff going through the reed bed is surface water only as foul water will be discharged to the public sewer network the reed beds provide an additional means of improving water quality beyond that typically provided for such a land use. They are being proposed following discussion with the BMBC to provide further resilience to the downstream receiving network.
- 7.9.6 Aeration is provided by the plants, which draw oxygen down to the roots via the leaves, where it becomes available for aerobic bacteria; tertiary polishing is carried out if the reed bed is built large enough, providing further removal of nitrogen and phosphorus.

## **7.10 Foul water flows**

- 7.10.1 There will be limited flow water flows from the site due to its nature, however any foul flows generated will be discharged to the public sewer network in Radcliffe Moor Road south of the site, the principle of which has been agreed with United Utilities.
- 7.10.2 A Section 104 Agreement is to be entered into with United Utilities as part of the new clubhouse development.

## 8.0 RISK MANAGEMENT

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### 8.1 Risks Identified

#### ***Earthworks / Loading Impact on Starmount Reservoir Embankment Structure***

- 8.1.1 Concern has been raised in relation to works (excavation / filling) that may impact on the reservoir embankment / structure. Care has been taken in the design and construction of the new pitches to ensure that the reservoir structure is not impacted in any way. See 8.2.1 below

#### ***Surface Water Ponding adjacent to embankment***

- 8.1.2 Ponding of overland flood or surface water to the existing reservoir embankments could have long-term implications to the integrity of the functionality of the existing reservoir and lodges.
- 8.1.3 It has been made clear in discussions that there must be no ponding against the reservoir embankments on its northern / eastern banks. It was noted during the site walkover that there is currently pooling of water at the base of the eastern embankment.
- 8.1.4 The development must incorporate a drainage and earthworks design that reduces the risk of ponding to the Bury MBC assets.

#### ***Changes to the water inflows entering the reservoir***

- 8.1.5 As the reservoir is understood to be spring fed, changes to adjacent springs, groundwater levels or aquifers could impact on the flows into the reservoir.
- 8.1.6 It is a priority of the drainage strategy for the development to ensure there is no change to the hydraulic continuity to the adjacent lodges given their strategic importance to the Borough. There will be no alteration to water supply to the reservoir.

#### ***Change in water levels to southern ponds/Lodges impacting on Reservoir Embankment***

- 8.1.7 The ponds to the south of the reservoir are located adjacent to the southern bank of the reservoir. Potential changes in the water levels within the ponds from flows entering the ponds from the development could impact on the stability of the reservoir. There will be no alterations to the water supply to the lodges.

#### ***Water Quality Issues***

- 8.1.8 The playing fields will be regularly maintained and there is a risk that fertiliser quantities may enter the adjacent waterbodies and could adversely impact on the fishing ponds

## 8.2 Mitigation Measures

### *Impact on Starmount Reservoir Embankment Structure*

- 8.2.1 The plans indicate a minimum of 3m from the toe of the embankment, though a 5m stand-off can be achieved with modest amendments to the position of Pitch 2 if necessary.
- 8.2.2 There is no excavation proposed anywhere in close proximity to the existing reservoir. The proposed swale adjacent to Pitch 1 is the closest feature requiring any excavation which is situated an average of 10m away from the toe of the eastern embankment.
- 8.2.3 It is concluded that the dimensional offset from the toe of the reservoir embankments through the development of the site and once completed poses no additional risk to the Starmount Reservoir Embankment Structure.

### *Surface Water Ponding adjacent to embankment*

- 8.2.4 Pitch drainage will be installed that will collect overland flood waters and will prevent the pooling of water at the embankment toe. Rainfall will enter the drainage system and will be allowed to recharge the groundwater or will be directed at attenuated greenfield rates via the pipe new pipe network into the swale/reedbed area.
- 8.2.5 In the reedbed location, water will be collected and will be allowed to re-charge the groundwater or, in heavy rainfall will overtop into the southern lodges in the same way as the hydrology currently operates. There will be no change to the water supply to the lodges.
- 8.2.6 It is concluded that the risk of pooling to the reservoir embankments which can cause long-term structural issues will be significantly reduced as a consequence of the new development.

### *Changes to the water inflows entering the reservoir*

- 8.2.7 The principal of the surface water drainage strategy is to mimic the existing drainage regime on the site. The net outcome of the development of the site must not result in additional water flowing into the waterbodies, nor must the development deliver any reduction of water volumes that may feed the ponds/lodges. Water feeds are considered in terms of rainfall, overland runoff flows or groundwater recharge.
- 8.2.8 Given there will be a change in topography and an introduction of a positive drainage system, the immediate overland flows will be affected. As noted in 8.2.2 these changes will have a positive impact on the risk associated with the ponding and pooling of surface water adjacent to the reservoir embankment.
- 8.2.9 In respect to groundwater, springs and the aquifer, the report provides the evidence that the same volumes of water will still enter the groundwater and therefore the aquifer and the identified spring to the south of the site will be unaffected. All flows from the building and pitches are to be attenuated to greenfield run-off rates and will be collected at the low point of the site in swales and reedbeds. These features will

provide control that does not currently exist, will enhance water quality and will ensure that the underground drainage receptors are not adversely impacted as a consequence of the site development.

#### ***Change in water levels to southern ponds/Lodges impacting on Reservoir Embankment***

- 8.2.10 The flow restriction and attenuation associated with the pitches and clubhouse development will restrict runoff to greenfield rates. The collection point for the overland flows is presently at the south of the fields. Regularisation of this pooling of water into formalised swales and reedbeds will ensure that the adjacent pond levels will not be changed as a consequence of the development of the site but with no formal pipe connection can ensure that the overtopping that does currently take place in this location will continue to be mimicked.
- 8.2.11 The pond immediately to the south of Starmount lodge has a piped outfall (towards Brinks Lane) and therefore a controlled water level. There are valves associated with the lodge that will allow the drain-down of the reservoir into the lower-level waterbodies

#### ***Water Quality Issues***

- 8.2.12 The pitch drainage will be the 1<sup>st</sup> receiver of the applied fertiliser following watering/rainfall. Any chemicals applied would pass through filter medium used in the pitch construction and shall pass through the pipe network into the swale/reedbed. The inherent characteristics of the reedbed planting is to filter and improve water quality.
- 8.2.13 The car parking area is proposed to be of permeable construction with a Type 3 subbase (large void ratio ~30%), this provides water quality improvement through filtration and the storage within the sub grade during high intensity rainfall events, again providing maximum opportunity for recharging of groundwater.
- 8.2.14 Presently the site has an agricultural use and there is no control on what chemicals are used on the land. Following grant of approval, Bury Council would have the ability for additional controls via planning conditions and enforceability of a treatment and maintenance regime to protect the adjacent assets and waterbodies.

### **8.3 Residual Risks**

- 8.3.1 Although no levels alterations are being undertaken within close proximity of the reservoir embankment and a 5m offset zone is being provided from the toe of embankment there is always a residual risk of the failure of this embankment even without the work being undertaken onsite. If the northern embankment fails then flood flow will be into site but would then flow west towards Blackshaw Brook based on the topography. A failure on the eastern embankment would also result in flow into site but would then flow south towards the middle and upper lodges.
- 8.3.2 There is a risk of human error or adverse weather conditions can result in the potential for nutrient enriched water to enter the runoff leaving the site. This is mitigated for insofar

as is possible by a robust methodology for application of nutrients (Nitrogen and Potassium) and also the construction of a swale and reed beds to provide some interception and delay to allow uptake and removal, however if fully saturated during or following an extreme storm event there is still this residual risk. It should be noted that this risk is already present from agricultural application of fertilisers, however at present there is no interception or delay mitigation in place.

## 8.4 Risk Tracker

| ID | Identified Risk                                    | Risk Level in Existing Situation                                                                                                                 | Risk Mitigation                                                                                                                                                                                  | Risk Level Post Development                                                                                                                                                                                                                                       |
|----|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Earthworks / Loading Impact on Starmount Reservoir | N/A                                                                                                                                              | Cut/Fill Earthworks stand off of 3-5m no work zone                                                                                                                                               | No change in risk level after works completed. Stand off from embankment toe could give Council better access for maintenance.                                                                                                                                    |
| 2  | Surface Water Ponding                              | High – Ponding exists adjacent to eastern bank of reservoir causing possible future structural issues                                            | Installation of new drainage will direct overland flows to controlled outlets in swale/reed bed.                                                                                                 | Low Risk following development and construction of drainage network.                                                                                                                                                                                              |
| 3  | Changes to the water inflows                       | N/A                                                                                                                                              | Drainage design will mimic existing drainage arrangements                                                                                                                                        | No change to aquifer, existing springs or groundwater following development                                                                                                                                                                                       |
| 4  | Change in water levels to southern ponds           | N/A                                                                                                                                              | Drainage design will mimic existing drainage arrangements                                                                                                                                        | As existing arrangements will be mimicked, groundwater levels will not be affected, overtopping in rainfall events will continue as per existing arrangements. Adjacent waterbodies will continue to be fed by overtopping and springs that will not be affected. |
| 5  | Water Quality Issues                               | Medium – Presently no real activity on agricultural fields, though this situation could alter without planning consent/control measures by Bury. | Filtration introduced through construction of pitch drainage, land drainage, car park sub-base, swales and reedbeds                                                                              | Rainwater will pass through new infrastructure will be purified through filtration medium. Controls can be put in place to ensure chemical based applications are appropriate and enforced                                                                        |
| 6  | Pitch Drainage /excavation impact on reservoir     | N/A                                                                                                                                              | New drainage is min 5m from reservoir embankment. Excavations are within re-graded land (ie. above current ground profile) due to cut/fill levels so no impact on reservoir from any excavations | No change during or post development                                                                                                                                                                                                                              |

| ID | Identified Risk                                                            | Risk Level in Existing Situation                                                                                                                                                                         | Risk Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Risk Level Post Development                                                                                                                                                                |
|----|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7  | <b>Earthworks / Drainage construction Impact on aquifer</b>                | N/A                                                                                                                                                                                                      | The rockhead has been identified across the site at 7-9m below existing ground level in the intrusive SI. The aquifer exists within this strata. The deepest cut as part of earthworks is 4m on pitch 3 to the north. This is some 4m above the rockhead. Artesean water was not identified in any of the exploratory holes in the SI works.                                                                                                                                                                                | No change - The aquifer will not be impacted through the development of the site.                                                                                                          |
| 8  | <b>Impact on artesian water / springs</b>                                  | N/A                                                                                                                                                                                                      | There is one identified spring to the south of the site. This will be retained in it's current location and will continue to be a source of water for the adjacent waterbodies. Artesean water has not been identified in the SI which extended to 30m below ground. Earthworks are shallow in comparison and are not likely be encountered. Existing springs would be easily identifiable given the site topography as water would flow overland to the northern toe of Starmount Lodge. This boundary is observed as dry. | No change                                                                                                                                                                                  |
| 9  | <b>Contamination entering adjacent waterbodies</b>                         | Medium – Presently no real activity on agricultural fields, though this situation could alter without planning consent/control measures by Bury.                                                         | Landscape Management Plan will be produced in accordance with the Agronomist Report. Controls of fertilisers can be in place and enforceable to ensure adjacent waterbodies are protected. New drainage will offer filtration in conjunction with swales and reed-beds that will provide good protection from any spills/excessive chemical use                                                                                                                                                                             | Low Risk - There is no positive pipe connection proposed into the waterbodies to the south. Planning conditions will provide additional, enforceable controls that do not exist at present |
| 10 | <b>Maintenance responsibilities of waterbodies adjacent to development</b> | Medium - No legal access is available to the boundaries of the off-site waterbodies. This prevents regular maintenance to vegetation or the reservoir embankment & potential long term structural issues | A Landscape Management Plan could deliver proper access and a maintenance regime that protects the long-term structural integrity of the reservoir                                                                                                                                                                                                                                                                                                                                                                          | Low Risk – Better access around the perimeter of the existing waterbodies provided post-development can protect the long-term future of the waterbodies                                    |

## 9.0 SUMMARY AND CONCLUSIONS

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- 9.1 The proposals acknowledge the complex hydrology and result in no detriment to the adjacent reservoir or fishing lodges. The approach to the management of surface water runoff is to maintain the current situation whilst providing potential water quality improvement measures by adopting a sustainable appropriate with multiple forms of treatment being included.
- 9.2 Reservoir safety is enhanced by the proposals as at present there is some ponding of runoff by the eastern embankment toe and no easement or suitable access to the embankment from the site for maintenance and inspection. The proposals would introduce a 5m offset from the toe improving the situation and propose drainage solutions that should avoid any standing water at the toe of the embankment.
- 9.3 There should be no impact on the aquifer feeding the reservoir based on the ground investigation works undertaken and the proposed depths of excavation.
- 9.4 There should be no adverse impact on the spring and surface water runoff feeding the lodge. The proposals aim to mimic the rate and volume of existing flow.
- 9.5 The introduction of a conveyance/attenuation swale, wet swale and reed beds provides further residual water quality improvements and some residual protection against nutrient enrichment or other contamination events.
- 9.6 The report addresses the concerns and objections raised and is considered commensurate with the scale of development.

## **APPENDIX A: LLFA/LPA CORRESPONDENCE**

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Paul Sinclair

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From: Tom Wanner <tom.wanner@stillwater-associates.co.uk>  
Sent: 09 May 2022 15:01  
To: Paul Sinclair  
Cc: richardnicholas@betts-associates.co.uk; B.Medlock@bury.gov.uk; David Littlemore  
Subject: FW: Proposed Sports Pitches at Radcliffe Moor Road (Planning Application Ref. 67658)

Good afternoon Paul,

As David Littlemore is on leave this week he has asked me to respond to the below.

We have the following reservoir safety related comments in relation to the proposed development:

1. The proposed works should not impact the reservoir embankment structure adversely. Therefore there should not be any filling / excavation on the embankment or within 5m of the toe of the embankment. A 5m buffer around the toe of the embankment should also be maintained to allow for adequate inspection of the embankment and maintenance.
2. Any additional surface water generated from the proposed works shall be drained sufficiently around the reservoir and not impound / pond up against the embankments, particular on the north side of the reservoir.
3. As the reservoir is spring fed any changes to the springs / groundwater level / aquifers could change the flows into the reservoir (increase or decrease). Your submission should include an assessment of possible changes to the inflows entering the reservoir.
4. As two of the ponds to the south of the reservoir are located adjacent to the reservoir embankment toe, any potential change in the water level within the ponds from additional flows entering the ponds from the development is to be assessed. If any changes in the pond level are possible the impact of these on the stability of the reservoir embankment is to be assessed.

We will leave the council to comment on possible quality issues in the reservoir and downstream ponds as this is outside our area of expertise.

Let us know if you have any questions regarding the above.

Regards,

Tom Wanner  
Stillwater Associates Limited

O: 01737 768237  
D: 01737 944354  
M: 07799 607148  
E: [tom.wanner@stillwater-associates.co.uk](mailto:tom.wanner@stillwater-associates.co.uk)  
W: [www.stillwater-associates.co.uk](http://www.stillwater-associates.co.uk)

Chapter House - 33 London Road, Reigate, Surrey, RH2 9HZ.  
Registered in England. Company No. 6713397

Paul Sinclair

---

From: Medlock, Benjamin <B.Medlock@bury.gov.uk>  
Sent: 30 April 2022 11:29  
To: Paul Sinclair  
Cc: Richard Nicholas; Steve Rowe  
Subject: RE: Update on the Sports Pitches at Radcliffe Moor Road (ref. 67658) [NLP-DMS.FID703536]

Dear All,

Thankyou Paul and Richard for attending the site visit this week and providing more details on the application. It was both a constructive and beneficial meeting.

#### Hydrology – Aquifer & Spring (s) network

On site visit we discussed issues around the Hydrology on the site and the way in which further mitigation measures could be implemented. Surface Springs were identified and further options were provided by Richard.

The application provided an EA desk study (Flood Risk Assessment) and identified that an Aquifer was present and that one is also present on Stormont Lodge providing the source for the reservoir. It is understood that no additional load can affect the reservoir structure or the site as whole as it is a self-balancing system as the reservoir feeds the adjoining ponds and balances the water flows.

Richard will provide more detailed mitigation measures and design for the swale will be provided. I will await to receive these and consult the necessary consultees.

There is need to establish to what extent that the Spring Network will be effected by the scheme and the how the swale will not impact on the structural wall of the reservoir. It was confirmed that the detailed swale design would confirm no interaction with the structure and it would stand off away from the supporting wall. Concerns still exist as to how the operator of the site will maintain the swale after construction and how this can maintained in the future.

#### Additional information and survey requirements

The application has received objection and a study of the Aquifer Network may be required. Given that the Spring Network is identified and the Aquifer is present at Stormont. The applicant agreed that they would consult with Stillwater Associates on obtaining any more additional information. There would be no cost to Bury Council for this. A study may be necessary to understand the reservoir structure further and Bury Council would not have to fund this.

#### Application

The commercial imperative was highlighted and the need to gain permission with the application being linked to housing in the Borough of Bolton. It was made clear that it would need to take place this year.

Objections still exist for the application and the need to reconcile this as it is important to any further progression. The Council does not wish to import any risk to the site which is not required. The site is Council owned and is a vital part of the Community in Radcliffe. It is in the public interest to protect this valuable asset and maintain it for future generations.

The application could potentially improve facilities in Bury and that is recognised. This is to be considered and further assessment is needed that the new proposed mitigation measures do not have any detrimental impact to Stormont Lodge.

Please advise further on when new mitigations designs can be provided and it can be considered.

Kind regards,

Benjamin Medlock  
Senior Planning Officer

Tel: 0161 253 5218

E mail: b.medlock@bury.gov.uk

Development Control, 3 Knowsley Place, Duke Street, Bury, BL9 0EJ.

---

From: Paul Sinclair <paul.sinclair@westchurchhomes.co.uk>  
Sent: 22 April 2022 18:00  
To: Medlock, Benjamin <B.Medlock@bury.gov.uk>  
Cc: Richard Nicholas <richardnicholas@betts-associates.co.uk>; Steve Rowe <steve.rowe@lichfields.uk>  
Subject: FW: Update on the Sports Pitches at Radcliffe Moor Road (ref. 67658) [NLP-DMS.FID703536]

Hi Ben,

Thanks for returning my call on Friday and for the explanation you provided. The conversation gave me more hope than the E-Mail you sent to Steve.

I've sent the invite out for the meeting on site on Wednesday. I feel it is important that your engineer attends if possible as they seem to hold information which is crucial to allow us to satisfy the Council on these matters. We have been trying to engage with them since even before the application was first submitted.

You referenced the desktop information within the FRA which mentioned the bedrock aquifer and a potential secondary source (possible spring). Your drainage colleagues seem convinced that the aquifer is the source of the feed to the Stormont lodge (Bedrock is 7.5-9m below our site levels and the reservoir is some 2-3m higher than our site level). In his view, our cut/fill operations will impact this reservoir feed - It is really important that this anecdotal evidence is provided to us (plans, archives, notes etc.) so that we can attempt to address the concern directly.

Anything you have would be of use as soon as possible.

As mentioned, I would also like to see any representation made on the application by Councillor Quinn including any minutes from the portfolio meeting held in relation to the site.

I look forward to meeting you in person on Wednesday at 1pm.

Regards,

**Paul Sinclair - Technical Director**

[paul.sinclair@westchurchhomes.co.uk](mailto:paul.sinclair@westchurchhomes.co.uk)

Direct: 0161 233 4011 | Office: 0161 233 4010 | Mobile: 07836 602768

Kennedy House, 31 Stamford St, Altrincham, Cheshire. WA14 1ES



---

From: Medlock, Benjamin <[B.Medlock@bury.gov.uk](mailto:B.Medlock@bury.gov.uk)>

Sent: 22 April 2022 14:10

To: Steve Rowe <[steve.rowe@lichfields.uk](mailto:steve.rowe@lichfields.uk)>

Cc: Simon Pemberton <[simon.pemberton@lichfields.uk](mailto:simon.pemberton@lichfields.uk)>

Subject: RE: Highways Comments for the Sports Pitches at Radcliffe Moor Road (ref. 67658) [NLP-DMS.FID703536]

CAUTION: This email originated from an external source.

Dear Both,

Please find attached formal Objection which is being added to the Planning Registry today. I have been considering the application and the issues raised by our Countryside Officer. I have met with Councillor Quin and sought guidance from our legal team.

I have consulted our panel reservoir engineer and is my understanding that the secondary bedrock aquifer feeds the Stormont reservoir and is also fed by a network of Springs. The Aquifer is referred to in the Flood Risk Assessment and was also discussed with your Hydrological Consultant at our meeting.

The Flood Risk Assessment identified the Aquifer but does not provide any further information. It states that EA mapping data was used to determine that the Aquifer was present. This is crucial to the ecology in the reservoir and the adjacent ponds.

I have considered this as a material consideration in the Planning Application and I am minded to refuse the application on the basis of insufficient information on the Aquifer and Springs present the application site. The corresponding relationship between the Aquifer and Springs could be comprised by the cut and fill method being proposed. A detailed study would be required to determine the location of the Springs and the Aquifer (s) and the corresponding relationship with the Council site.

I understand the importance of this application to your pending application with Bolton Council and I am balancing the proposal against its potential impacts.

Given the above, are you still minded to press on with the application? As stated, the application lacks full detail and can proceed to a decision alternatively you can withdraw the application and re-submit.

Kind regards,

Benjamin Medlock  
Senior Planning Officer

Tel: 0161 253 5218

E mail: [b.medlock@bury.gov.uk](mailto:b.medlock@bury.gov.uk)

Development Control, 3 Knowsley Place, Duke Street, Bury, BL9 0EJ.

---

From: Steve Rowe <[steve.rowe@lichfields.uk](mailto:steve.rowe@lichfields.uk)>  
Sent: 19 April 2022 09:52  
To: Medlock, Benjamin <[B.Medlock@bury.gov.uk](mailto:B.Medlock@bury.gov.uk)>  
Cc: Simon Pemberton <[simon.pemberton@lichfields.uk](mailto:simon.pemberton@lichfields.uk)>  
Subject: Highways Comments for the Sports Pitches at Radcliffe Moor Road (ref. 67658) [NLP-DMS.FID703536]

Hi Benjamin

We note we are only outstanding comment from highways on the application for sports pitches at Radcliffe Moor Road (ref. 67658). We would be very grateful if you could chase highways for their comment.

Kind regards

Steve

Steve Rowe  
Planner  
Lichfields, Ship Canal House, 98 King Street, Manchester M2 4WU  
T 0161 837 6130 / M 07764 905994 / E [steve.rowe@lichfields.uk](mailto:steve.rowe@lichfields.uk)

lichfields.uk  



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Nathaniel Lichfield & Partners Limited (trading as "Lichfields") is registered in England, no. 2778116, registered office at The Minster Building, 21 Mincing Lane, London EC3R 7AG.

Paul Sinclair

---

From: Schoon, Graham <G.Schoon@bury.gov.uk>  
Sent: 13 April 2022 12:09  
To: Medlock, Benjamin  
Cc: Bent, Michael; Long, Neil S; Cllr. Quinn, Alan; Veal, Jackie S  
Subject: Planning Application No.6758 Land at Radcliffe Moor Road

Hi Benjamin,

Further to our meeting yesterday I am writing to formally object to Planning Application No.6758.

The Council owns the adjoining land to the south of the application site.

The area is public open space and has a large raised reservoir and three smaller lodges. The angling on the reservoir and lodges is managed by Radcliffe Angling Society on behalf of the Council. The reservoir and two of the lodges are used for angling. The third lodge is managed as a wildlife area. Over the last few years, the Council has invested in the angling facilities on site and have provided the anglers with a classroom to facilitate their coaching programme which aims to encourage juniors and others to take up angling and the wider community to engage with the sport.

Maintaining water quality/quantity is fundamental to the health of all waterbodies and any alteration or interruption to the water supply caused by the proposed development would be highly detrimental to the fishery.

The continuing success of Radcliffe Angling Society depends on maintaining the good water quality/quantity within the lodges to sustain a productive healthy fishery.

Introduction of fertilisers through the drainage system from the proposed development would increase the nutrient levels in the water which is likely to trigger excessive aquatic weed growth rendering the water unfishable. There is a further risk of blue green algal blooms that are hazardous to public health and can trigger fish kills due to oxygen deficiency.

The Council has had experience of other waters that it owns becoming eutrophic following disruptions to water supplies or introduction of nutrients. Repairing the damaged caused has proved to be difficult, expensive and has taken several years.

#### Water supply to the reservoir.

- The proposed development does not ensure that the quantity and quality of the water feeding the reservoir is not reduced.
- The water supply to the raised reservoir is believed to originate from springs within the confines of the reservoir that are connected to an aquafer(s) within the application site. There is a risk that the proposed excavation works will sever the water supply and lead to the reservoir drying out.
- There is a risk that the proposed excavation works may lead to the aquafer becoming contaminated with water from the abandoned mine workings, and/or from the fertilizers and herbicides used to maintain the pitches, and/or surface water drainage from the carpark.

There is no site investigation information, design details, risk assessments or method statements demonstrating how the above risks might be managed.

#### Reservoir Safety.

The reservoir is classified as high risk under the Flood and Water Management Act, 2010 as there is a risk of death should it breach.

- As proposed increased standing water or water flows along the toe of the east and north dam increases the risk that the dam may become unstable and breach.
- Carrying out excavation works in close proximity to the toe of the north and east embankment may cause the dam to become unstable and breach.
- Increased flows of water or an increase in water level into and through the three lower lodges may cause the adjoining south dam to become unstable and breach.

There is no site investigation information, design details, risk assessments or method statements demonstrating how the above risks might be managed.

The development as proposed in the application does not demonstrate how the safety and stability of the reservoir structure will be maintained both during and after the construction phase.

#### Water supply to the three lower lodges.

The lodges are supplied from a spring/stream entering the eastern lodge on the north side where they adjoin the application site. There is also a supply from the reservoir spillway entering the middle lodge.

- The proposed development does not ensure that the quantity and quality of the water feeding the lodges is not reduced.
- If the water quality/quantity from raised reservoir is reduced (see above) this would in turn contaminate the two lower lodges.
- There is a risk that the springs/stream may become contaminated with water from the abandoned mine workings, and/or from the fertilizers and herbicides used to maintain the pitches, and/or surface water drainage from the car park.
- There is no assessment of the suitability, condition, or capacity for the existing drainage system from the lodges to Blackshaw Brook.

There is no site investigation information, design details, risk assessments or method statements demonstrating how the above risks might be managed.

Graham Schoon  
Countryside Officer  
Bury Council  
Town Hall  
Knowsley Street  
Bury  
BL9 0SW

## **APPENDIX B: LOCATION PLAN**

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# LOCATION PLAN

Pitch Development, Bury New Road, Little Lever, BL2 6QB



|                    |                                |
|--------------------|--------------------------------|
| OS X (Eastings)    | 375544                         |
| OS Y (Northings)   | 409104                         |
| Nearest Post Code  | BL2 6QB                        |
| Lat (WGS84)        | N53:34:41 (53.577956184792676) |
| Long (WGS84)       | W2:22:15 (-2.3708278560719718) |
| Lat, Long          | 53.577956184792676, -          |
| 2.3708278560719718 |                                |
| Nat Grid           | SD755091 / SD7554409104        |

## **APPENDIX C: TOPOGRAPHIC SURVEY**

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PROPOSED DEVELOPMENT AT  
BURY NEW ROAD, LITTLE LEVER

WESTCHURCH HOMES LTD

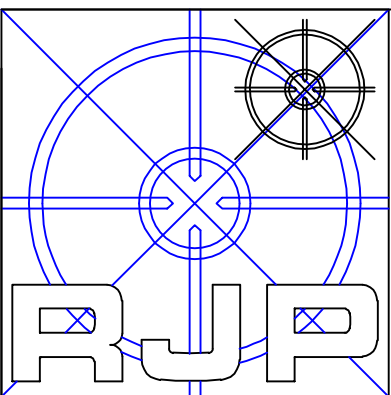
TOPOGRAPHICAL SURVEY

WC0045 / T00

DrawnS. FAIRHURST

DateOCTOBER 2010

Scale1:500 @ A1



RJP Surveying Consultants Ltd

LAND SURVEYORS & SITE ENGINEERS

AYREFIELD COTTAGE  
AYREFIELD ROAD  
ROBY MILL  
UPHOLLAND  
LANCASHIRE  
WN8 0QP

TEL: 01257 251554  
MOBILE: 07710 308709  
WEBSITE : [www.rjpsurveyors.co.uk](http://www.rjpsurveyors.co.uk)  
E-MAIL: [mail@rjpsurveyors.co.uk](mailto:mail@rjpsurveyors.co.uk)

| Rev | Description | Date |
|-----|-------------|------|
|-----|-------------|------|

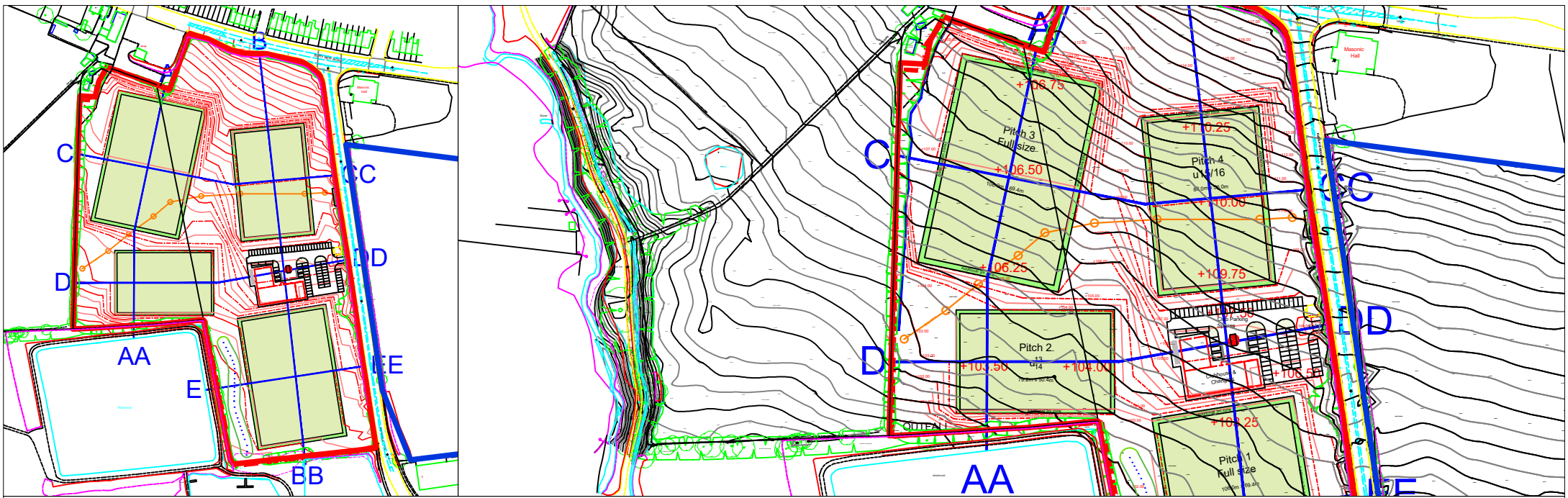
This topographical survey map displays the proposed development area at Bury New Road, Little Lever. The map features a grid with easting coordinates (408800N to 409100N) and northing coordinates (408900E to 409000E). A prominent red boundary outlines the development site, which is situated between Bury New Road to the north and Radcliffe Moor Road to the east. The terrain is characterized by numerous contour lines, with elevations ranging from approximately 107.00 to 115.00 meters. A network of roads is shown, including Bury New Road, Radcliffe Moor Road, and a smaller road labeled 'BURY NEW ROAD' running parallel to the main road. The map also includes a north arrow in the bottom left corner, indicating the orientation of the survey. The survey was conducted by RJP Surveying Consultants Ltd, as indicated by the logo and contact information in the top left corner.



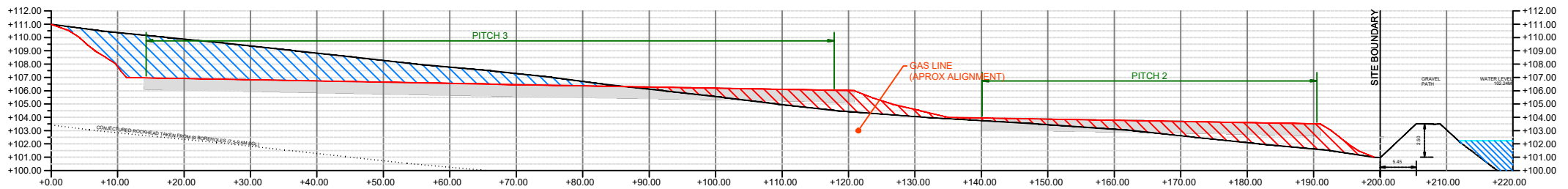
## **APPENDIX D: CROSS-SECTION DRAWINGS**

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- EXISTING TOPOGRAPHY PROFILE
- PROPOSED TOPOGRAPHY PROFILE
- ▨ PROPOSED AREA OF EXCAVATION
- ▨ PROPOSED AREA OF FILL
- CONSTRUCTION ZONE FOR PITCH DRAINAGE



PROJECT:

PROPOSED FOOTBALL PITCHES,  
LAND SOUTH OF BURY NEW ROAD

DRAWING TITLE:

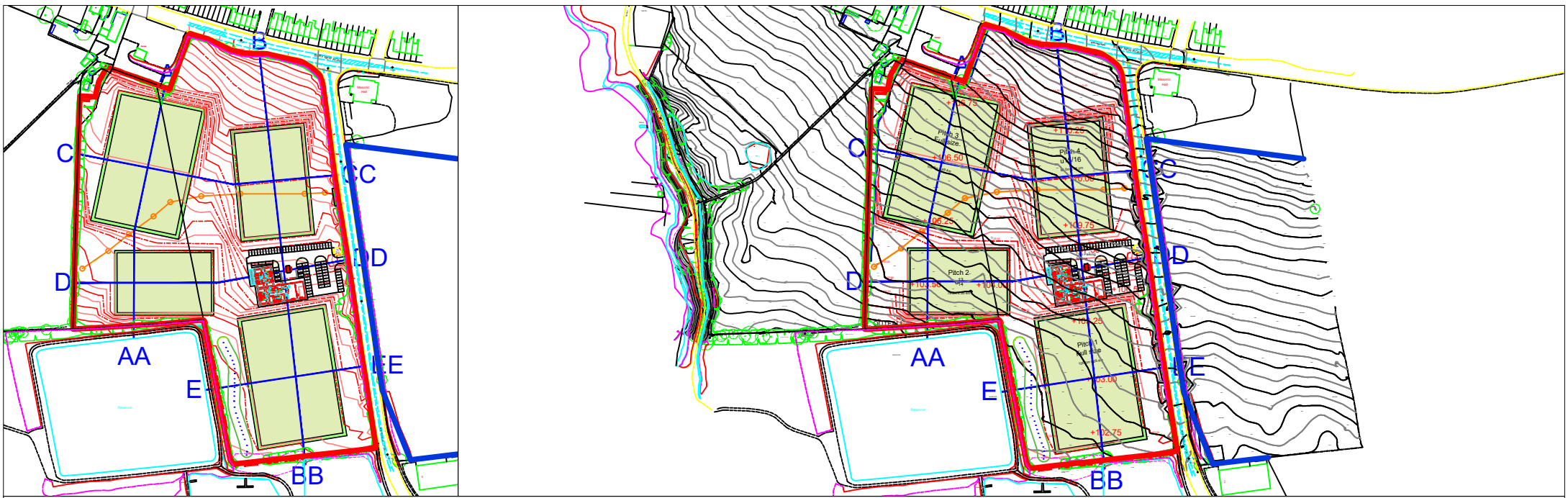
EXTENDED  
CROSS-SECTION: A - AA  
EXISTING & PROPOSED CONTOUR PROFILE

DATE:

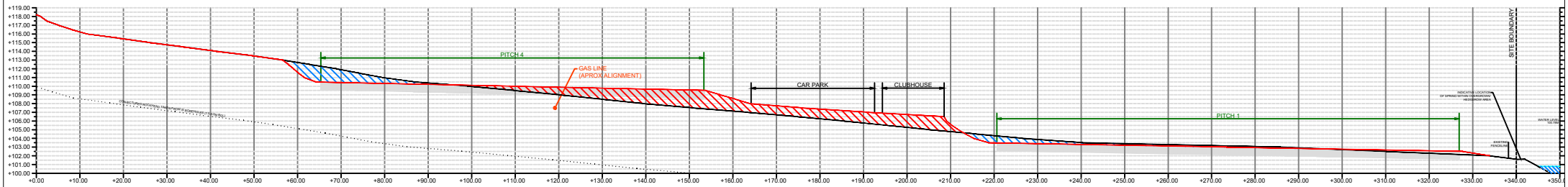
MAY 2022

LAYOUT:

ISO A4



- EXISTING TOPOGRAPHY PROFILE
- PROPOSED TOPOGRAPHY PROFILE
- ▢ PROPOSED AREA OF EXCAVATION
- ▢ PROPOSED AREA OF FILL
- ▢ CONSTRUCTION ZONE FOR PITCH DRAINAGE



PROJECT:

PROPOSED FOOTBALL PITCHES,  
LAND SOUTH OF BURY NEW ROAD

DRAWING TITLE:

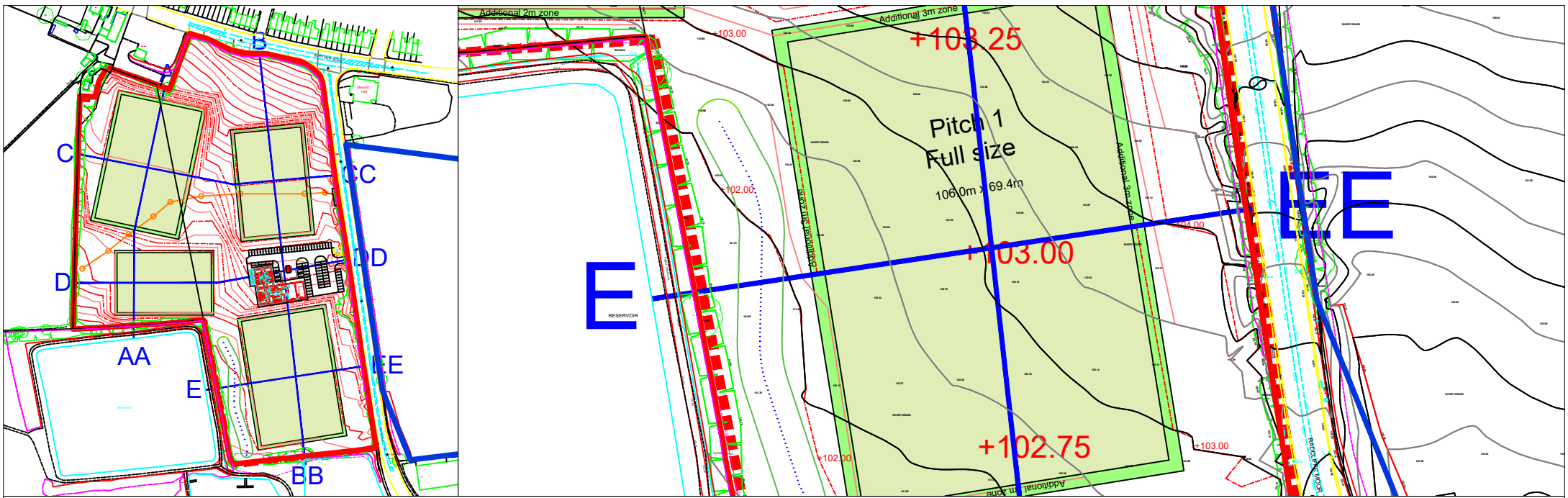
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EXISTING & PROPOSED CONTOUR PROFILE

DATE:

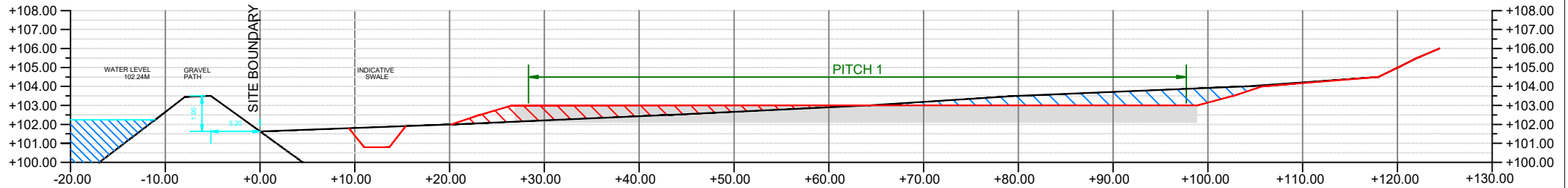
MAY 2022

LAYOUT:

ISO A4



- EXISTING TOPOGRAPHY PROFILE
- PROPOSED TOPOGRAPHY PROFILE
- ▨ PROPOSED AREA OF EXCAVATION
- ▨ PROPOSED AREA OF FILL
- CONSTRUCTION ZONE FOR PITCH DRAINAGE



PROJECT:

PROPOSED FOOTBALL PITCHES,  
LAND SOUTH OF BURY NEW ROAD

DRAWING TITLE:

EXTENDED  
CROSS-SECTION: E - EE  
EXISTING & PROPOSED CONTOUR PROFILE

DATE:

MAY 2022

LAYOUT:

ISO A4

## **APPENDIX E: SURFACE WATER RUN-OFF CALCULATIONS**

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|                |                   |
|----------------|-------------------|
| Calculated by: | Megan Berry       |
| Site name:     | RADCLIFFE MOOR RD |
| Site location: | BURY              |

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Site Details

|            |                   |
|------------|-------------------|
| Latitude:  | 53.57615° N       |
| Longitude: | 2.36912° W        |
| Reference: | 1729619536        |
| Date:      | Jul 23 2021 13:13 |

## Runoff estimation approach

FEH Statistical

## Site characteristics

|                       |      |
|-----------------------|------|
| Total site area (ha): | 2.97 |
|-----------------------|------|

## Methodology

|                                             |                             |
|---------------------------------------------|-----------------------------|
| Q <sub>MED</sub> estimation method:         | Calculate from BFI and SAAR |
| BFI and SPR method:                         | Specify BFI manually        |
| HOST class:                                 | N/A                         |
| BFI / BFIHOST:                              | 0.377                       |
| Q <sub>MED</sub> (l/s):                     |                             |
| Q <sub>BAR</sub> / Q <sub>MED</sub> factor: | 1.08                        |

## Hydrological characteristics

|                                | Default | Edited |
|--------------------------------|---------|--------|
| SAAR (mm):                     | 1084    | 1084   |
| Hydrological region:           | 10      | 10     |
| Growth curve factor 1 year:    | 0.87    | 0.87   |
| Growth curve factor 30 years:  | 1.7     | 1.7    |
| Growth curve factor 100 years: | 2.08    | 2.08   |
| Growth curve factor 200 years: | 2.37    | 2.37   |

## Notes

(1) Is  $Q_{BAR} < 2.0$  l/s/ha?

When  $Q_{BAR}$  is  $< 2.0$  l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates  $< 5.0$  l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is  $SPR/SPRHOST \leq 0.3$ ?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

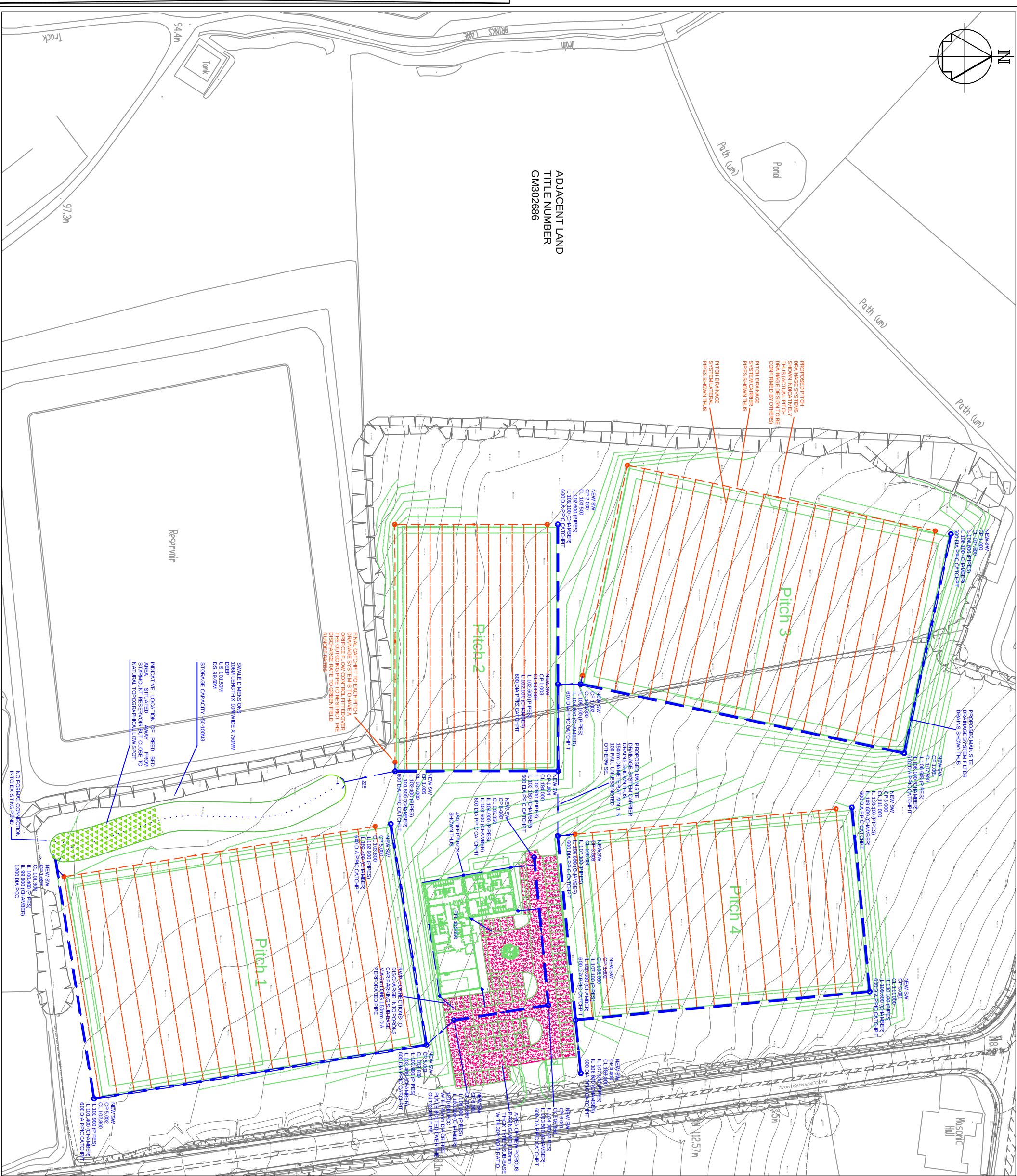
|                         | Default | Edited |
|-------------------------|---------|--------|
| Q <sub>BAR</sub> (l/s): |         | 33.71  |
| 1 in 1 year (l/s):      |         | 29.33  |
| 1 in 30 years (l/s):    |         | 57.31  |
| 1 in 100 year (l/s):    |         | 70.12  |
| 1 in 200 years (l/s):   |         | 79.9   |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://www.uksuds.com). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

## **APPENDIX F: PROPOSED DRAINAGE PLANS**

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General notes:  
do not scale the drawing.  
all dimensions to be checked on site prior to commencement of work and any discrepancy shall be immediately reported and resolved prior to work commencing. this drawing is to be read in conjunction with all relevant drawings and specifications relating to the job whether or not indicated on the drawing.  
copyright reserved to mix associates ltd and this drawing may not be used or reproduced without prior written consent.

- KEY
- EXISTING HP GAS MAIN LOCATION (AV. 1.5M BELOW EXISTING GROUND LEVEL)
  - SW DRAINAGE FOR PITCHES AND SITE REDEVELOPMENT
  - INDICATIVE PITCH DRAINAGE NETWORK FINAL CATCHPIT TO EACH PITCH DRAINAGE SYSTEM IS TO HAVE A ORIFICE FLOW CONTROL FITTED OVER THE OUTGOING PIPE TO RESTRICT THE DISCHARGE RATE TO GREEN FIELD RUNOFF RATES
  - PROPOSED 8M WIDE SW DRAINAGE EASMENT THROUGH ADJACENT LAND AND INTO DITCH/ WATERCOURSE IN BURY LAND
  - EXISTING GROUND LEVELS AS PER INVEK SURVEY'S DRAINAGE INVESTIGATION
  - PROPOSED COLLECTION SWALE

| Rev | Date | By | Description |
|-----|------|----|-------------|
|     |      |    |             |



Project:  
ALTERNATIVE DRAINAGE ARRANGEMENT #2  
SWALE ARRANGEMENT  
WITH NO CONNECTION

Drawing Title:  
LAND TO THE NORTH OF STARMOUNT LODGES  
RADCLIFFE MOOR ROAD  
BURY

|                 |                        |                  |
|-----------------|------------------------|------------------|
| DRAWN<br>PWS    | CHECKED<br>1:12:50@A3  | DATE<br>8.3.2022 |
| JOB NO.<br>1013 | DRAWING NO.<br>ENG001B | REV.<br>         |

CONSTRUCTION

## **APPENDIX G: STORMWATER STORAGE ESTIMATES**

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## Quick Storage Estimates

Building = 0.0785 ha

Discharge rate – 11.3 l/s/ha

Discharge rate for building = 0.887 l/s

QSE – 100yr plus 40% CC = 43cu.m to 61cu.m = Mean 52cu.m

| Variables                            |                                         |
|--------------------------------------|-----------------------------------------|
| FEH Rainfall                         | Cv (Summer) 0.750                       |
| Return Period (years) 100            | Cv (Winter) 0.840                       |
| Version 2013 Point                   | Impervious Area (ha) 0.079              |
| Site GB 375609 408947 SD 75609 08947 | Maximum Allowable Discharge (l/s) 0.9   |
|                                      | Infiltration Coefficient (m/hr) 0.00000 |
|                                      | Safety Factor 2.0                       |
|                                      | Climate Change (%) 40                   |

| Results                                                                                               |
|-------------------------------------------------------------------------------------------------------|
| <b>Global Variables require approximate storage of between 43 m<sup>3</sup> and 61 m<sup>3</sup>.</b> |
| <b>These values are estimates only and should not be used for design purposes.</b>                    |

Car Park = 0.1714 ha

Discharge rate – 11.3 l/s/ha

Discharge rate for car park = 1.936 l/s

QSE – 100yr plus 40% CC = 93cu.m to 133cu.m = Mean 113cu.m

| Variables                            |                                         |
|--------------------------------------|-----------------------------------------|
| FEH Rainfall                         | Cv (Summer) 0.750                       |
| Return Period (years) 100            | Cv (Winter) 0.840                       |
| Version 2013 Point                   | Impervious Area (ha) 0.171              |
| Site GB 375609 408947 SD 75609 08947 | Maximum Allowable Discharge (l/s) 1.9   |
|                                      | Infiltration Coefficient (m/hr) 0.00000 |
|                                      | Safety Factor 2.0                       |
|                                      | Climate Change (%) 40                   |

| Results                                                                                                |
|--------------------------------------------------------------------------------------------------------|
| <b>Global Variables require approximate storage of between 93 m<sup>3</sup> and 133 m<sup>3</sup>.</b> |
| <b>These values are estimates only and should not be used for design purposes.</b>                     |

## **APPENDIX H:     NOTES OF LIMITATIONS**

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The data essentially comprised a study of available documented information from various sources together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information.

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