

WHITEFIELD FIRE STATION, MANCHESTER

FLOOD RISK ASSESSMENT & OUTLINE DRAINAGE STRATEGY

Job Number: FRA 22 1159

Date: January 2023

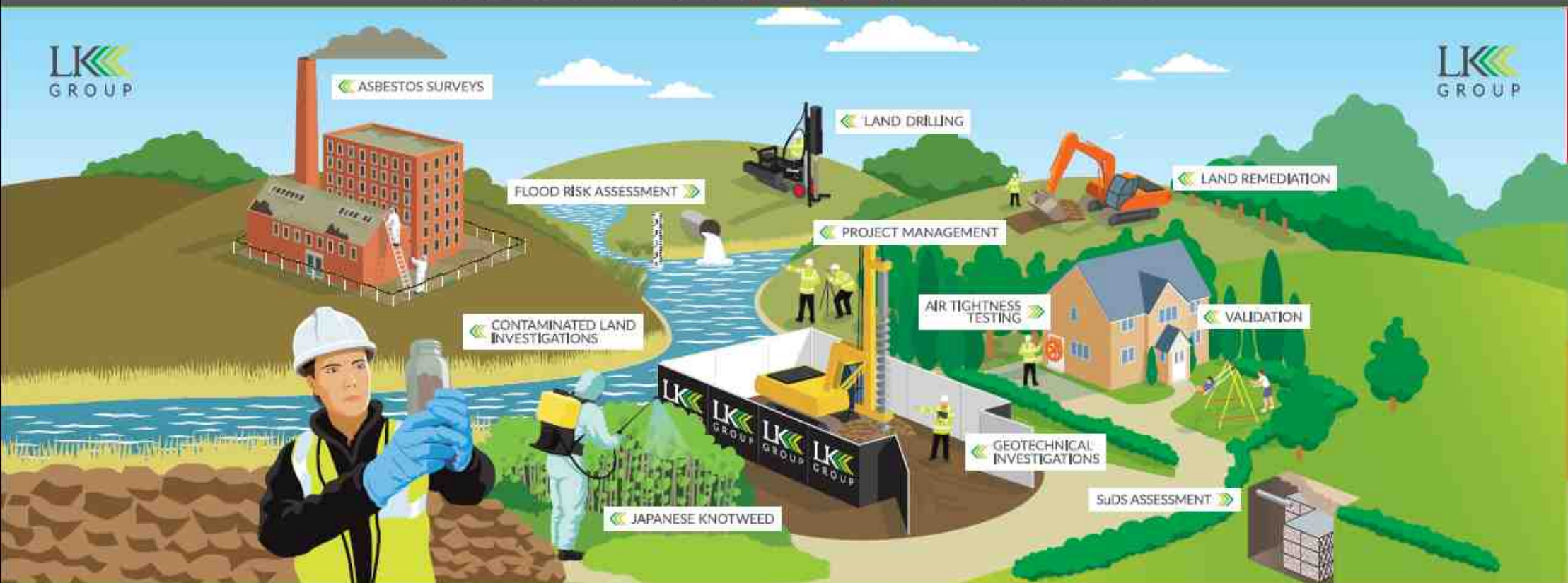
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EXECUTIVE SUMMARY

Scope and Background

This Flood Risk Assessment and Outline Drainage Strategy (FRA) has been undertaken by LK Consult Ltd (LKC) to support a planning application for the redevelopment of Whitefield Fire Station, Manchester. The development comprises a new Fire Station building with training space and car parking.

LKC has prepared this FRA in line with the NPPF and Technical Guidance where appropriate.

In considering the proposals the following key principles have therefore been applied:

- Identification of flood risks.
- Protection of users of the new development.
- No increased flood risk to third parties.

Consultations

The Environment Agency (EA) has been consulted to inform the preparation of this report. They have provided a more detailed flood map, but no modelled data was available.

Bury Metropolitan Borough Council (LLFA) and United Utilities (UU) were also consulted concerning flood risk.

All relevant consultees have confirmed that there is a Negligible to Very Low risk of flooding to this site from all sources.

Flood Risk

Environment Agency flood maps indicate that the site is potentially vulnerable to fluvial flooding from the River Irwell, northwest of the site.

The site is shown on the Environment Agency's (EA) website Flood Zone Mapping as being in Flood Zone 1 (PPG Table 1).

The site is in Flood Zone 1 – Very Low Risk – annual probability of flooding less than 0.1% (1 in 1000).

Mitigation

Design

Site falls will be arranged to allow reasonably level access for occupants and visitors and to allow the site to be free-draining in case of local ponding at times of heavy rainfall. Floor levels of the Fire Station will be set as high as possible above the flood level giving regard to necessary access for the less-able.

The development will not result in a reduction in flood plain storage compared to the existing situation.

In considering the potential drainage options for the site at present it is assumed that surface water runoff arising from the development will discharge into the existing combined sewer to

the west of the site as per UU's preferred location. Currently the existing drainage falls towards to the northeast but is shallow.

The proposed development will marginally decrease the proportion of the site covered by impermeable surfaces and will therefore generate less runoff. Attenuation will be required as an allowance for climate change.

Foul sewage arising from the development will be discharged into the public combined sewer in Bury New Road to the west of the site.

The outline drainage strategy considers the use of attenuation-based SuDS to be feasible with a discharge to the combined sewer on the western boundary of the site. Therefore, the most effective strategy, in line with the SuDS management train, would be to have a detention facility at the western boundary. The required detention facility or similar has been estimated to be **47.5m³** for the 1 in 30-year flow restriction.

Similarly, the estimated volume to be retained on site for the 1 in 100-year storm event including an allowance for climate change is between **92.4m³** and **114.9m³**.

The site is considered to be at Low risk of flooding. It is recommended that the minimum finished floor levels for the development should be set at a nominal height above the proposed ground levels. This is to allow for overland flow during exceedance flows from an extreme event or a drainage failure.

Access

Access close to the site is elevated above potential flood levels and will always provide safe access to and from the site from Bury New Road.

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1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by Greater Manchester Combined Authority to carry out a Flood Risk Assessment (FRA) and Outline Drainage Strategy for Whitefield Fire Station, Manchester. The report was undertaken in support of a future planning application to demolish and replace the existing Fire Station building with a new Fire Station building with updated facilities.

The report will address the vulnerability to flooding from all possible sources and will also consider the impact of the development on surface water runoff accounting for climate change and the potential to increase flood risk elsewhere. The Outline Drainage Strategy in Section 5 will provide an overview of the SuDS techniques which could be considered on the site. The issues of actual flood risk are discussed in Section 4.

Government policy with respect to development in flood risk areas is contained within the Department of Communities and Local Government National Planning Policy Framework¹ and accompanying Technical Guidance of March 2012 (revised to the Planning Practice Guidance (PPG)², which supersedes Planning Policy Statement 25 (PPS25) 'Development and Flood Risk'. The guidance on Climate Change allowance issued by the Environment Agency in February 2016 has also been considered.

LKC has prepared this Flood Risk Assessment (FRA) in line with the NPPF and the PPG where appropriate. The level of detail entered into any flood risk assessment is dependent upon the scale and potential impact of the proposed development, and the vulnerability classification of the proposed land-use.

1.2 Site Details

A summary of the general site details is presented in Table 1-1. Plans, Drawings and Figures are provided in Appendix A. Figure 1 indicates the site location and boundary. Figure 2 indicates the proposed development.

Site Details	
Location	Whitefield Fire Station, Bury New Road, Manchester, M45 7SY. Centred at approximate National Grid Reference 380480E, 406485N.
Area	Approximately 0.38 Ha.
Topography	103.43 metres above ordnance datum (AOD) in the southwest and 102.64m AOD in the east of the site. The site is sloping down gently towards the south east.
Current Land Use	<u>Site</u> Fire Station with hardstanding and access road. <u>Surrounding Area/ Boundary Treatment</u> North: Residential properties. East: Residential properties and recreational ground. South: George Street and commercial properties. West: Bury New Road and residential properties.
Proposed Development	Replacement fire station building with training yard, training tower and car parking. Access will be from Bury New Road.

Table 1-1: Summary of site details.

¹ DCLG (2021). "National Planning Policy Framework." Department of Communities and Local Government. July 2021.

² DCLG (2014). "Planning Practice Guidance" <http://planningguidance.communities.gov.uk>, April 2014.

2 Site Setting

2.1 Vulnerability

As an initial phase in identifying whether a site is potentially at risk of flooding, LKC has consulted the Environment Agency's (EA) website Flood Zone Mapping. This mapping is (often) based on coarse scale modelling and provides only an initial indication of the flood risk to a site. The Environment Agency Flood Zone maps were developed using a very coarse Digital Elevation Map (DEM) and are superseded by a more detailed analysis of modelled flood levels and topographic survey levels.

The Flood Zones divide the floodplain into three categories of flood risk, and do not take flood defences into account. The NPPF defines the Flood Zones as:

- Flood Zone 1 – little or no risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).
- Flood Zone 2 – low risk, with annual probability of flooding of 0.1 to 1.0% from rivers and 0.1 to 0.5% from the sea.
- Flood Zone 3 – medium to high risk of flooding with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.

The Flood Zone Mapping indicates the site as being within Flood Zone 1 in the PPG (paragraph 065, Table 1).

The proposed development is for a Fire Station, and this is classified within the 'Highly Vulnerable' category in the PPG (paragraph 066, Table 2).

2.2 The Sequential and Exception Tests

The NPPF does not require that the Sequential Test be applied to development proposals in Flood Zone 1. Since the site has been shown to be located in Zone 1 for flood risk (see section 4.1), a sequential approach should not be required for planning.

However, the principles should still be applied for developments within the site such that, for example, dwellings are situated on a high part of the site when there is a risk of local surface water flooding. The issues of actual flood risk are discussed below. The issues of safety and reduction in flood risk to others required by an Exception Test are also addressed in this document.

The Local Planning Authority (LPA) will make the final decision with regard to any planning application.

2.3 Environmental Setting

LKC has undertaken a review of public domain information including British Geological Survey data, Environment Agency data, historical mapping, and aerial photography to provide a summary of the environmental setting of the site. This is summarised in Table 2-1 below.

Summary of the Environmental Setting			
Geology	Superficial		Till, Devensian (Diamicton) for the majority of the site. Glaciofluvial Deposits, Devensian (Sand and Gravel) towards the eastern boundary.
	Bedrock		Collyhurst Sandstone Formation (Sandstone) towards the N of the site. Manchester Marls Formation (Mudstone) towards the S of the site.
	BGS Boreholes		BH Ref: SD80NW388, 25m S: Concrete to 0.50m, Infill to 2.70m, Sands and Clay bands to 57.00m, red Marl and Sandstone to 70.00m, red and grey Marl to 163.50m and red and grey Sandstone to 182.00m. (Water struck at 42.73mbgl). BH Ref: SD80NW709, 285m S: Made Ground comprising dark brown / black loose sandy soil and ash fill with fragments of brick and sandstone present to 0.60m, Made Ground comprising loose fine orange and brown Sand and fragments Sandstone fill and very sandy soil to 1.70m and medium dense orangey brown slightly silty fine Sand becoming denser with depth to 4.00m. BH Ref: SD80NW6, 410m N: Sand to 51.20m, stiff Clay and stones to 53.03m, hard Shale to 62.17m and grey Sandstone to 63.70m.
	Defra Soilscape Mapping		Type 10 – Freely draining slightly acid sandy soils.
	Hydro-geology	Aquifer Designation	Superficial
Bedrock			Principal Aquifer.
Source Protection Zone (SPZ)		Site not within an SPZ.	
Hydrology	All adjacent and internal surface water		No internal watercourses on site. The closest watercourses are the River Irwell (Roch to Croal) and the confluence of the River Roch (Spodden to Irwell) approximately 660m northwest of the site. Parr Brook is located approximately 1.05km northeast of the site. Bealey's Goit is located approximately 1.1km northwest of the site.
	Flooding		Flood Zone 1.
Site History			Historical mapping indicates that the site and surrounding area has been urbanised since at least 1922 consisting of residential and commercial properties. A mill and adjoining reservoir were present to the south of the site from the earliest mapping in 1894 until it was infilled between 1954 to 1965. The Fire Station was developed upon a former allotment after the latest available historical mapping in 1965.

Table 2-1: Summary of the Environmental Setting.

2.4 Site Reconnaissance

A site reconnaissance was undertaken in November 2022 and photographs are provided in below.

Relevant features identified on site are summarised below:

- Hardstanding (tarmacadam) across the majority of the site with a maintained grassland area and established trees towards the southern boundary.
- Access is via Bury New Road towards the western boundary and a further vehicular access point is present towards the eastern boundary within George Street.
- The Fire Station building is present towards the west of the site and a car parking area is present towards the east.
- Existing drainage downpipes and gutters are present on the Fire Station building and a fuel station and storage building, towards the eastern corner. These discharge directly onto the surfacing.
- Several manholes are present within the site boundary. Three were observed towards the north eastern corner adjacent to the existing fuel station and storage area.
- Further manholes are present towards the south eastern corner, adjacent to the rear of the Fire Station building and within the vehicular access road adjacent to the north western boundary.
- Highway gullies are present within the adjacent highways in George Street and Bury New Road. Drainage gullies are present on site towards the front of the Fire Station building as well as the fire engine storage area and towards the rear of the building within the car parking area.
- A concrete drainage channel is present adjacent to the eastern boundary within the car parking area. This slopes down towards the south eastern corner and appears to collect the majority of the surface water from the rest of the site.
- Towards the eastern and northern boundaries, the site is elevated above the adjacent infrastructure by approximately 1.0m.
- The surrounding area comprises residential properties towards the north, east and west and commercial properties towards the south.

Relevant photographs are provided in Plate 2-1.



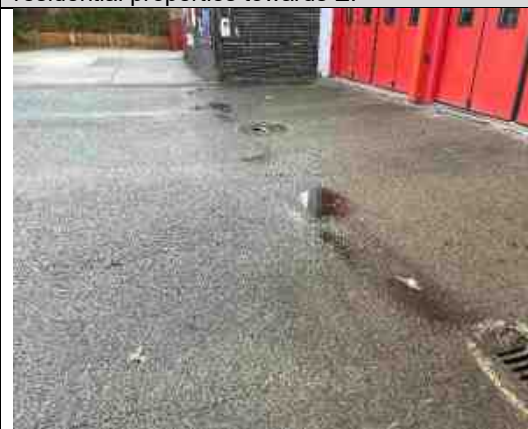
Photograph 1: Site slopes down slightly towards SE.



Photograph 2: Site is elevated above adjacent residential properties towards E.



Photograph 3: Grassed area in SW of site. Highway gullies observed in George Street.



Photograph 4: Highway gullies adjacent to the W boundary.



Photograph 5: Vehicular access towards N boundary. Site slopes down towards E.



Photograph 6: Manhole cover adjacent to N boundary.

Plate 2-1: Site photographs.



Photograph 7: Existing downpipes of rear of fire station building.



Photograph 8: Concrete drainage channel adjacent to George Street and S boundary.



Photograph 9: Manhole covers towards NE boundary.



Photograph 10: Downpipe and gutter on existing fuel storage building.



Photograph 11: Manhole cover adjacent to front of Fire Station building.



Photograph 12: Drainage gully and existing drainage of side of Fire Station building (facing S).

Plate 2-1 (continued): Site photographs.

2.5 Site and Access Levels

A topographic survey of the site has been undertaken to OS GPS datum, and information is included on the drawings in Appendix B. The site elevation ranges from 102.64m AOD in the east of the site to 103.43m AOD in the southwest. The site is sloping down gently towards the east. The proposed access would join Bury New Road at approximately 103.22m AOD.

3 Consultation

Information from all relevant consultees is summarised in Table 3-1 below.

Relevant correspondence is provided in Appendices C (EA) and D (others).

For modelled levels refer to extracted Level table and node location map in Appendix C.

Source	Details	
Environment Agency (EA)	Flood Zone 1: Very Low risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).	
	Modelled River Levels	As the site does not fall within 150m of an area at risk of flooding from rivers or the sea, the EA do not hold any detailed flood modelling data that would impact the site.
	Records of Flooding	No information available.
	Records of Flood Warning Service	Not within a flood warning service area.
	Surface Water Flooding	Very low risk of surface water flooding across the site. Within the highways to the west, east and the residential development to the north there is a low risk of surface water flooding up to a depth of 300mm.
	Flooding from reservoirs	No risk from reservoirs.
	Groundwater Source Protection Zone	Not within a Source Protection Zone.
Bury Metropolitan Borough Council (LLFA)	Correspondence with Bury Metropolitan Borough Council has confirmed that there are no flood defences within the vicinity of the site and no records of historic flood events. There are no records of restrictions applied to ordinary watercourses and sewers in the area or highway drainage restrictions and records. The site is not located within a Critical Drainage Area. The scheme must be based on the hierarchy of drainage options in the National Planning Practice Guidance and be designed in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems.	
	Possible or known incidents of highway flooding	Unaware of any current flooding problems associated with Bury New Road or George Street.

Table 3-1: Summary consultee information

Source	Details	
United Utilities (UU)	Likely conditions for connecting into their sewerage system	UU would request conditions for a separate system with only foul draining to foul / combined sewers and surface water draining to soakaway/SuDS, watercourse or surface water sewer. All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80 of the National Planning Practice Guidance. Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible. If not feasible, UU will consider a connection to the 375mm diameter public combined sewer located in Bury New Road to the west at a pass forward flow to be agreed by the Lead Local Flood Authority. UU request that any agreed rate does not exceed 5l/s. Foul flow from this site will be allowed to drain into the public combined sewer system. UU's preferred point of discharge would be to the 375mm diameter public combined sewer within Bury New Road at an unrestricted rate. UU Wastewater Developer department was contacted regarding sewer flooding history for the site. UU confirmed that they did not have records of internal or external sewer flooding of properties in the vicinity of the site as a result of overloaded sewers.
	Sewer map	There is a 375mm public combined sewer within Bury New Road to the west of the site running in a northerly direction. There is a 225mm public combined sewer within George Street to the east of the site running in an easterly direction towards the adjacent recreational ground.
Strategic Flood Risk Assessment (SFRA)	Level 1 SFRA ³	The site has no history of flooding from any source.
	Level 2 SFRA ⁴	The site has no history of flooding from any source.
Preliminary Flood Risk Assessment (PFRA) ⁵	The Preliminary Flood Risk Assessment (PFRA) ³ for the area indicates that there are no records of flooding for the area which conforms with information supplied by the EA.	

Table 3-1: Summary consultee information (continued).

³ Strategic Flood Risk Assessment Level 1: Greater Manchester Combined Authority; 'Level 1 SFRA for Greater Manchester – Bolton MBC Sites Assessment' (2019), JBA Consulting.

⁴ Strategic Flood Risk Assessment Level 2: Greater Manchester Combined Authority; 'Level 2 Hybrid SFRA – Main Report' (2020), JBA Consulting.

⁵ Preliminary Flood Risk Assessment: Bury Council; 'Bury Council Preliminary Flood Risk Assessment' (2011), JBA Consulting.

4 Assessment of Flood Risk

4.1 Flood Zones

The detailed flood map provided by the EA indicates that the site is in Flood Zone 1. (see Appendix C).

The EA did not have any modelled levels for the stretch of the River Irwell closest to the site. Therefore, the comparison data was extracted by comparison with the flood map extents and the available topographical data provided.

The extents of the 0.1% (1000-year) flood level remain outside of the development area (see Appendix C).

4.2 Sources of Flooding

The risk of flooding from the following flood sources has been considered:

Fluvial – The EA has confirmed the study area is within Flood Zone 1. Therefore, the flood risk associated with this source is considered Very Low.

Tidal – The study area is remote from the sea and tidally influenced water bodies. Therefore, the flood risk associated with this source is considered Negligible.

Pluvial (Rainfall) – The surface water flood risk maps show areas adjacent to the south eastern and north eastern boundaries outside of the site in George Street and Bury New Road which have the potential to flood during prolonged heavy rainfall. These areas are associated with the highway and are likely to be positively drained. Areas within the lower end of the site need consideration within the detailed design phase or there is the potential to have areas of standing water in car parks, gardens, and landscaped areas not positively drained if overland flow routes are not considered. Therefore, the risk of flooding from surface water flooding is Very Low but should be considered further during the detailed design.

Surface Water (Overland flow) – This relates to surface water entering the site. Surface water arising from the south and west of the study area is likely to be intercepted by the highway drains and therefore pose no threat to the development. If there was a drainage failure causing overland flow, it would flow towards the eastern boundary. Therefore, the flood risk associated with this source is considered Very Low.

Groundwater – The BGS has groundwater records for the study area in the form of borehole records. The records show the water table is recorded at 42.73m below the surface. This makes it unlikely for groundwater flooding to occur. Therefore, the flood risk associated with this source is considered Very Low.

Sewers – UU sewer records show combined water sewers within the vicinity of the study area. The Pre-development Enquiry states that no property on land within close vicinity of the site is at risk of internal flooding due to overloaded public sewers. There are no records of sewer flooding at the site location. The highways to the west would intercept any overland flow before it enters the site. Therefore, the flood risk associated with this source is considered Very Low.

Artificial sources – According to the EA online maps, the study area is not at risk from reservoir flooding. Therefore, the flood risk associated with this source is considered Negligible.

4.3 Summary of Flood Risk

Source of Flooding	Risk Assessment Level
Fluvial	Very Low
Pluvial (Rainfall)	Very Low
Surface Water	Very Low
Tidal	Negligible
Groundwater	Very Low
Sewers	Very Low
Artificial Sources	Negligible

Table 4-1: Summary of Existing Risk Level.

The site is located within Flood Zone 1 and a Negligible to Very Low risk of flooding from all sources have been identified for the site. LKC consider that a strategy for surface water management will be required at the site to mitigate the risk to others. The assessments of a range of measures that are feasible for the site are outlined in Section 5.

5 Surface Water Management

The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface run-off from development sites through the use of Sustainable Drainage Systems (SuDS), this being complementary to the control of development within the floodplain.

SuDS will not alleviate flooding in an area prone to flooding; however, properly designed SuDS have the potential to prevent the surface water runoff from new development worsening the flood risk. The effective disposal of surface water from any new development is a material planning consideration in determining if the proposals for the development and use of land are acceptable.

The accepted principles are that surface water arising from a developed area should, as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

The Building Regulations Requirement H3⁶ stipulates that rainwater from roofs and paved areas is carried away from the surface to discharge to one of the following, listed in order of priority:

- an adequate soakaway or other adequate infiltration system,
- a watercourse or, where that is not practicable,
- a sewer.

The concept of a sustainable drainage system has been incorporated into the outline drainage strategy for the study area in order to comply with the Flood and Water Management Act 2010⁷.

Suitability of different SuDS will be governed by prevailing site conditions, such as the type and scale of development, topography, ground conditions (soil permeability, ground stability, depth to water table), local hydrogeology and risk of groundwater contamination (presence of sensitive aquifers and source protection zones) etc.

⁶ Building Regulations part H3 2010: Approved Document, Drainage and Waste Disposal.

⁷ Flood and Water Management Act 2010: UK Government.

5.1 Infiltration

The Groundwater Source Protection Zone mapping from the EA website shows that the site is not within any identified protection zones. A summary of the British Geological Survey superficial and bedrock aquifer descriptions and classifications supplemented by local records is shown in Table 5-1 below:

Classification	Description	Aquifer Classification	Recorded Water Table Depth	Soakaway Potential
Till Deposits majority of site	Sand and Clay bands	Secondary A	42.73mbgl	Limited
Glaciofluvial Deposits in E	Sand and Gravel			Good
Collyhurst Sandstone Formation in N	Sandstone	Principal	N/A	Good
Manchester Marls Formation in S	Mudstone			Limited

Table 5-1: Geological and Hydrogeological Setting.

Infiltration methods such as soakaways are unlikely to be practicable, but this may be investigated further at the detailed design stage if required. The site is occupied by an existing Fire Station located within a densely built urban area with limited space for utilising any infiltration facilities.

5.2 Surface Water Drainage Strategy

There is a slope over the site and surrounding area which indicates that groundwater in the vicinity of the site would drain towards the east. There are no observable watercourses within or near the boundary of the site.

The utilities survey shows that the current drainage discharges from the north east corner into the north east branch of George Street. There are a number of unmarked manholes in the main part of George Street.

A short length of surface water sewer is shown at the northeast end of George Street adjacent to Elms Park but remote from the fire station.

The drainage options relating to the final discharge of surface water for this section of the site are listed in Table 5-2 in order of priority within the NPPF:

Option No:	Drainage Solution	Most feasible solution	Comments
a	Soakaway/Infiltration	2	Not likely to be feasible as the site is constrained by the proximity of the adjacent highways and residential properties.
b	Connection to Watercourse	N/A	No watercourses within the vicinity of the site.
c	Discharge into a sewer	1	There are several manholes and gullies present on site towards the eastern boundary which currently provide drainage for the site. A connection into the 375mm combined sewer in Bury New Road to the west would be possible – subject to approval from the LLFA and connection consent from UU.

Table 5-2: Drainage options.

Table 5-3 provides a summary of the SuDS options appraisal with consideration of CIRIA C753 (The SUDS Manual)⁸ for the development:

SuDS Option	Appropriate to Development	Comments
Soakaways	X	Due to the confined nature of site, the use of infiltration systems may not be feasible.
Infiltration basin	X	Depressions that store and dispose of water via infiltration. May not be appropriate given the confined nature of the site.
Sand filter	X	Treatment devices using sand beds as filter media.
Filter drains	*	Linear trenches filled with a permeable granular material, often with a perforated pipe in the base of the trench.
Detention basin	X	Dry depressions designed to hold water for a specific retention time.
Swales	X	Swales are shallow grass-lined channels that provide capacity for conveying flows at a controlled rate into ponds and watercourses.
Rainwater harvesting	*	Rainwater harvesting collects the rain which falls onto roofs, then stores it in a tank until required for a non-potable use. When required, the water is pumped to the point of use, thus displacing what would otherwise be a demand for mains-water. In the process, a volume of water is kept out of the storm-water management system, thereby helping to reduce flooding risks. Rainwater harvesting systems are currently not included in the development proposals.
Green/blue roofs	*	Green roof installations can help to reduce surface water runoff from roof areas depending on the system specified. Green roofs are not currently included in the development proposals.
Geo-cellular storage systems	✓	Modular block systems can be used to provide an underground storage facility. Any geo-cellular storage systems should be lined with a geo-membrane to provide attenuation storage.
Permeable Pavements – with granular and geo-cellular storage systems	✓	Permeable pavements allow inflow of rainwater into underlying construction. Any geo-cellular storage systems would have to be lined with an impermeable membrane to provide storage rather than infiltration for runoff from highways.
Ponds	X	Attenuation ponds can be used to offset the increase in surface water flows attributable to increased area of hard standing, in order to minimise the risk of flooding to and from the proposed development. Ponds will attenuate the surface water flow prior to discharging to the public surface water sewers. The storage volume afforded by these features should not include any permanent water in the pond.
Oversized Pipes	✓	Oversizing the pipes that make up the on-site drainage network is a cost-effective method for providing attenuation storage within the network. Such systems could be considered on the parts of the development where gradients are relatively flat.
Tanks	✓	Prefabricated underground tanks could be considered at the detailed design stage in order to provide storage to attenuate surface water runoff.
Flow control devices	✓	The peak flow rates will be controlled by flow control devices e.g. hydrobrake style flow control systems, and restricted orifices. Flow control devices enable the discharge to be restricted to a constant rate from the development.

Table 5-3: Summary of the SuDS options appraisal.

Notes

✓ Suitable for use given the nature and scale of the development

* Possibly suitable for use – not included in the client and architect design proposal at present

X Not suitable

⁸ CIRIA C753 - The SUDS Manual. London 2015.

5.3 Surface Water Attenuation Requirements

In line with local guidance, the flow from this development should be reduced by the minimum of 50% from the existing runoff rates for estimating the attenuation volumes required.

It is estimated from the supplied plan (see Appendix A) that the site will have the following designated areas (Table 5-4). Table 5-4 shows the assumed split in area included within the calculations.

Designated Areas	Plot Area
Total area (ha)	0.38
Development Area (ha)	0.29
Green Infrastructure (ha)	0.09
Contributing Catchment	
Developable Area (ha)	0.38
Impermeable split (ha)	0.28
Permeable split (ha)	0.10

Table 5-4: Assumed plot areas.

It can be seen that there is a slight reduction in impermeable area from the existing usage to the proposed. This is likely to require attenuation to reduce the proposed flow off site to a level which is acceptable to the LLFA and to UU, including an allowance for climate change.

5.3.1 Attenuation Estimate

Surface water storage and greenfield runoff estimations based on the HR Wallingford procedure have been undertaken for the development and the output report is presented in Appendix E.

For the contributing catchment an estimate has been produced assuming a developable area of 0.28ha and a greenspace of 0.10ha. This gives the following runoff rates and attenuation requirements for this section based on the Wallingford method:

» Q_{bar} :	37.20 l/s
» 1 in 1-year runoff rate:	26.20 l/s
» 1 in 30-year runoff rate:	65.50 l/s
» 1 in 100-year runoff rate:	82.80 l/s

This reduced by 50% would give the following rates:

» Q_{bar} :	18.60 l/s
» 1 in 1-year runoff rate:	13.10 l/s
» 1 in 30-year runoff rate:	32.75 l/s
» 1 in 100-year runoff rate:	41.40 l/s

United Utilities has specified an allowable discharge rate of 5l/s to their adjacent 375mm diameter combined sewer. Therefore, the 5l/s rate has been utilised.

All runoff estimates, and subsequent storage estimates are included in Appendix E.

The following attenuation has been estimated for the development using 5l/s runoff rates and utilises the FSR methodology⁹ as:

- Attenuation storage volume: **47.5 m³** (1 in 30-year event)
- Retention on site volume: **92.4 m³** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **114.9 m³** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the 5l/s runoff rates for a range of annual flow rate probabilities before discharging into a sewer. As the flow from the development would be restricted to 5l/s there should be little change in the flows that enter the public sewer and thus the risk of flooding as a result from the development should be negligible.

The attenuation required for a 1 in 30-year storm event, requires a storage volume of **47.5 m³**. For the 1 in 100-year event, a storage capacity of between **92.4 m³** and **114.9 m³** will be required from on-site storage as well as SuDS systems. All volumes can be stored within the site boundary and discharges will be limited by flow control devices to the adjacent sewer.

5.4 Site Specific SuDS

The use of an attenuation tank or similar is deemed to be the most feasible and practical option for the development. The attenuation tank will provide required storage volume to limit peak runoff arising from the development.

Utilisation of a flow control device at the end of the system will control the peak flow rates.

The use of permeable paving may be viable dependant on the detailed design of the proposed development. If this drainage technique is considered to be feasible then it will reduce the requirement for attenuation as it will reduce the contributing impermeable area. The permeable paving will also provide some level of water treatment reducing effects of pollution in runoff on the environment.

Assuming that the outline drainage strategy is acceptable to the Local Authority, a more detailed design can be presented and agreed with the appropriate regulatory bodies during the detailed design phase.

5.5 Foul Drainage

The foul water could be discharged into the adjacent 375mm diameter combined sewer in Bury New Road at unrestricted rate.

⁹ Flood Studies Report Wallingford NERC 1975.

6 Mitigation Measures

6.1 Proposed Site levels and Developments Level

Current Environment Agency guidance recommends that the minimum ground floor levels of developments are set at a minimum of 600mm above the 1% annual probability (1 in 100 year) flood level including an additional fluvial allowance for climate change. It is generally accepted that vehicle parking can be accommodated within the flood zone with suitable safeguards. The 'design' flood level for the site should therefore be the 1% annual probability event with allowance for climate change.

This and the 0.1% annual probability (1 in 1000-year) are below the lowest existing ground level measured on site. On this basis the finished floor levels (FFL) should be set at a nominal height above the finalised ground levels to allow for any overland flow from a drainage failure. No further mitigation measures are therefore recommended.

6.2 Safe Access

Safe and dry access is available via Bury New Road to the west of the site. Therefore, no mitigation is proposed.

6.3 Flood Resistance and Resilience

The development proposed may be subject to flooding at more extreme events than those considered. However, the risk appears to be sufficiently low that flood resilience measures need not be included into ground floor construction to aid recovery after any event. If utilised, typical measures would include solid floors, use of suitable materials and services fed from upper floors with outlets at high level. The need can be discussed and agreed with building control officers during detailed design.

6.4 Residual Risk

It is impossible to completely guard against flooding since extreme events greater than the design standard event are always possible. However, it is likely that with the 1% annual probability flood event with an allowance for climate change significantly below the lowest site levels, the relatively elevated position of the development will safeguard it from localised fluvial flooding during extreme rainfall events and fluvial flooding events outside the scope of this assessment. However, ground floor levels should be set above proposed levels across the site and provide a nominal freeboard to allow overland flow under exceptional conditions. Overland flow routes should be considered in case of drainage failure and the extreme events.

7 Conclusions

The site is currently a Fire Station, and the proposal is to demolish the existing building and build a new Fire Station building with modern facilities, car parking and training space.

The site is shown on published mapping to be located within the Environment Agency's Flood Zone 1. Comparison of topographical data with the EA modelled flood level data indicates that the whole site is in Flood Zone 1 – Very Low Risk of fluvial flooding.

Negligible to Very Low risks of flooding from all sources have been identified from information provided by the EA and BGS.

An assessment of these risks in conjunction with the development proposals have resulted in the following recommendations for the safe development of the site:

- » The finished floor level should be set at a nominal height above the finished ground levels to allow for overland flow routes in extreme events and drainage failures.
- » Safe pedestrian and vehicular access to and from the site is achievable under all conditions via the access road off Bury New Road.
- » Potential for soakaway use for rainwater disposal is low; however, this could be investigated further at the detailed design phase.
- » Surface water flow will likely need to be attenuated to the 5l/s runoff rate or a rate agreed with the LLFA and UU.
- » Surface water arising from the site could potentially discharge into the combined sewer located to the west of the site.
- » Foul sewage could be discharged into the existing public combined sewer in Bury New Road subject to the agreement of United Utilities.
- » A formal evacuation plan is not considered to be required.

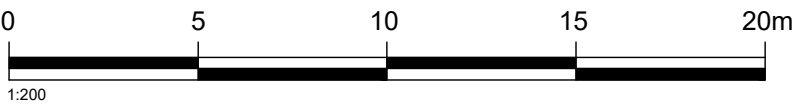
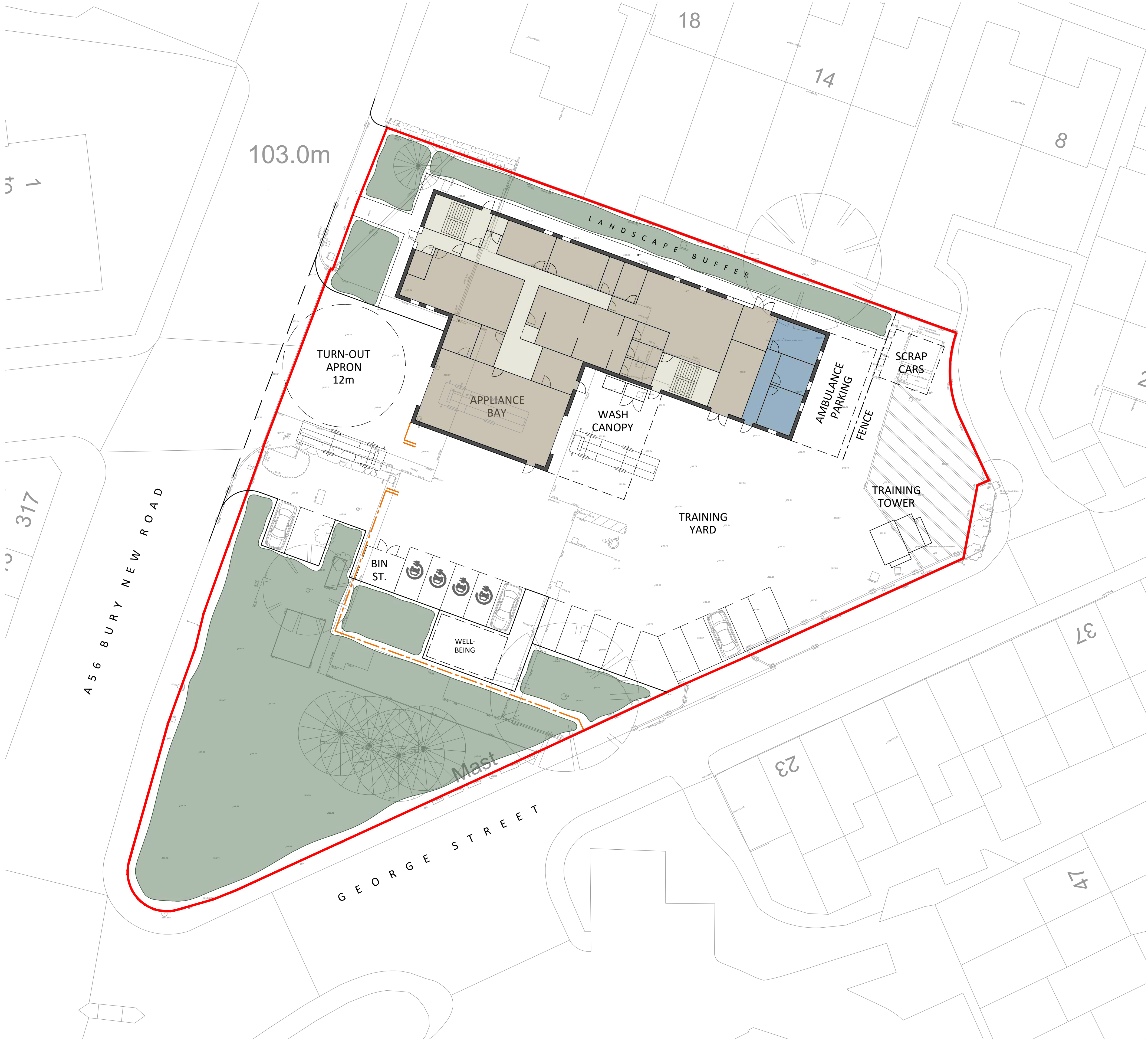
Further details on the proposed mitigation measures are provided in Section 6. All proposed measures should be agreed with the Local Authority prior to commencement of the development.

Appendix A

Figures, Plans and Drawings



Client: Greater Manchester Combined Authority				Title: Site Location & Boundary Plan			
Site: Whitefield Fire Station, Manchester				Scale (see scale bar): 1:25,000 & 1:1,500 @ A4			
Job No.: FRA 22 1159	Drawn By: JL	Checked By: MJ	Drawn: Oct 2022	Figure: 1			
				Revision:			



status

FEASIBILITY

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All dimensions are to be checked on site by the contractor prior to proceeding with any work.

Hazard Identification

ref

hazard

date

N

P3	UPDATED FOLLOWING REVIEW AT MTG. 02.08.22	ST	22.08.22
P2	BUILDING FOOTPRINT UPDATED. APPLIANCE BAY DELETED.	ST	16.06.22
P1	FIRST ISSUE	ST	06.06.22
ref	revision	by	date

B
&
H

Bradshaw Gass & Hope LLP

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email@bghbolton.co.uk
www.bghbolton.co.uk

Architects
Consulting Engineers
Quantity Surveyors

client

GREATER MANCHESTER
COMBINED AUTHORITY

project

NEW FIRE STATIONS
FEASIBILITY STUDIES

drawing

WHITEFIELD FIRE STATION
PROPOSED SITE PLAN

drawn by

ST

date

JUN 22

checked by

date

scale

1:200

rev

A1

dwg no

1978.35.4203

rev

P3

Appendix B

Site Information

[illegible]

ABBREVIATION KEY

[illegible]

UTILITY SURVEY NOTES

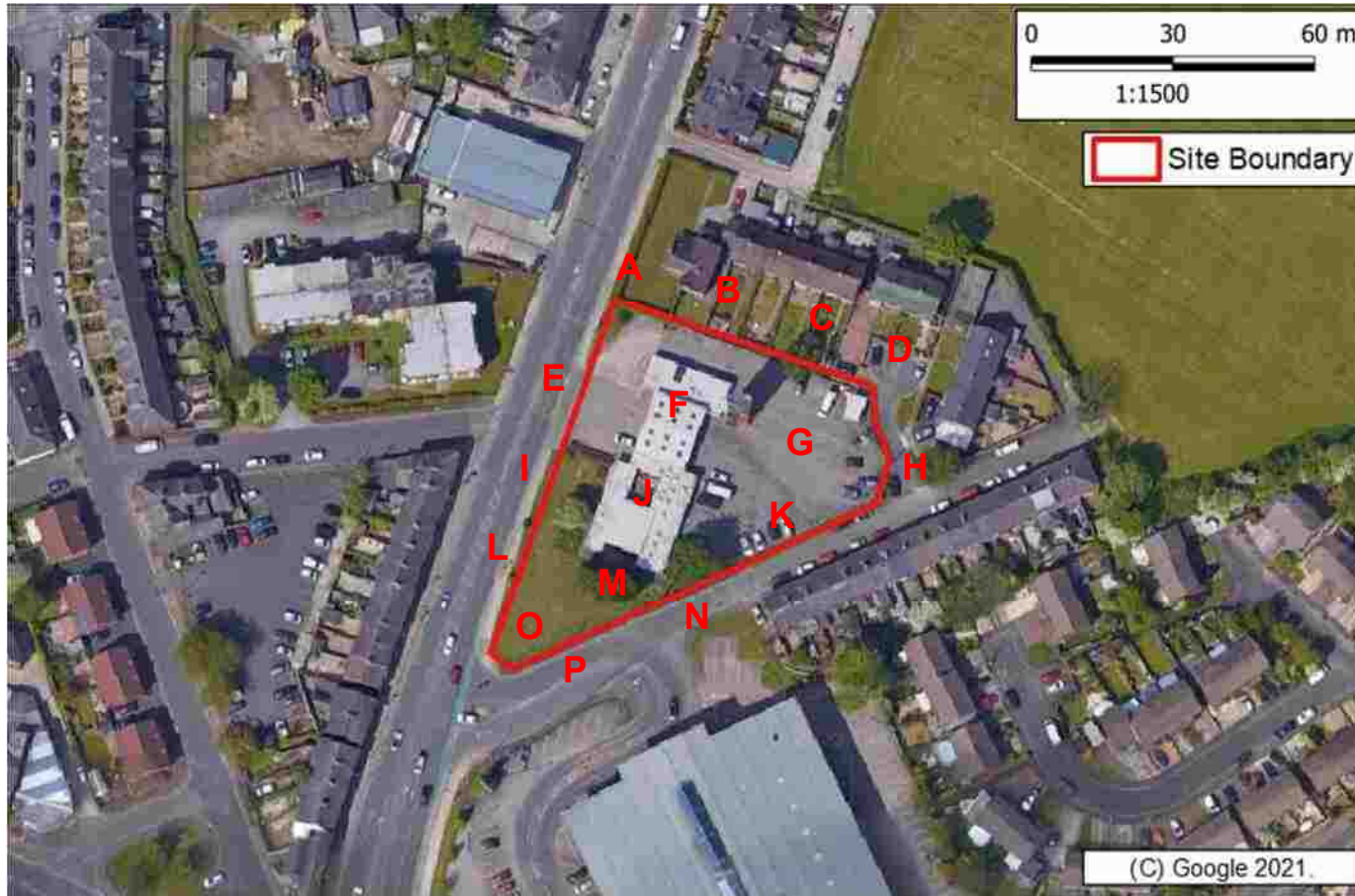
[illegible]

Disclaimer

Only manholes that were accessible on site during survey or other manholes may be present but covered all invert levels taken where possible at main channel. Man Entry to sewers has not been undertaken. Depths, Pipelines etc are measured from the ground. All sewers and inverts to be checked prior to any works commencing on site. The CAD Room Ltd are not responsible for manholes, services, information not surveyed which may have an impact on site development.

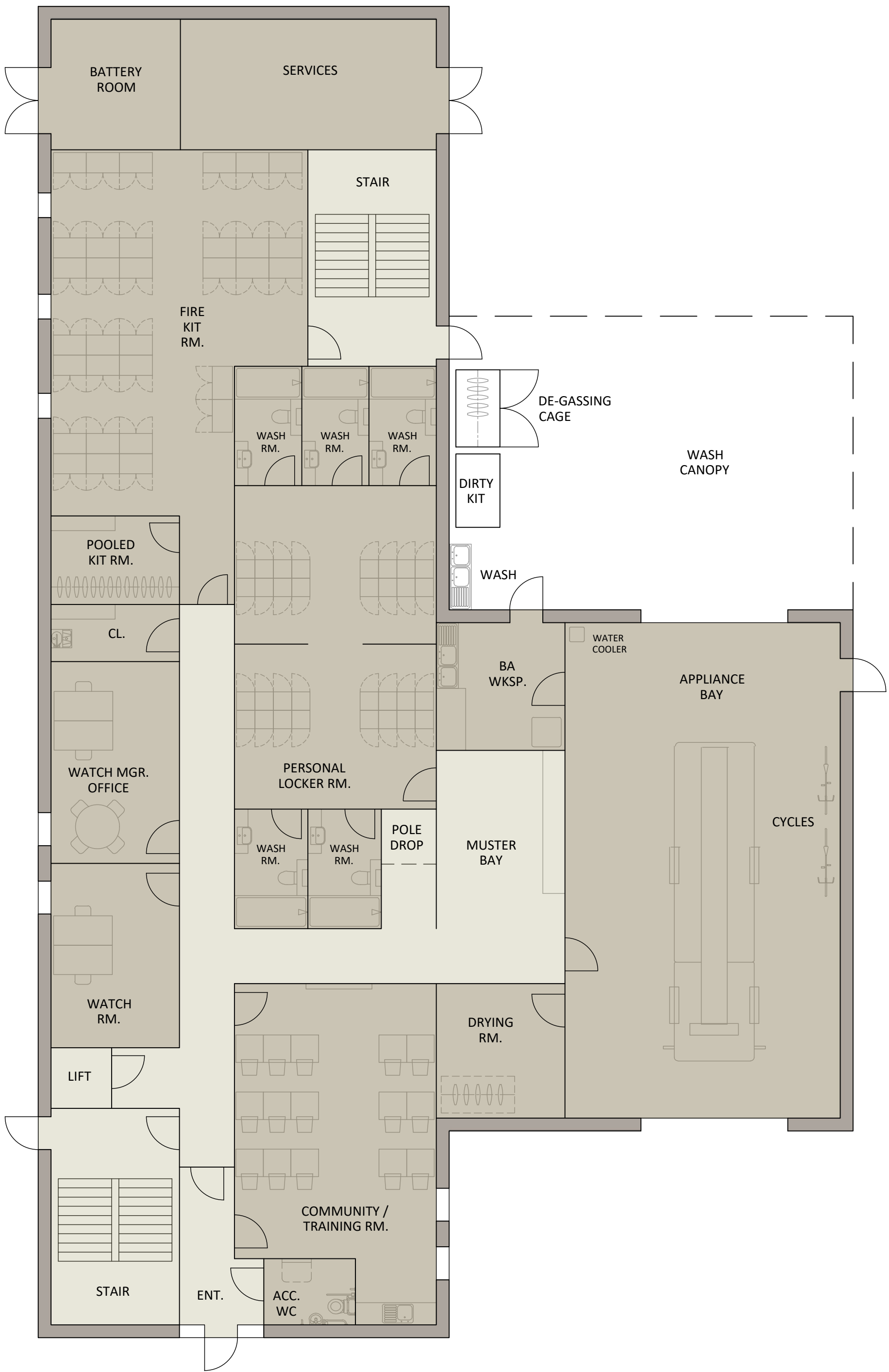
Boundaries shown are physical and may not represent legally conveyed

	Unit 1 Arcan Business Centre Horsfield Way Bredbury Ind. Estate Bredbury SUSSEX T: 01642 677 0348 E: info@thecadroom.com							
	N 							
Client: MICA Location: Chalfont Fire Station Comments:								
<table border="1" style="width: 100%;"> <tr> <td>Drawing Number: 01-S-1072-GM Fire Stations</td> <td>Revision: A</td> </tr> <tr> <td>Date: 10.02.2022</td> <td>Scale: 1:100 @ A0</td> </tr> <tr> <td>Drawn By: LK</td> <td>Checked By: JCG</td> </tr> </table>			Drawing Number: 01-S-1072-GM Fire Stations	Revision: A	Date: 10.02.2022	Scale: 1:100 @ A0	Drawn By: LK	Checked By: JCG
Drawing Number: 01-S-1072-GM Fire Stations	Revision: A							
Date: 10.02.2022	Scale: 1:100 @ A0							
Drawn By: LK	Checked By: JCG							

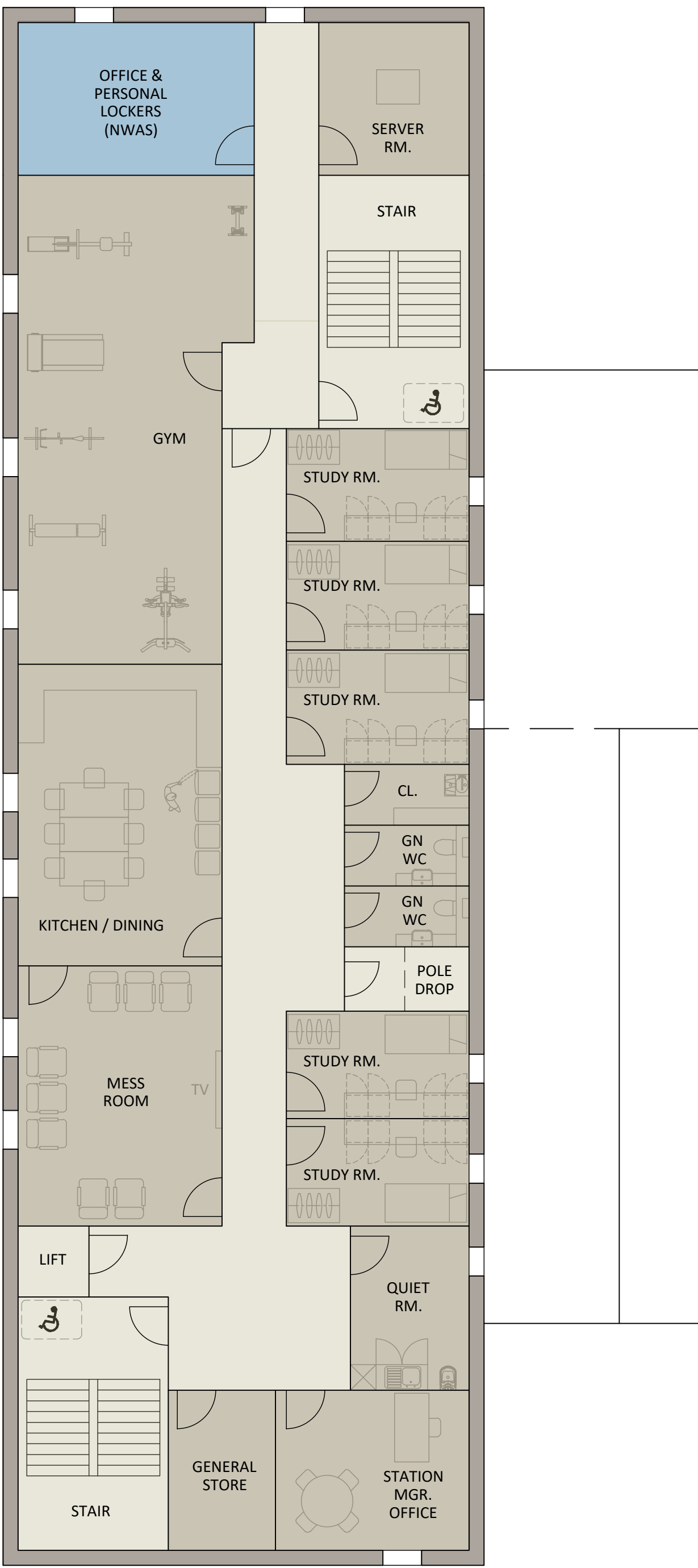


LiDAR Elevation Key (m AOD)

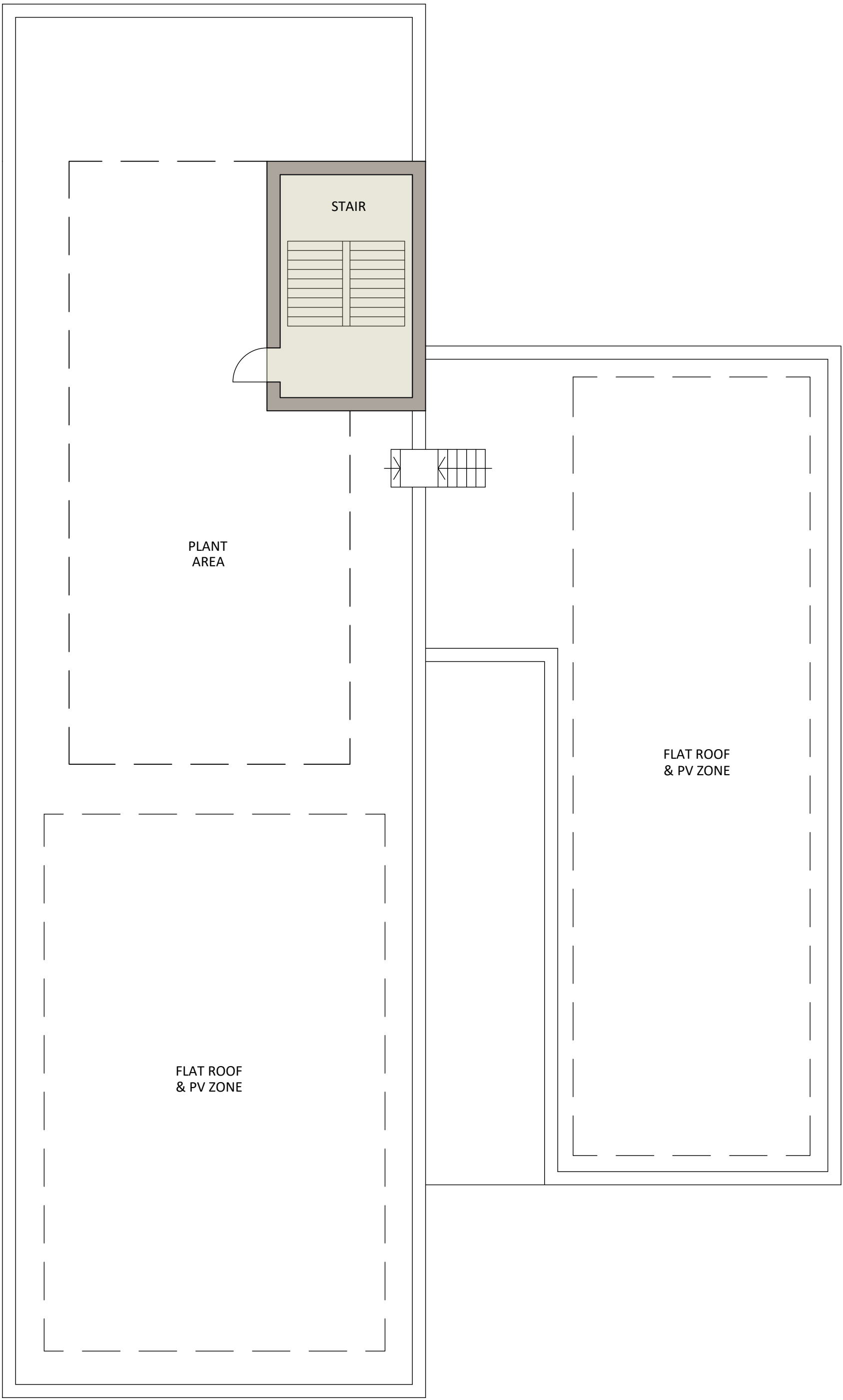
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B	=	102.14
C	=	101.94
D	=	101.99
E	=	103.07
F	=	102.97
G	=	102.71
H	=	102.56
I	=	103.20
J	=	103.01
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L	=	103.43
M	=	103.16
N	=	103.35
O	=	103.73
P	=	103.91



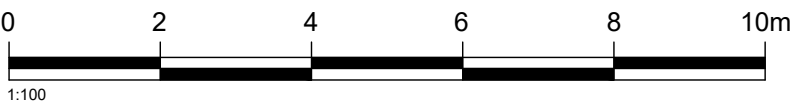
LEVEL 0



LEVEL 1



ROOF



status

FEASIBILITY

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All dimensions are to be checked on site by the contractor prior to proceeding with any work.

Hazard Identification

!

ref	hazard	date

P7	2NO. WASHROOMS ADDED. WALL & DOOR ADDED TO KITCHEN / DINING / MESS ROOM	ST	21.09.22
P6	REVISED FOLLOWING REVIEW AT MEETING 08.09.22	ST	09.09.22
P5	REVISED FOLLOWING REVIEW AT MEETING 30.08.22	ST	01.09.22
P4	REVISED FOLLOWING REVIEW AT MEETING 23.08.22	ST	27.08.22
P3	UPDATED FOLLOWING REVIEW AT MTG. 02.08.22	ST	22.08.22
P2	STAIR ADJUSTED & FIRST FLOOR LAYOUT ADJUSTED TO SUIT	ST	28.06.22
P1	FIRST ISSUE	ST	16.06.22
ref	revision	by	date

BGH

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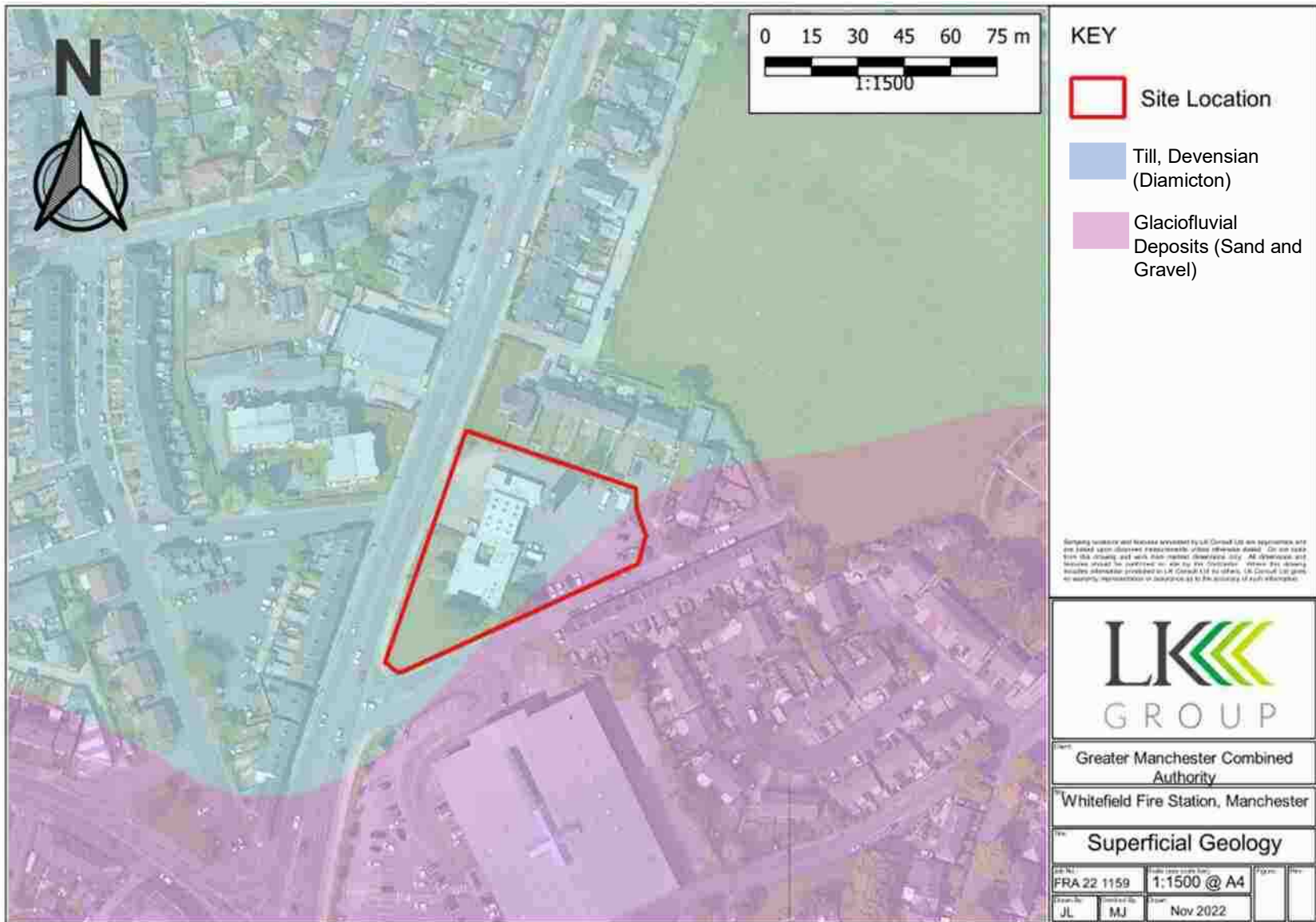
BRADSHAW GASS & HOPE LLP

client
GREATER MANCHESTER
COMBINED AUTHORITY

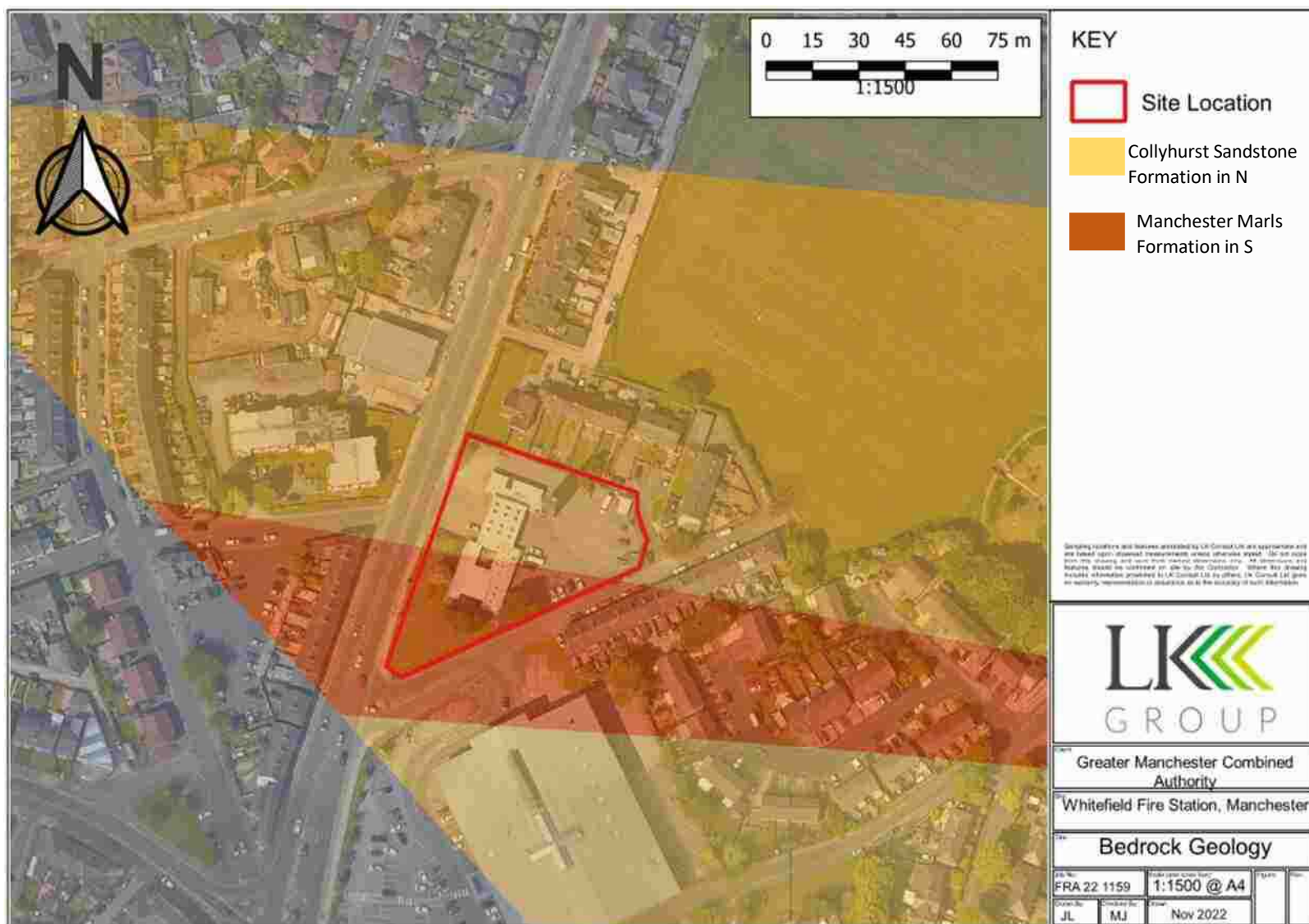
project
NEW FIRE STATIONS
FEASIBILITY STUDIES

drawing
WHITEFIELD FIRE STATION
PROPOSED FLOOR PLANS

drawn by	ST	date	JUN 22
checked by		date	
scale	1:100		A1
dwg no	1978.35.4301	rev	P7



BGS Superficial Geology – Contains British Geological Survey Materials © UKRI 2020



BGS Bedrock Geology – Contains British Geological Survey Materials © UKRI 2020



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British
Geological
Survey

Version 2.0.6.6

BGS ID: 27199 : BGS Reference: SD80NW6
British National Grid (27700) : 380500,406900

[Report an issue with this borehole](#)

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< Prev

Page 1 of 4 ▼

Next >

>>

8050 0690
RECORD OF WELL (SHAFT OR BORE) **SD 80 NW 6**

At The Lilly Hill Dyeing Co., Ltd. 1" N.S. 6
1" O.S. 6
Grid Ref. 1

Town or Village Whitefield County Lancashire Six-inch quarter sheet 96 NW

Exact site _____ } (A rough sketch-map or a tracing from a map is very desirable)

_____ in parish of _____

Level of ground surface above sea-level (O.D.) 630 ft. If well starts below ground surface, state how far _____ ft.

Shaft _____ ft., diameter _____ ft. Bore _____ ft. Diameter of bore: at top _____ ins.; at bottom _____ ins.

Details of permanent lining tubes (internal diameters preferred) _____

Water struck at depths of (feet) _____

Rest-level of water ~~below~~ ^{above} top of well 170 feet. Suction at _____ feet. Yield on _____ hours' test _____ days'

2,500 gallons per hour (with pump of capacity _____ g.p.h.); depressing water level to _____ feet below top. Time of recovery _____ hrs. Amount normally pumped daily _____ g.p.h. for _____ hours.

Quality (attach copy of analysis if available) _____

Sunk by Messrs. T. Matthews for Mr. Lilly Hill Dyeing Co. Date of well 1936

Information from Messrs. Thomas Matthews, Pendleton, Manchester.

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS		DEPTH	
		Feet.	Inches.	Feet.	Inches.
	Sand (<u>25/40 NW 1</u>)				
	Sand and boulders	m	cm	26	(7.22)
	Stiff clay and stones			28	(8.53)
<u>Drift</u>	Rough Stones	51	21	168	-
	Sandstone	53	04	174	-
	Rough stone, no core	56	39	185	-
	Brown shale	57	00	187	-
	Hard shale	61	87	203	-
	Brown sandstone	62	18	204	-
	Grey sandstone	62	48	205	-
	Brown shale fairly hard	63	09	207	-
	Brown shale, no core	63	70	209	-
	Brown and grey shale	64	62	212	-
	Grey shale	66	14	217	-
	Grey soapy shale, no core	67	97	223	-
	Brown shale	69	19	227	-
	Grey shale with fairly hard bands	80	16	263	-
	Black shale	82	60	271	-
	Shale	84	43	277	-
	Shale and sandstone	91	74	301	-
	Fairly hard brown sandstone	93	88	308	-
	Brown shale	97	84	320	-
	Blue shale	103	63	340	-
	Coal	104	85	344	-
	Blue shale	104	85	344	-
	Brown shale	112	17	368	-
	Blue shale	114	41	377	-
	Coal	117	46	387	-
	No cores	118	87	390	-
	Blue shale	121	01	397	-
	Coal	125	27	411	-
	Brown shale and fine sandstone	125	58	412	-
	Iron shale and fine brown sandstone	128	32	421	-
	Hard brown sandstone	131	37	431	-
	Brown shale	134	72	442	-
	Grey sandstone	142	34	467	-
		154	84	508	-
		154	110	509	-

Coal	153	97	500	-
Grey shale	156	97	515	-
Coal	157	58	517	-
Grey shale	159	72	524	-
Coal	161	24	529	-
Grey shale	173	13	568	-
Fine sandstone	173	74	570	-

Geological Survey

GEOLOGICAL SURVEY AND MUSEUM,
SOUTH KENSINGTON,
LONDON, S.W.7.

For Survey use only

Date received	G.S.M. Office File No.	Site marked on 1" map (use symbol)

Geological Survey

(7998) Wt. 980064/0849 5,000 12/88
A.&E.W.Ltd. Gp. 686



British
Geological
Survey

Version 2.0.6.6

BGS ID: 13096877 : BGS Reference:
SD80NW388

British National Grid (27700) : 380460,406400

[Report an issue with this borehole](#)

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< Prv

Page 3 of 9 ▼

Nxt >

>>

TEST PUMPING SUMMARY (Please supply full details on form WFA 239)

SD80/119

Test Pumping Datum (if different from borehole datum)	EDGE OF MANHOLE (mbd)	above m below borehole datum
Pump Suction Depth	43	mbd
Water Level (Start of Test)	42.73	mbd
Water Level (End of Test)	86.70	mbd
Pumping rate	6.94 m ³ HOUR	m/d : h/s
for	14	days/hours
Recovery to (from end of pumping)	42.58 mbd in 15	mins : hrs : days
Date(s) of measurements		
Please Supply Chemical Analysis If Available		

D. STRATA LOG

Geological Classification	Description of Strata	Thickness m	Depth m
(BGS only)			
	CONCRETE	0.50	0.50
	INFILL	2.20	2.70
	SANDS AND CLAY BANDS	54.30	57.00
	RED MARL AND SANDSTONE	13.00	70.00
	RED AND GREY MARL	93.50	163.50
	RED AND GREY SANDSTONE	18.50	182.00
	(continue on separate page if necessary)		
	Other Comments (eg gas encountered, saline water intercepted, etc)		

FOR OFFICIAL USE ONLY

FILE CONSENT NO BGS REF NO
 LICENCE NO USE OF BH NGR.....

CLIENT JOHN ALLEN ASSOCIATES			JOB NO CB724	LOCATION GMN 0135, WHITEFIELD		BOREHOLE NO BH2	
DATE DECEMBER 1996		SCALE 1 to 50	BORING METHOD DYNAMIC PROBING & SAMPLING RIG			Sheet: 1	
Drilling & Casing Progress	SAMPLE/TEST		SPT N - value or COHESION	DESCRIPTION	O D LEVEL	LEGEND	DEPTH
	Type & No.	Depth(M)					
16TH	B	0.00 - 0.50		MADE GROUND—Grass on dark brown/black loose sandy soil & ash fill with fragments of brick & sandstone present.			0.0
	B	0.50 - 1.00					0.30
	B	1.00 - 2.00		MADE GROUND—Loose fine orange & brown sand & fragmented sandstone fill.			0.60
	B	2.00 - 3.00		MADE GROUND—Loose soft dark brown/black very sandy soil & ash fill with large fragments of brick present.			1.70
	B	3.00 - 4.00		Medium dense orangy brown slightly silty fine SAND. Becoming more dense with depth.			4.00
16TH							
DUNELM DRILLING COMPANY TEL0191-528-2534 FAX0191-517-0085				BOREHOLE LOGSHEET			
Water Observations, Remarks, Etc Borehole dry.							





CHARACTERISTICS AND SYMBOLS FOR BOUNDARIES:—

W	Change of Boundary indicating the point at which the character of a Boundary changes	27
D	Antiquities (Site of)	4 17°
P	Isognomonic Station	
R	Peer-Less Union	
Sept	Every parcel is numbered thus: Its area is given underneath in Acres this: Acres indicating that the space so connected are included in the same reference number and area	
U	For other information see Characteristics Sheet	

WHITEFIELD N.D.

WHITEFIELD P.E.

XCVI. 5.

Printed and Published by the Director General at the Ordnance Survey Office, Southampton.

The Altitudes are given in Feet above Ordnance Survey Datum (approximate Mean Sea Level at Liverpool). Altitudes indicated thus (B.M. 547) refer to Bench Marks on Buildings, Walls, &c. those marked thus (152) to 152 feet above Ordnance Survey Datum.

Note.—To convert Decimal parts of an Acre into Roods and Perches, multiply by 4, this will give Roods and Decimals of a Rood. multiply the Decimal by 40 thus obtaining Perches and Decimals of a Rood.

Example.—.357 = 1 Rood 17.280 Perches

Roods 1.425

Perches 77.180



Fi
Wat
Wor

The
ing Clough
& Dye Works

u r s c

375

Filter
Beds

Spring Water
Cottage

Lily Hill
Dye Wks

B.S.

Clough Gate
Cottage

325

F.P.

U.D. By

30

Lily
Hill

The Green

F.P.
Elms
Farm

Playing
Fields

Bury 2 1/2
M.S. Manchester 5

The
Elms

Dunkirk House

Rises

Tank

F.P.

325

Tanks

Tank

325

Whitefield

WHITEFIELD
PARK

Whitefield
Station

Moss Lane
Works
Water Tower

Albert
New Mill
Tk.

School

392-68

All Saints

S.P.

359/13

B.M. 349-56

A668

Club House

Aqueduct

Inn

MYRTLE GROVE

Spring
Water
House

Spring
Bank

Allot.
Gdns.

The Clough

CROMWELL

W. R. O. A. D. B.S.

F.P.

F.P.

F.P.

F.P.

F.P.

F.P.

F.P.

F.P.

F.P.

F.P.

F.P.

RA.

3000

Boro Const Bdy

07

Boro Const Bdy

Radcliffe 1 Mile

BURY AND RADCLIFFE BORO CONST
RADCLIFFE MB & PH

06

LAT. 53° 33'

Ringley 2 1/2 Miles

500



Appendix C

Environment Agency Data

Flood map for planning

Your reference
Whitefield FS

Location (easting/northing)
380480/406485

Created
7 Nov 2022 10:42

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

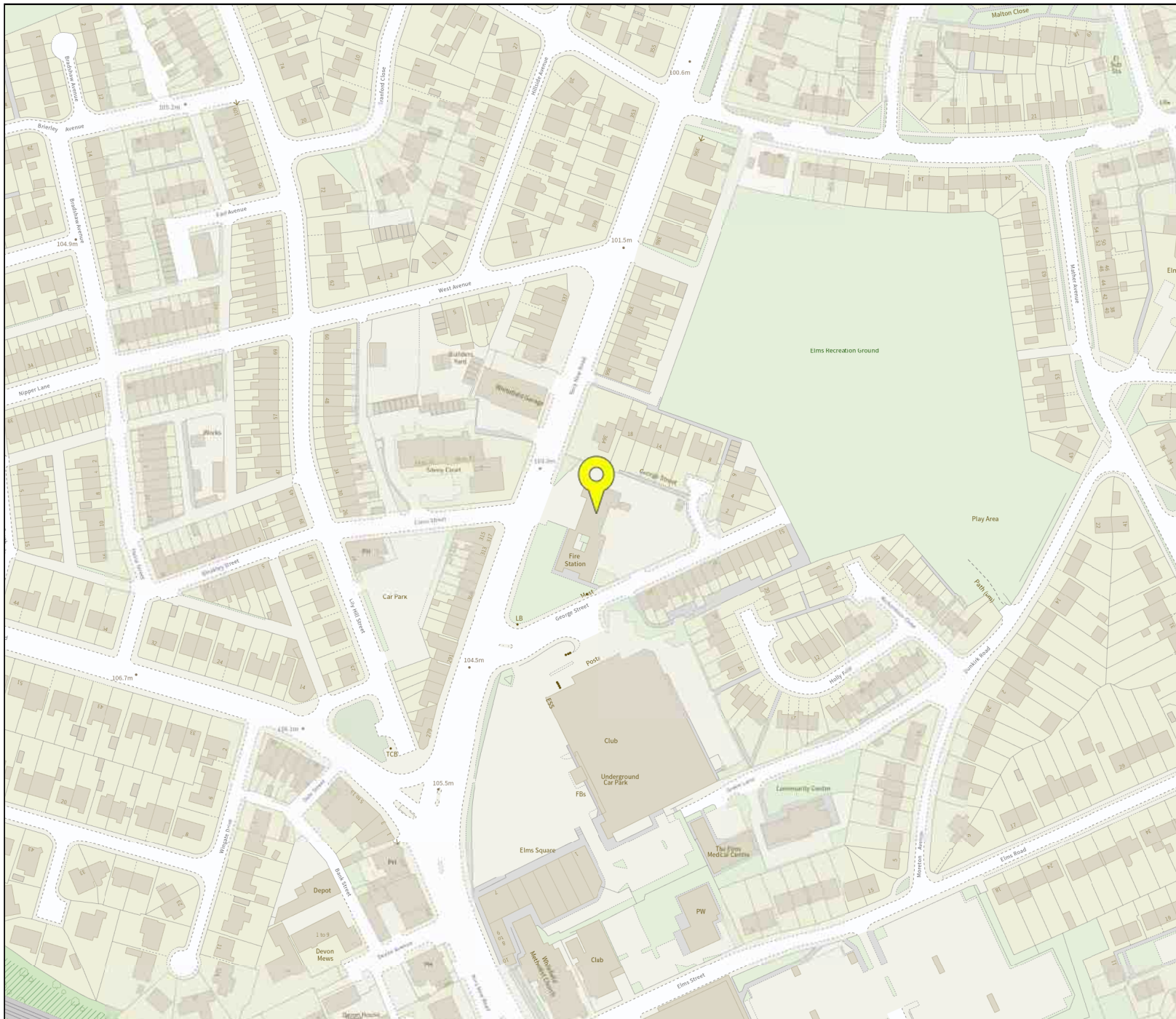
Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2021 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference
Whitefield FS

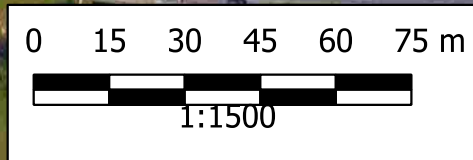
Location (easting/northing)
380480/406485

Scale
1:2500

Created
7 Nov 2022 10:42

-  Selected point
-  Flood zone 3
-  Flood zone 3: areas benefiting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area


0 20 40 60m



KEY



Site Location

Sampling locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client: Greater Manchester Combined Authority			
Site: Whitefield Fire Station, Manchester			
Title: Low Surface Water Risk			
Job No: FRA 22 1159	Scale (see scale bar): 1:1500 @ A4	Figure:	Rev:
Drawn By: JL	Checked By: MJ	Drawn: Nov 2022	

Appendix D

Consultee Correspondence

Jenna Lowe

From: Planning Policy <Planning.Policy@bury.gov.uk>
Sent: 31 October 2022 14:18
To: Jenna Lowe
Subject: RE: FRA QUERY - FRA 22 1159 - Whitefield Fire Station, Manchester

Hi Jenna,

Apologies for the delay. Answers to your questions are in red below.

Kind regards,
Bury Planning Policy

From: Jenna Lowe <j.lowe@thelkgroup.com>
Sent: 10 October 2022 10:51
To: Development Control <Development.Control@bury.gov.uk>; Planning Policy <Planning.Policy@bury.gov.uk>
Subject: FRA QUERY - FRA 22 1159 - Whitefield Fire Station, Manchester

Dear Sir/Madam,

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA) for a site located at Whitefield Fire Station, Bury New Road, Manchester, M45 7SY, centred at approximate National Grid Reference 380490E, 406496N.

The area of interest appears to be within Flood Zone 1.

BGS data indicates that the site is within an area underlain by Till, Devensian – Diamicton superficial deposits and Collyhurst Sandstone Formation – Sandstone bedrock.

The site location is attached to this email.

To complete the FRA, we would be grateful if you could supply us with the following, if available, for the vicinity of the site:

- Details of any flood defences in the immediate area, including their extent, crest levels (and datum), assumed level of standard, construction and maintenance regime, as well as any other structures which may influence the local hydraulics. **None in the vicinity.**
- Records of any historic flood events and potential sources of flooding from rivers, land drainage, groundwater, foul and surface water sewers on site and in the area. **None on record.**
- Any restrictions applied to ordinary watercourses and sewers in the area. **None on record.**
- Highway drainage restrictions and records. **None.**
- Indications if the site is within the Critical Drainage Area. **No.**
- Policies that may relate to Sustainable Drainage Systems (SuDS). **The scheme must be based on the hierarchy of drainage options in the National Planning Practice Guidance and be designed in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems.**

If you have any queries, please do not hesitate to get in touch.

We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available, what the charge will be, and we will pay the relevant fees by debit card as soon as possible.

Any advice or recommendations you may have regarding the potential discharges from the development of this site would also be appreciated.

We will be in contact with all other relevant authorities to get a more complete understanding of the issues in the area.

Regards,
Jenna



Jenna Lowe MSc, BSc. (Hons)
Flood Risk Engineer
0161 763 7200 | 07467 957756
Manchester | London | Swindon | Liverpool | Glasgow
www.thelkgroup.com

I N C R E A S I N G L A N D V A L U E

LKGroup**Unit 29 Eton Business Park
Unit 29, Eton Business Park,
Radcliffe, Greater Manchester
M26 2ZS****FAO:****How to contact us:****United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP****Telephone: 0370 7510101****E-mail: propertysearches@uuplc.co.uk****Your Ref: FRA 22 1159
Our Ref: UUPS-ORD-441977
Date: 25/10/2022****Dear Sirs****Location: GREATER MANCHESTER FIRE & RESCUE SERVICE FIRE STATION BURY NEW ROAD,
WHITEFIELD, MANCHESTER, M45 7SY**

I acknowledge with thanks your request dated 24/10/2022 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. <http://www.unitedutilities.com/work-near-asset.aspx>.

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please [contact us](#).

Yours Faithfully,



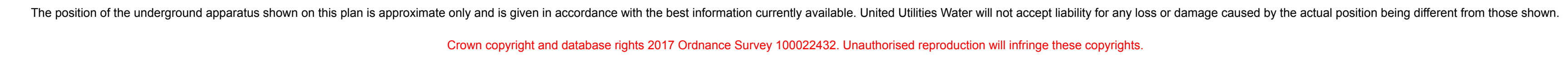
Karen McCormack
Property Searches Manager

TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.



SEWER RECORDS  Water for the North West

Jenna Lowe

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 19 October 2022 13:49
To: Jenna Lowe
Subject: Pre Development Enquiry for: Whitefield Fire Station, Bury New Road, Manchester, M45 7SY UU Reference Number : 02929688

Good Afternoon, Jenna

Pre Development Enquiry for: Whitefield Fire Station, Bury New Road, Manchester, M45 7SY UU Reference Number : 02929688

We have carried out an assessment of your application which is based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your drainage strategy will need to be reviewed by other competent authorities as part of the planning process, and we advise that you carry out the necessary site investigations to confirm the viability of your proposals.

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 6723 723 or refer to the link below:

<https://www.unitedutilities.com/builders-developers/working-near-our-assets/>

Historic Flooding

I can confirm that we have no current record of sewer flooding on our DG5 register within the vicinity of the proposed development. The DG5 register is a register of properties that have flooded as a result of hydraulic inadequacy of the public sewer network.

Please note that United Utilities Water Limited (Uuw) can only record and check flooding events which are reported to us and we have to comply with our Regulators instructions on the qualification of flooding events to place on the register.

Our response does not include:

- any sewer flooding events caused by blockages or collapses which are the result of third party actions, natural events or other actions over which Uuw has no control and not a facet of sewer capacity; or
- any historical sewer flooding events that have been removed from the register as a result of investment in our infrastructure.

Foul Water

Foul flow from this site will be allowed to drain into the public foul water/combined sewer system.

Our preferred point of discharge would be to the 375mm diameter public combined sewer within Bury New Road located to the West of your proposed development at an unrestricted rate.

If you are able to identify an alternative, more suitable point of discharge, we request that you contact us at your earliest convenience so that we can assess suitability.

In accordance with our infrastructure plans we may ask you to change your point of connection. Therefore please contact us when you are ready to formalise your drainage proposals, we would suggest before you submit for Full Planning.

Surface Water

All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80, (Reference ID: 7-080-20150323), of the National Planning Practice Guidance. We also recommend you prioritise the use of multi-functional sustainable drainage systems for the management of surface water in accordance with national planning policy.

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.

This is outlined as follows, in order of priority:

1. **into the ground (infiltration);**
2. **to a surface waterbody;**
3. **to a surface water sewer or highway drain;**
4. **to a combined sewer.**

For guidance, The [**North West SuDS Pro-Forma**](#) provides information on the appropriate evidence required at each stage of the hierarchy, to demonstrate how each level has been discounted.

The Lead Local Flood Authority has responsibility for all surface water drainage concerns and their input to your proposal is critical. You should also consider whether it is necessary to discuss your proposal with the Environment Agency, or Internal Drainage Board (if operating in your area).

The Local Planning Authority are the determining authority for any application for planning permission and the appropriate authority for determining cost viability of a proposed drainage scheme, such assessments are outside of the jurisdiction of United Utilities.

Infiltration

Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible.

A detailed evidence based feasibility assessment must be carried out in line with Chapter 25 of the CIRIA SuDS Manual 2015 to determine whether infiltration is a suitable method of surface water disposal.

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:

<https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs>

If your site is in a Groundwater Source Protection Zone, you should have regard to the Environment Agency's approach to Groundwater Protection. Information on this is available via the link below:

<https://www.gov.uk/government/publications/groundwater-protection-position-statements>

Please note that such a location could have implications for the principle of your development and the need for additional mitigating measures to protect the groundwater environment and public water supply in the detailed design of your site.

Highway Drainage

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you investigate the possibility of draining surface water to the highway drain where this ultimately discharges to a watercourse, by contacting the relevant Highway Authority.

Public Sewer

In accordance with the hierarchy of drainage options within the National Planning Practice Guidance, both discharge to ground via infiltration and discharge to a waterbody should be discounted prior to consideration of discharging surface water to the public sewer system. Evidence should be provided to demonstrate how these have been discounted, as outlined in the North West SuDS pro-forma.

Once evidence is provided as outlined above, United Utilities will consider a connection to the 375mm diameter public combined sewer within New Bury Road located West of the proposed site at a pass forward flow to be agreed by the Lead Local Flood Authority. United Utilities request that any agreed rate does not exceed 5l/s.

This has been calculated via the HR Wallingford Greenfield estimation tool, utilising soil type 5 for the peak greenfield flow rate.

As a Water Company, we have no obligation to accept highway drainage into our public sewer network. However, should your proposals include runoff from highways, we would request that consideration is given to SuDS components that deliver source control are incorporated within the design of the scheme to reduce the volume and frequency of discharges of these flows to the public sewer.

Levels

For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist, we recommend that you contact us to discuss further. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.

Land drainage / Overland flows / track drainage

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage

into the public sewerage network under any circumstances

Existing Wastewater Assets Crossing the Site

We have reviewed our records and can confirm that there does not appear to be any charted public sewers located within the boundary of proposed development. However, due to the accuracy of the records and the public sewer transfer legislation in 2011, not all public sewers are shown on our records so we would ask that you proceed with caution and carry out your own site investigation works. If any uncharted sewers are identified while carrying out your works we would ask that you contact United Utilities at the earliest opportunity so that we can offer guidance and update our records.

Please refer to the link below to obtain full details of the processes involved with sewer diversions:

<https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-diversions/>

Existing Water Assets Crossing the Site

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address:

DeveloperServicesWater@uuplc.co.uk. Further information for this service can be found on our website via the link below:

<https://www.unitedutilities.com/builders-developers/larger-developments/pre-development/water-pre-dev/>

Connection Application

Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

<https://www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/sewer-connection/>

We recommend that the detailed design should confirm the locations of all utilities in the area and ensure that any proposed drainage solution considers routing and clash checks where required.

If we can be of any further assistance please don't hesitate to contact us further.

Sewer Adoptions

You have indicated on your application form that you intend to put the sewers forward for adoption (including any SuDS components that can come within the meaning of a sewer).

United Utilities assess adoption applications based on the current Design & Construction Guidance and local practices which have now replaced 'Sewers For Adoption 6th Edition'.

We recommend that you submit a pre design assessment to the sewer adoption mailbox (SewerAdoptions@uuplc.co.uk) stating pre design assessment in the title

Please refer to links below to obtain further guidance:

<https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-adoptions/>

Site drainage must be designed in accordance with Building Regulations, National Planning Policy, and local flood authority guidelines, we would recommend that you speak and make suitable agreements with the relevant statutory bodies.

If you intend to put forward your wastewater assets for adoption by United Utilities, the proposed detail design will be subject to a technical appraisal by an Adoption Engineer as we need to be sure that the proposals meets the requirements set out in the Design & Construction Guidance. The proposed design should give consideration to long term operability and give United Utilities a safe and cost effective proposal for the lifetime of the assets. In these cases, we strongly recommend that no construction commences until the detailed drainage design, submitted as part of the Section 104 application, has been assessed and accepted in writing by United Utilities. Any work carried out prior to the technical assessment being approved is done entirely at the developer's own risk and could be subject to change.

SuDS

If your development proposal incorporates any SuDS component(s) which interact with a sewer network you plan on offering for adoption to United Utilities; contact should be made with our technical team at your earliest convenience, please complete the 'Section 104 pre-application form : ' and include as much relevant detail as you can. These discussions can help prevent delays later in the development process.

Section 104 Pre application form (1b)

As per the sewerage sector guidance, all SuDS should be designed in accordance with the standards within the Design & construction guidance & the CIRIA SuDS manual (C753)

Codes For Adoption

The new Codes for Adoption are outlined on the Water UK Website. The link below takes you to their webpage:

<https://www.water.org.uk/technical-guidance/developers-services/codes-for-adoption/>

A free copy of the new Design & Construction Guidance can be downloaded via the link below:

<https://www.water.org.uk/sewerage-sector-guidance-approved-documents/>

Many thanks and kind regards,



Gary Jaundrell
Assistant Developer Engineer
Developer Services & Metering
Customer Services
T: 07388 715 589
unitedutilities.com

If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow

Did you know we now have a live chat facility available to you Mon to Friday 8 -5pm. You just click on the orange live chat box on our webpage and one of our advisors will be ready to chat to you and help you with your enquiry <https://www.unitedutilities.com/builders-developers/> or you can email us at WastewaterDeveloperServices@uuplc.co.uk

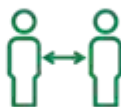
Coronavirus | Prevent the spread



Wash your
hands



Disinfect
common surfaces



Practise social
distancing



FEVER +
COUGH

Stay home if you
have symptoms

[Click for our message to customers](#)

----- Original Message -----

From: wastewaterdeveloperservices@uuplc.co.uk [wastewaterdeveloperservices@uuplc.co.uk]

Sent: 12/10/2022 11:19

To: j.lowe@thelkgroup.com

Subject: Our reference - 02929688 - Whitefield Fire Station, Bury New Road, Manchester, M45 7SY



To help protect your privacy, Microsoft Office prevented automatic download of this picture from the Internet.

Dear Jenna,

PRE DEVELOPMENT APPLICATION AT: Whitefield Fire Station, Bury New Road,
Manchester, M45 7SY

UU Ref: 02929688

Please accept this email as receipt of your application received on 10 October 2022 for the above development. This has now been logged on our system and the job reference is 02929688 we would ask that you quote this reference in all future correspondence.

I have reviewed your application (and attachments) and can confirm this is suitable to be passed to Gary Jaundrell for technical assessment. You will receive their response within 8 working days.

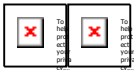
Kind regards



Natasha Astell
Customer Advisor Advanced
Developer Services & Metering
Customer Services
Direct Tel: 01925
Tel: 0345 072 6067
unitedutilities.com

If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow

Did you know we now have a live chat facility available to you Mon to Friday 8 -5pm. You just click on the orange live chat box on our webpage and one of our advisors will be ready to chat to you and help you with your enquiry <https://www.unitedutilities.com/builders-developers/> or you can email us at WastewaterDeveloperServices@uuplc.co.uk



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United Utilities Group PLC, Haweswater House, Lingley Mere
Business Park, Lingley Green Avenue, Great Sankey,
Warrington, WA5 3LP
Registered in England and Wales. Registered No 6559020

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www.unitedutilities.com/subsidiaries

Appendix E

Calculations



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 02/11/22		
By	Checked	Reviewed

Project	Qbar Existing Runoff Whitefield Fire Station, Manchester
Title	Qbar Existing Runoff Whitefield Fire Station, Manchester

Area data:-

FSR data

M5-60 = 18.5

Soil index = 0.45

WRAP value = 4

$r = 0.33$

SAAR = 1100

Nat grid = SD 8006

Site data:-

Ret. period (yrs) = 2.33

Time of entry = 7.00

Impervious area drained = 2900 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 7.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 62.0%

Rainfall rate = 56.8 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 37.2 l/s

Methods

Runoff factor (RF) = 62.0, calculated from:-

$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

$\text{PIMP} = \text{Impervious Area} \times 100 / (\text{Impervious Area} + \text{Pervious Area})$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



MasterDrain
SW

The LK Group

www.thelkgroup.com

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Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 02/11/22		
By	Checked	Reviewed

Project	1 in 1 Year Existing Runoff Whitefield Fire Station, Manchester
Title	1 in 1 Year Existing Runoff Whitefield Fire Station, Manchester

Area data:-

FSR data

M5-60 = 18.5

Soil index = 0.45

WRAP value = 4

$r = 0.33$

SAAR = 1100

Nat grid = SD 8006

Site data:-

Ret. period (yrs) = 1

Time of entry = 10.00

Impervious area drained = 2900 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 10.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 62.0%

Rainfall rate = 40.0 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 26.2 l/s

Methods

Runoff factor (RF) = 62.0, calculated from:-

$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

$\text{PIMP} = \frac{\text{Impervious Area} \times 100}{\text{Impervious Area} + \text{Pervious Area}}$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 02/11/22		
By	Checked	Reviewed

Project	1 in 30 Years Existing Runoff Whitefield Fire Station, Manchester
Title	1 in 30 Years Existing Runoff Whitefield Fire Station, Manchester

Area data:-

FSR data

M5-60 = 18.5

Soil index = 0.45

WRAP value = 4

r = 0.33

SAAR = 1100

Nat grid = SD 8006

Site data:-

Ret. period (yrs) = 30

Time of entry = 6.00

Impervious area drained = 2900 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 6.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 62.0%

Rainfall rate = 100.1 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 65.5 l/s

Methods

Runoff factor (RF) = 62.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = $\text{Impervious Area} \times 100 / (\text{Impervious Area} + \text{Pervious Area})$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



MasterDrain
SW

The LK Group

www.thelkgroup.com

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Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 02/11/22		
By	Checked	Reviewed

Project	1 in 100 Years Existing Runoff Whitefield Fire Station, Manchester
Title	1 in 100 Years Existing Runoff Whitefield Fire Station, Manchester

Area data:-

FSR data

M5-60 = 18.5

Soil index = 0.45

WRAP value = 4

r = 0.33

SAAR = 1100

Nat grid = SD 8006

Site data:-

Ret. period (yrs) = 100

Time of entry = 6.00

Impervious area drained = 2900 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 6.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 62.0%

Rainfall rate = 126.5 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 82.8 l/s

Methods

Runoff factor (RF) = 62.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = $\text{Impervious Area} \times 100 / (\text{Impervious Area} + \text{Pervious Area})$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



MasterDrain
SW

The LK Group

www.thelkgroup.com

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Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 02/11/22		
By	Checked	Reviewed

Project	30 Years Storage Event Whitefield Fire Station, Manchester
Title	30 Years Storage Event Whitefield Fire Station, Manchester

Data:-

FSR Hydrology:-

Location = WHITEFIELD FS
M5-60 (mm) = 18.5
Soil index = 0.45
Return period = 30
UCWI = 113.8

Grid reference = SD 8006
r = 0.33
SAAR (mm/yr) = 1100
WRAP = 4
Climate change = 0

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Runoff factor (RF) = 61.0, calculated from:-

$$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$$

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2800 m²
Total area (TA) = 3800 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 1000 m²
Equiv area = 2318 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 0

Calculated data:-

Time to max = 78.0 mins
Rainfall at max = 23.90 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 47.5 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 8.00 mm/hr

Calculated storage volume = 0.7 m³
Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	6042.9	1125	47.7	400 x 600	263.6	500 x 500	189.8
150	2685.7	1200	42.0	600 x 900	114.8	500 x 750	126.5
225	1193.7	1275	37.2	800 x 1200	64.6	500 x 1000	94.9
300	671.4	1350	33.2			750 x 1000	63.3
375	429.7	1425	29.8			750 x 1200	52.7
450	298.4	1500	26.9			750 x 1500	42.2
525	219.2	1575	24.4			1000 x 1000	47.5
600	167.9	1650	22.2			1000 x 1200	39.5
675	132.6	1725	20.3			1000 x 1500	31.6
750	107.4	1800	18.7			1000 x 1800	26.4
825	88.8	1875	17.2			1000 x 2000	23.7
900	74.6	1950	15.9			1500 x 1500	21.1
975	63.6	2025	14.7			1500 x 1800	17.6
1050	54.8	2100	13.7			1500 x 2000	15.8



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Data:-

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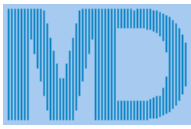
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Job No.		
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Project	30 Years Storage Event Whitefield Fire Station, Manchester
Title	30 Years Storage Event Whitefield Fire Station, Manchester

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	80.0	30.528	3.000	27.528
20	56.0	42.543	6.000	36.543
30	44.0	50.279	9.000	41.279
40	37.0	56.115	12.000	44.115
50	32.0	60.850	15.000	45.850
60	28.0	64.858	18.000	46.858
70	26.0	68.347	21.000	47.347
80	24.0	71.445	24.000	47.445
90	22.0	74.234	27.000	47.234
100	20.0	76.775	30.000	46.775
110	19.0	79.109	33.000	46.109
120	18.0	81.270	36.000	45.270
130	17.0	83.282	39.000	44.282
140	16.0	85.164	42.000	43.164
150	15.0	86.933	45.000	41.933
160	15.0	88.602	48.000	40.602
170	14.0	90.181	51.000	39.181
180	13.0	91.680	54.000	37.680
190	13.0	93.106	57.000	36.106
200	12.0	94.465	60.000	34.465
210	12.0	95.765	63.000	32.765
220	12.0	97.008	66.000	31.008
230	11.0	98.200	69.000	29.200
240	11.0	99.345	72.000	27.345
250	11.0	100.446	75.000	25.446
260	10.0	101.505	78.000	23.505
270	10.0	102.527	81.000	21.527
280	10.0	103.513	84.000	19.513
290	9.0	104.540	87.000	17.540
300	9.0	105.518	90.000	15.518
310	9.0	106.470	93.000	13.470
320	9.0	107.399	96.000	11.399
330	9.0	108.306	99.000	9.306
340	8.0	109.192	102.000	7.192
350	8.0	110.057	105.000	5.057
360	8.0	110.903	108.000	2.903
370	8.0	111.732	111.000	0.732
380	8.0	112.543	114.000	0.000
390	8.0	113.337	117.000	0.000
400	8.0	114.116	120.000	0.000
410	7.0	114.880	123.000	0.000
420	7.0	115.629	126.000	0.000
430	7.0	116.365	129.000	0.000
440	7.0	117.088	132.000	0.000
450	7.0	117.798	135.000	0.000
460	7.0	118.495	138.000	0.000
470	7.0	119.181	141.000	0.000
480	7.0	119.856	144.000	0.000
490	6.0	120.520	147.000	0.000
500	6.0	121.174	150.000	0.000
510	6.0	121.817	153.000	0.000
520	6.0	122.451	156.000	0.000
530	6.0	123.075	159.000	0.000
540	6.0	123.690	162.000	0.000
550	6.0	124.297	165.000	0.000
560	6.0	124.895	168.000	0.000
570	6.0	125.484	171.000	0.000
580	6.0	126.066	174.000	0.000
590	6.0	126.640	177.000	0.000
600	6.0	127.206	180.000	0.000

Storage volume (m³) = 47.5 m³



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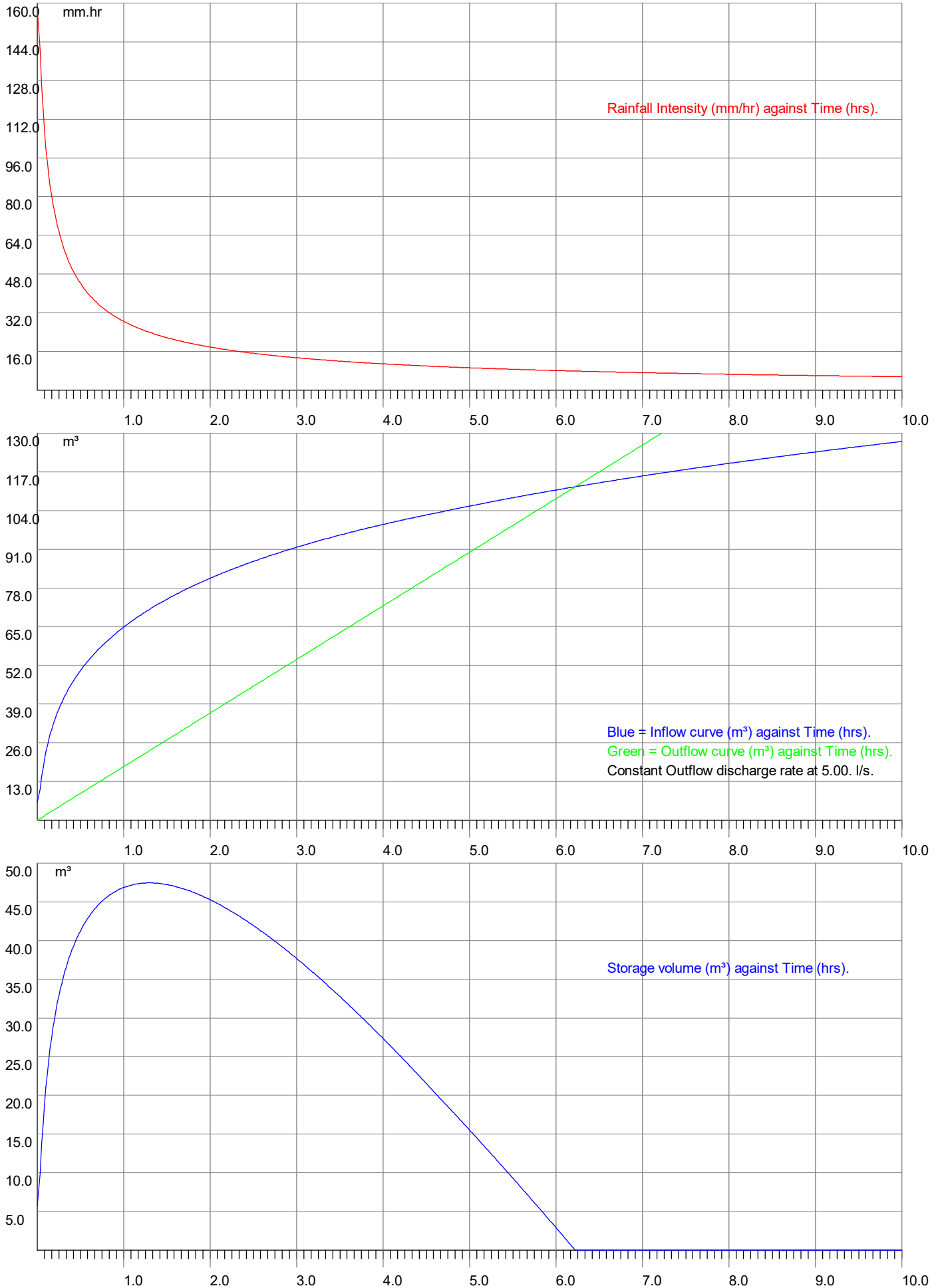
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Project **30 Years Storage Event Whitefield Fire Station, Manchester**
Title **30 Years Storage Event Whitefield Fire Station, Manchester**





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Project	30 Years Storage Event Whitefield Fire Station, Manchester
Title	30 Years Storage Event Whitefield Fire Station, Manchester

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage. The outflow volume is constant throughout the process at the specified discharge rate.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps. The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.



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Job No.		
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Project	100 Years +20% CC Storage Event Whitefield Fire Station, Manchester
Title	100 Years +20% CC Storage Event Whitefield Fire Station, Manchester

Data:-

FSR Hydrology:-

Location = WHITEFIELD FS
M5-60 (mm) = 18.5
Soil index = 0.45
Return period = 100
UCWI = 113.8

Grid reference = SD 8006
r = 0.33
SAAR (mm/yr) = 1100
WRAP = 4
Climate change = 20

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Runoff factor (RF) = 61.0, calculated from:-

$$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$$

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2800 m²
Total area (TA) = 3800 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 1000 m²
Equiv area = 2318 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 20

Calculated data:-

Time to max = 131.0 mins
Rainfall at max = 26.45 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 92.4 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 12.00 mm/hr

Calculated storage volume = 62.7 m³
Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	11763.5	1125	92.9	400 x 600	513.2	500 x 500	369.5
150	5228.2	1200	81.7	600 x 900	223.4	500 x 750	246.3
225	2323.6	1275	72.4	800 x 1200	125.7	500 x 1000	184.7
300	1307.1	1350	64.5			750 x 1000	123.2
375	836.5	1425	57.9			750 x 1200	102.6
450	580.9	1500	52.3			750 x 1500	82.1
525	426.8	1575	47.4			1000 x 1000	92.4
600	326.8	1650	43.2			1000 x 1200	77.0
675	258.2	1725	39.5			1000 x 1500	61.6
750	209.1	1800	36.3			1000 x 1800	51.3
825	172.8	1875	33.5			1000 x 2000	46.2
900	145.2	1950	30.9			1500 x 1500	41.1
975	123.7	2025	28.7			1500 x 1800	34.2
1050	106.7	2100	26.7			1500 x 2000	30.8



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Data:-

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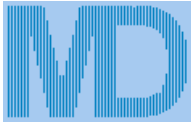
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Project	100 Years +20% CC Storage Event Whitefield Fire Station, Manchester
Title	100 Years +20% CC Storage Event Whitefield Fire Station, Manchester

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	123.0	46.871	3.000	43.871
20	87.0	66.213	6.000	60.213
30	69.0	78.699	9.000	69.699
40	58.0	88.125	12.000	76.125
50	50.0	95.761	15.000	80.761
60	45.0	102.207	18.000	84.207
70	41.0	107.797	21.000	86.797
80	37.0	112.739	24.000	88.739
90	34.0	117.170	27.000	90.170
100	32.0	121.186	30.000	91.186
110	30.0	124.859	33.000	91.859
120	28.0	128.240	36.000	92.240
130	27.0	131.372	39.000	92.372
140	25.0	134.287	42.000	92.287
150	24.0	137.011	45.000	92.011
160	23.0	139.566	48.000	91.566
170	22.0	141.971	51.000	90.971
180	21.0	144.239	54.000	90.239
190	20.0	146.385	57.000	89.385
200	20.0	148.419	60.000	88.419
210	19.0	150.351	63.000	87.351
220	18.0	152.189	66.000	86.189
230	18.0	153.940	69.000	84.940
240	17.0	155.611	72.000	83.611
250	17.0	157.208	75.000	82.208
260	16.0	158.735	78.000	80.735
270	16.0	160.198	81.000	79.198
280	15.0	161.601	84.000	77.601
290	15.0	163.139	87.000	76.139
300	14.0	164.577	90.000	74.577
310	14.0	165.977	93.000	72.977
320	14.0	167.340	96.000	71.340
330	13.0	168.670	99.000	69.670
340	13.0	169.967	102.000	67.967
350	13.0	171.233	105.000	66.233
360	13.0	172.471	108.000	64.471
370	12.0	173.680	111.000	62.680
380	12.0	174.864	114.000	60.864
390	12.0	176.022	117.000	59.022
400	12.0	177.157	120.000	57.157
410	11.0	178.268	123.000	55.268
420	11.0	179.358	126.000	53.358
430	11.0	180.427	129.000	51.427
440	11.0	181.476	132.000	49.476
450	11.0	182.505	135.000	47.505
460	10.0	183.517	138.000	45.517
470	10.0	184.510	141.000	43.510
480	10.0	185.486	144.000	41.486
490	10.0	186.446	147.000	39.446
500	10.0	187.391	150.000	37.391
510	10.0	188.319	153.000	35.319
520	10.0	189.234	156.000	33.234
530	9.0	190.134	159.000	31.134
540	9.0	191.020	162.000	29.020
550	9.0	191.893	165.000	26.893
560	9.0	192.753	168.000	24.753
570	9.0	193.601	171.000	22.601
580	9.0	194.436	174.000	20.436
590	9.0	195.260	177.000	18.260
600	9.0	196.073	180.000	16.073

Storage volume (m³) = 92.4 m³



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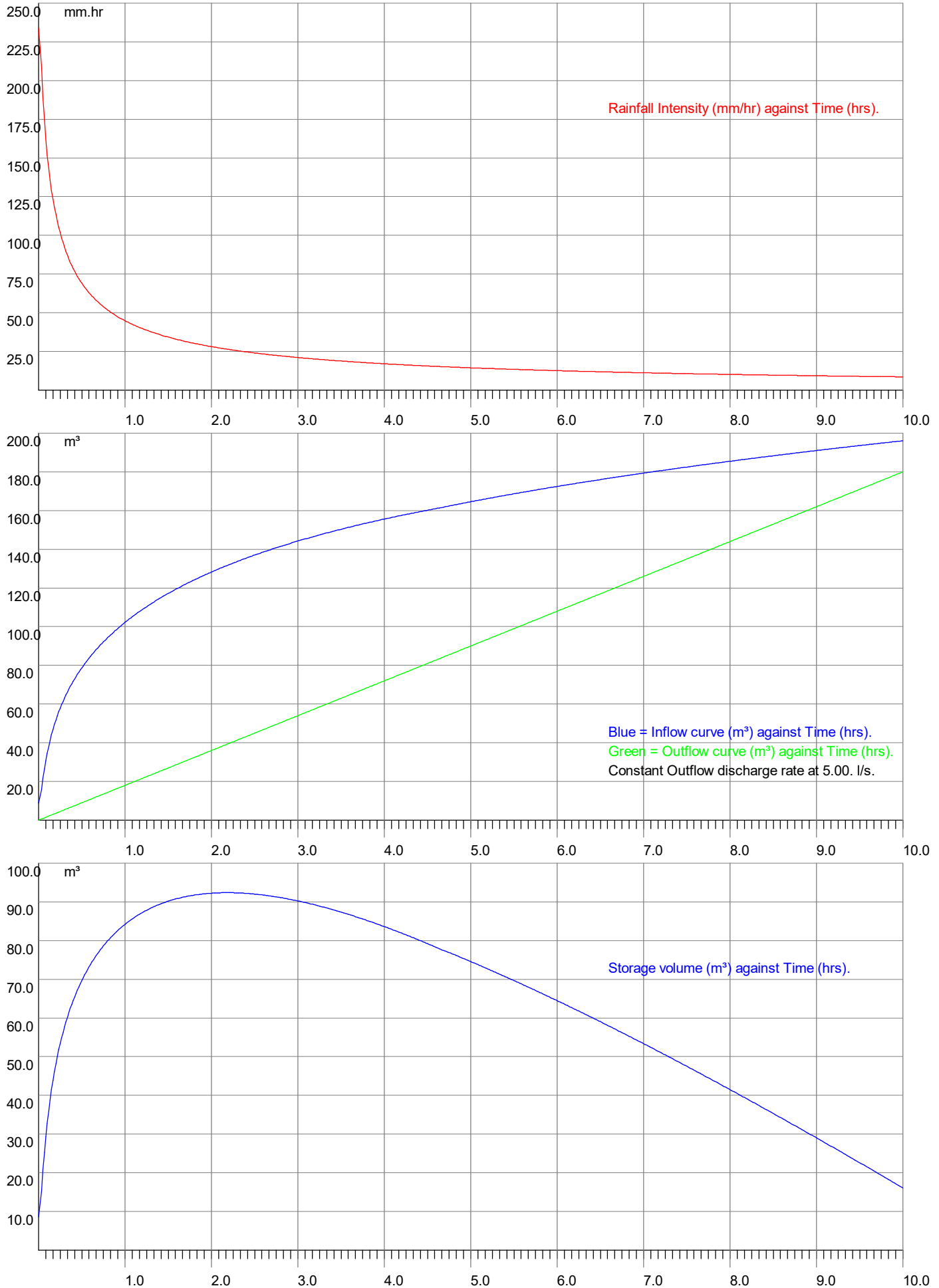
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Project **100 Years +20% CC Storage Event Whitefield Fire Station, Manchester**

Title **100 Years +20% CC Storage Event Whitefield Fire Station, Manchester**





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Project **100 Years +20% CC Storage Event Whitefield Fire Station, Manchester**

Title **100 Years +20% CC Storage Event Whitefield Fire Station, Manchester**

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage. The outflow volume is constant throughout the process at the specified discharge rate.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps. The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.



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Project	100 Years +40% CC Storage Event Whitefield Fire Station, Manchester
Title	100 Years +40% CC Storage Event Whitefield Fire Station, Manchester

Data:-

FSR Hydrology:-

Location = WHITEFIELD FS
M5-60 (mm) = 18.5
Soil index = 0.45
Return period = 100
UCWI = 113.8

Grid reference = SD 8006
r = 0.33
SAAR (mm/yr) = 1100
WRAP = 4
Climate change = 40

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Runoff factor (RF) = 61.0, calculated from:-

$$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$$

where

PIMP = Impervious Area*100/(Impervious Area+Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2800 m²
Total area (TA) = 3800 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 1000 m²
Equiv area = 2318 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 40

Calculated data:-

Time to max = 154.0 mins
Rainfall at max = 27.52 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 114.9 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 14.00 mm/hr

Calculated storage volume = 91.6 m³
Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	14627.3	1125	115.6	400 x 600	638.1	500 x 500	459.4
150	6501.0	1200	101.6	600 x 900	277.8	500 x 750	306.3
225	2889.3	1275	90.0	800 x 1200	156.3	500 x 1000	229.7
300	1625.3	1350	80.3			750 x 1000	153.1
375	1040.2	1425	72.0			750 x 1200	127.6
450	722.3	1500	65.0			750 x 1500	102.1
525	530.7	1575	59.0			1000 x 1000	114.9
600	406.3	1650	53.7			1000 x 1200	95.7
675	321.0	1725	49.2			1000 x 1500	76.6
750	260.0	1800	45.1			1000 x 1800	63.8
825	214.9	1875	41.6			1000 x 2000	57.4
900	180.6	1950	38.5			1500 x 1500	51.0
975	153.9	2025	35.7			1500 x 1800	42.5
1050	132.7	2100	33.2			1500 x 2000	38.3



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Data:-

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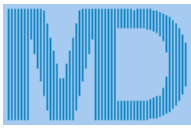
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Project	100 Years +40% CC Storage Event Whitefield Fire Station, Manchester
Title	100 Years +40% CC Storage Event Whitefield Fire Station, Manchester

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	144.0	54.683	3.000	51.683
20	102.0	77.249	6.000	71.249
30	81.0	91.815	9.000	82.815
40	68.0	102.813	12.000	90.813
50	59.0	111.721	15.000	96.721
60	52.0	119.241	18.000	101.241
70	47.0	125.763	21.000	104.763
80	43.0	131.529	24.000	107.529
90	40.0	136.698	27.000	109.698
100	37.0	141.384	30.000	111.384
110	35.0	145.668	33.000	112.668
120	33.0	149.613	36.000	113.613
130	31.0	153.267	39.000	114.267
140	29.0	156.668	42.000	114.668
150	28.0	159.846	45.000	114.846
160	27.0	162.827	48.000	114.827
170	26.0	165.633	51.000	114.633
180	25.0	168.279	54.000	114.279
190	24.0	170.783	57.000	113.783
200	23.0	173.156	60.000	113.156
210	22.0	175.409	63.000	112.409
220	21.0	177.553	66.000	111.553
230	21.0	179.596	69.000	110.596
240	20.0	181.546	72.000	109.546
250	19.0	183.409	75.000	108.409
260	19.0	185.191	78.000	107.191
270	18.0	186.898	81.000	105.898
280	18.0	188.534	84.000	104.534
290	17.0	190.328	87.000	103.328
300	17.0	192.006	90.000	102.006
310	16.0	193.640	93.000	100.640
320	16.0	195.230	96.000	99.230
330	16.0	196.781	99.000	97.781
340	15.0	198.295	102.000	96.295
350	15.0	199.772	105.000	94.772
360	15.0	201.216	108.000	93.216
370	14.0	202.627	111.000	91.627
380	14.0	204.008	114.000	90.008
390	14.0	205.359	117.000	88.359
400	14.0	206.683	120.000	86.683
410	13.0	207.980	123.000	84.980
420	13.0	209.251	126.000	83.251
430	13.0	210.498	129.000	81.498
440	13.0	211.722	132.000	79.722
450	12.0	212.923	135.000	77.923
460	12.0	214.103	138.000	76.103
470	12.0	215.262	141.000	74.262
480	12.0	216.401	144.000	72.401
490	12.0	217.521	147.000	70.521
500	12.0	218.622	150.000	68.622
510	11.0	219.706	153.000	66.706
520	11.0	220.773	156.000	64.773
530	11.0	221.822	159.000	62.822
540	11.0	222.856	162.000	60.856
550	11.0	223.875	165.000	58.875
560	11.0	224.878	168.000	56.878
570	10.0	225.867	171.000	54.867
580	10.0	226.842	174.000	52.842
590	10.0	227.804	177.000	50.804
600	10.0	228.752	180.000	48.752

Storage volume (m³) = 114.9 m³



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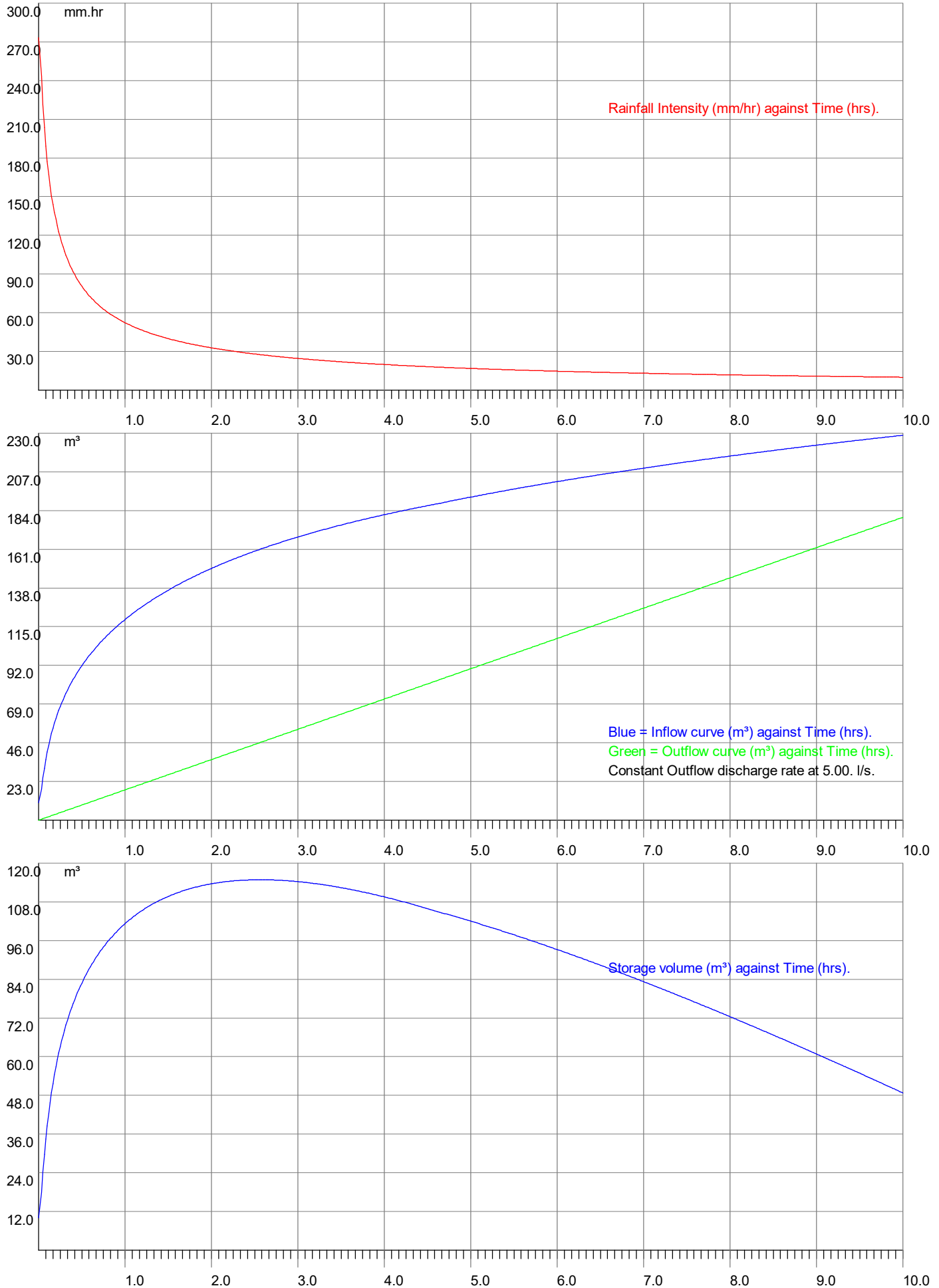
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Job No.		
Sheet no. 3		
Date 02/11/22		
By	Checked	Reviewed

Project **100 Years +40% CC Storage Event Whitefield Fire Station, Manchester**

Title **100 Years +40% CC Storage Event Whitefield Fire Station, Manchester**





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Project **100 Years +40% CC Storage Event Whitefield Fire Station, Manchester**

Title **100 Years +40% CC Storage Event Whitefield Fire Station, Manchester**

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage. The outflow volume is constant throughout the process at the specified discharge rate.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps. The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

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