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Limited**

Flood Risk Assessment and Surface
Water Management Strategy for the
Proposed Development at Lower Road,
Northfleet, Kent

May 2022

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1 Background and Scope of Appraisal

Flooding is a major issue in the United Kingdom. The impacts can be devastating in terms of the cost of repairs, replacement of damaged property and loss of business. The objectives of the Flood Risk Assessment (FRA) are therefore to establish the following:

- whether a proposed development is likely to be affected by current or future flooding from any source.
- whether the development will increase flood risk elsewhere within the floodplain.
- whether the measures proposed to address these effects and risks are appropriate.
- whether the site will pass Part B of the Exception Test (where applicable).

In addition, new development has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

Herrington Consulting has been commissioned by Jackson Family Holdings Limited to prepare a Flood Risk Assessment (FRA) and Surface Water Management Strategy (SWMS) for the proposed development at **Unit K6 Lower Road, Northfleet, Kent, DA11 9BL**.

This appraisal has been undertaken in accordance with the requirements of the National Planning Policy Framework (2021) and the National Planning Practice Guidance Suite (August 2021) that has been published by the Department for Communities and Local Government. The *Flood Risk and Coastal Change* planning practice guidance included within the Suite represents the most contemporary technical guidance on preparing FRAs. In addition, reference has also been made to Local Planning Policy.

To ensure that due account is taken of industry best practice, this FRA has been carried out in line with the CIRIA Report C624 'Development and flood risk - guidance for the construction industry'.

Reference has also been made to CIRIA Report C753 'The SuDS Manual' and any relevant local planning policy guidance. The SWMS included within this report is not intended to constitute a detailed drainage design.

2 Development Description and Planning Context

2.1 Site Location and Existing Use

The site is located at OS coordinates 561410, 175040, off Lower Road in Northfleet. The site covers an area of approximately 2,330m² and currently comprises an industrial unit for metal services. The location of the site in relation to the surrounding area and the River Thames is shown in Figure 2.1.

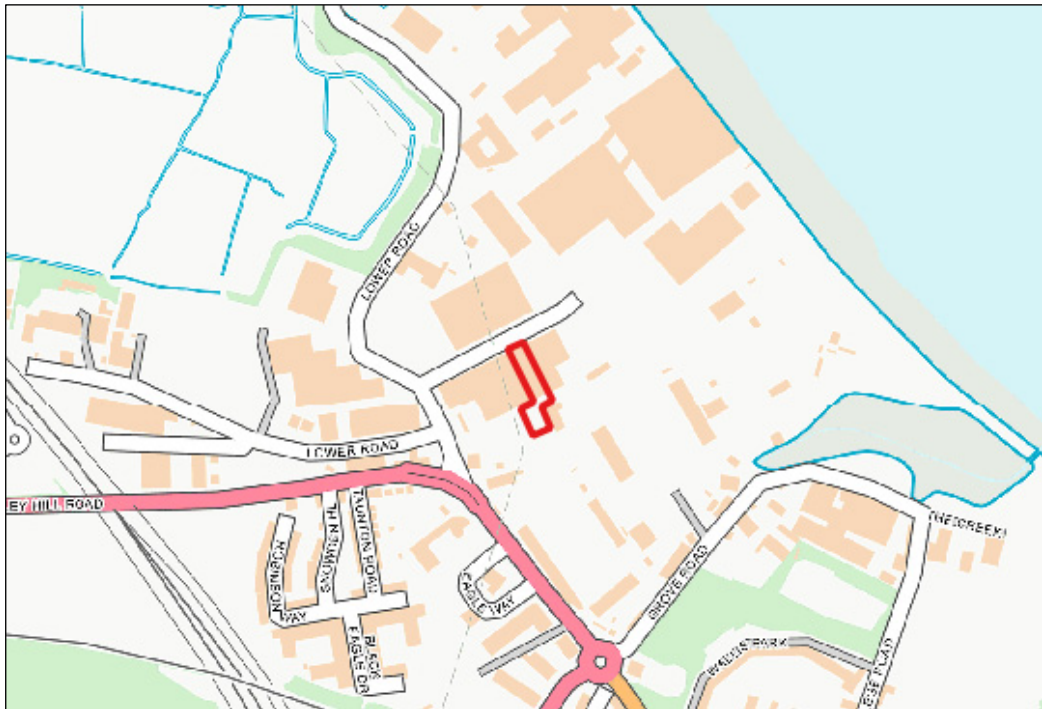


Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2022).

The site plan included in Appendix A.1 of this report provides more detail in relation to the site location and layout.

2.2 Proposed Development

The proposals for development comprise extending the existing building to include a first and second floor for office use with the warehouse use remaining on the ground floor. In addition, the proposals include the construction of a multi-storey car park to the rear (Figure 2.2).

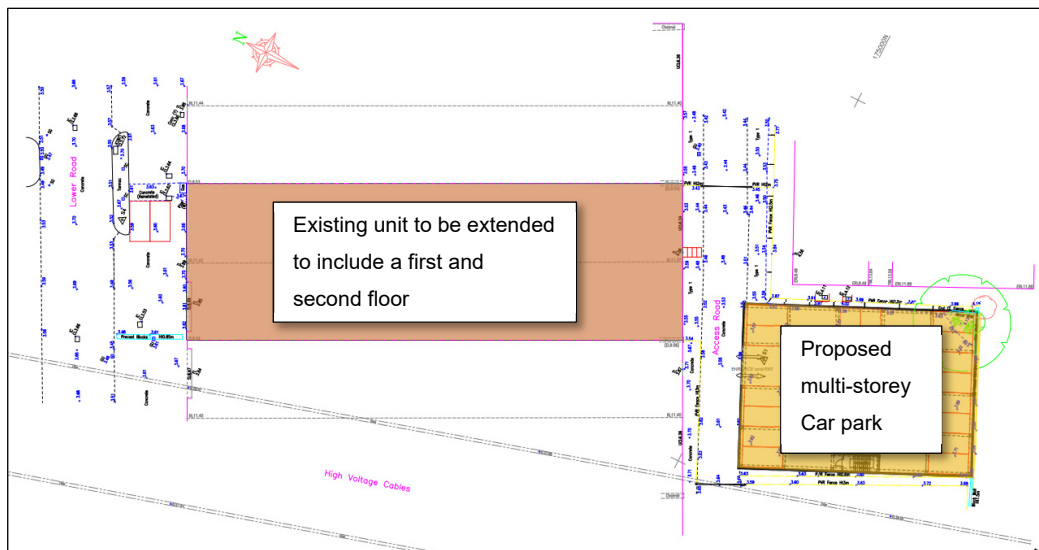


Figure 2.2 – Proposed site layout.

Drawings of the proposed scheme are included in Appendix A.1 of this report.

2.3 The Sequential Test

The National Planning Policy Framework (NPPF) requires the Sequential Test to be applied at all stages of the planning process and generally the starting point is the Environment Agency's (EA) 'Flood Map for Planning' (Figure 2.3). These maps and the associated information are intended for guidance and cannot provide details for individual properties. They do not take into account other considerations such as existing flood defences, alternative flooding mechanisms and detailed site-based surveys. They do, however, provide high level information on the type and likelihood of flood risk in any particular area of the country. The Flood Zones are classified as follows:

Zone 1 – Low probability of flooding – This zone is assessed as having less than a 1 in 1000 annual probability of river or sea flooding in any one year.

Zone 2 – Medium probability of flooding – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any one year.

Zone 3a – High probability of flooding - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding or 1 in 200 or greater annual probability of sea flooding in any one year.

Zone 3b – The Functional Floodplain – This zone comprises land where water has to flow or be stored in times of flood and can be defined as land which would flood during an event having an annual probability of 1 in 20 or greater. This zone can also represent areas that are designed to flood in an extreme event as part of a flood alleviation or flood storage scheme.

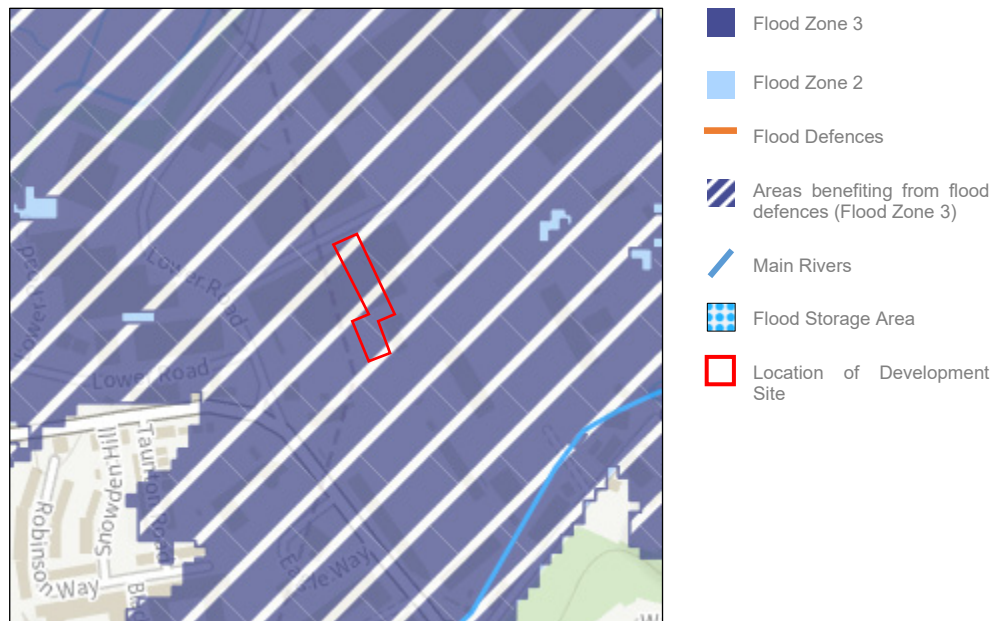


Figure 2.3 – EA's 'Flood Map for Planning' (© Environment Agency).

Figure 2.3 shows the development site is located within Flood Zone 3 and identifies that the site does benefit from existing flood defences. This mapping does not distinguish between high risk areas and the functional floodplain, i.e., Zones 3a and 3b. This is an important differentiation that needs to be made by the FRA because the NPPF states that no development, other than essential transport and utilities infrastructure, should be located within the functional floodplain.

The NPPG states that the Functional Floodplain is land where water has to flow or be stored in times of flood. The NPPG provides the following definition:

The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain. Areas which would naturally flood with an annual exceedance probability of 1 in 20 (5%) or greater, but which are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain.

Based on information provided by the EA and that derived as part of this appraisal, the following Functional Floodplain test is applied:

Do predicted flood levels show that the site will be affected by an event having a return period of 1 in 20 years or less?	X
Is the site defended by flood defence infrastructure that prevents flooding for events having a return period of 1 in 20 years or greater?	✓
Does the site provide a flood storage or floodwater conveyance function?	X
Does the site contain areas that are 'intended' to provide transmission and storage of water from other sources?	X
Is site within the functional floodplain (Zone 3b)?	No

Table 2.1 – Functional floodplain test.

The flood zone mapping and associated information has been summarised in Table 2.2 below.

Flood Zone (percentage of site within zone)		Source of Flooding	Benefiting from existing flood defences
Zone 1	0%		
Zone 2	0%		
Zone 3a	100%	River (Tidal)	Yes
Zone 3b	0%		

Table 2.2 – Flood zone classification.

The NPPF states that the Local Planning Authority (LPA) should apply the sequential approach as part of the identification of land for development in areas at risk from flooding. The overarching objective of the Sequential Test is to ensure that lower risk sites are developed before sites in higher risk areas. When applying the Sequential Test, it is also necessary to ensure that the subject site is compared to only those sites that are available for development and are similar in size.

In this case, a Sequential Test assessment has not been undertaken in support of this FRA. However, it is recognised that the proposals are to construct a first and second floor extension to the existing building to provide office space in addition to the warehouse use on the ground floor. Furthermore, the proposed multi-storey car parking is ancillary to the extended unit. Consequently, the proposals cannot be located elsewhere and on this basis, it is assumed that the requirements of the Sequential Test can be met.

The second level of appraisal is through the application of the more detailed and refined flood risk information contained within the Strategic Flood Risk Assessments (SFRA). Such a document has

been prepared for the Gravesham Borough Council and this has been referenced as part of this site-specific FRA.

The most detailed stage at which the sequential approach can be applied is at a site-based level. Careful consideration of the topography of the site and development uses can provide opportunities to locate more vulnerable buildings on the higher parts of the site and placing less vulnerable elements such as car parking or recreational use in the areas exposed to higher risk. This approach is examined later on in this FRA.

2.4 The Exception Test

According to the NPPF, if it is not possible, consistent with wider sustainability objectives, for the development to be located in areas at lower risk, the Exception Test may have to be applied. The application of the Exception Test will depend on the type and nature of the development, in line with the Flood Risk vulnerability classification set out in the NPPG. This has been summarised in Table 2.3 below.

Flood Risk Vulnerability Classification	Zone 1	Zone 2	Zone 3a	Zone 3b
Essential Infrastructure – Essential transport infrastructure, strategic utility infrastructure, including electricity generating power stations.	✓	✓	e	e
High Vulnerability – Emergency services, basement dwellings, caravans and mobile homes intended for permanent residential use.	✓	e	×	×
More Vulnerable – Hospitals, residential care homes, buildings used for dwelling houses, halls of residence, pubs, hotels, non-residential uses for health services, nurseries and education.	✓	✓	e	×
Less Vulnerable – Shops, offices, restaurants, general industry, agriculture, sewerage treatment plants.	✓	✓	✓	×
Water Compatible Development – Flood control infrastructure, sewerage infrastructure, docks, marinas, ship building, water-based recreation etc.	✓	✓	✓	✓
Key : ✓ Development is appropriate × Development should not be permitted e Exception Test required				



Shaded cell represents the classification of this development

Table 2.3 - Flood risk vulnerability and flood zone compatibility.

From Table 2.3 above it can be seen that the development falls into a classification that does not require the Exception Test to be applied. Notwithstanding this, Paragraph 167 of the NPPF requires

all development in Flood Zones 2 and 3 to be subject to a FRA and to meet the requirements for flood risk reduction. This is therefore the primary focus of this document.

3 Definition of Flood Hazard

3.1 Site Specific Information

Information from a wide range of sources has been referenced to appraise the true risk of flooding at this location. This section summarises the additional information collected as part of this FRA.

Site specific flood level data provided by the EA – The EA has provided the model results of the Thames Tidal Phase 2 Downriver Breach Modelling and Mapping Study carried out in 2018 (by others), which have been referenced as part of this appraisal.

Information contained within the SFRA – The Kent Thameside SFRA (2009) contains detailed mapping showing historic flood outlines. This document has been referenced as part of this site-specific FRA.

Information on localised flooding contained within the SWMP – A Surface Water Management Plan (SWMP) is a study to understand the risk of flooding that arises from local surface water flooding, which is defined by the Flood and Water Management Act 2010 as flooding from surface runoff, groundwater, and ordinary watercourses. Such a document has been prepared for Kent County Council (2013) and has therefore been referenced as part of this report.

Information provided by Southern Water – Southern Water has provided the results of an asset location search for the site. The response is included in Appendix A.2.

Site specific topographic surveys – A topographic survey has been undertaken for the site and a copy of this is included in Appendix A.1. From the survey, it can be seen that the level of the site varies between 3.43m and 3.82m Above Ordnance Datum Newlyn (AODN). Ground levels gradually reduce from the south to the north.

Geology – Reference to the British Geological Survey (BGS) map shows that the underlying solid geology in the location of the subject site is Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated). Overlying this are superficial deposits of Alluvium (clay, silt, sand, and peat).

Historic flooding – Information provided by the SFRA shows that the site is located within a historic flood outline. Further investigation of the EA's 'Recorded Flood Outlines' GIS layer shows that the site flooded in 1953 due to waves overtopping the flood defences. Nevertheless, following the storm surge in 1953, the defence infrastructure in this area has since been improved.

3.2 Potential Sources of Flooding

The main sources of flooding have been assessed as part of this appraisal. The specific issues relating to each one and its impact on this development are discussed below. Table 3.1 at the end of this section summarises the risks associated with each of the sources of flooding.

Flooding from Rivers (Tidal) – The site lies within Flood Zone 3 of the tidal reaches of the River Thames (main river) as shown on the EA's 'Flood Map for Planning' (Figure 2.3). The flood zone maps are used as a consultation tool by planners to highlight areas where more detailed investigation into the risk of flooding is required. Consequently, the risk of flooding from this source has been examined in more detail in Section 5 of this FRA.

Flooding from Ordinary or Man-Made Watercourses – Natural watercourses that have not been enmained and man-made drainage systems such as irrigation drains, sewers or ditches could potentially cause flooding.

Inspection of the site and surrounding area reveals that there are non-main rivers or artificial watercourses within close proximity of the site. The nearest watercourse to the site is the Robins Creek which is located approximately 230m southeast of the site. In addition, there is a canal and drainage network approximately 200m to the northeast of the site which is connected to the River Thames. Consequently, the risk of flooding from these watercourses is directly linked to the risk of flooding from the River Thames which will be appraised further in Section 5 of this report.

Flooding from the Sea – The site is a significant distance inland and whilst the River Thames is still tidally influenced at this location, the risk of flooding from the sea is considered to be *low*.

Flooding from Surface Water – Surface Water, or overland, flooding typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This mechanism of flooding can occur almost anywhere, but is likely to be of particular concern in any topographical low spot, or where the pathway for runoff is restricted by terrain or man-made obstructions.

The EA's 'Flood Risk from Surface Water' map (Figure 3.1) shows the development site is located in an area classified as being predominantly 'very low' risk of surface water flooding. However, there are small localised areas which are shown to be at 'low' to 'high' risk of flooding from surface water.

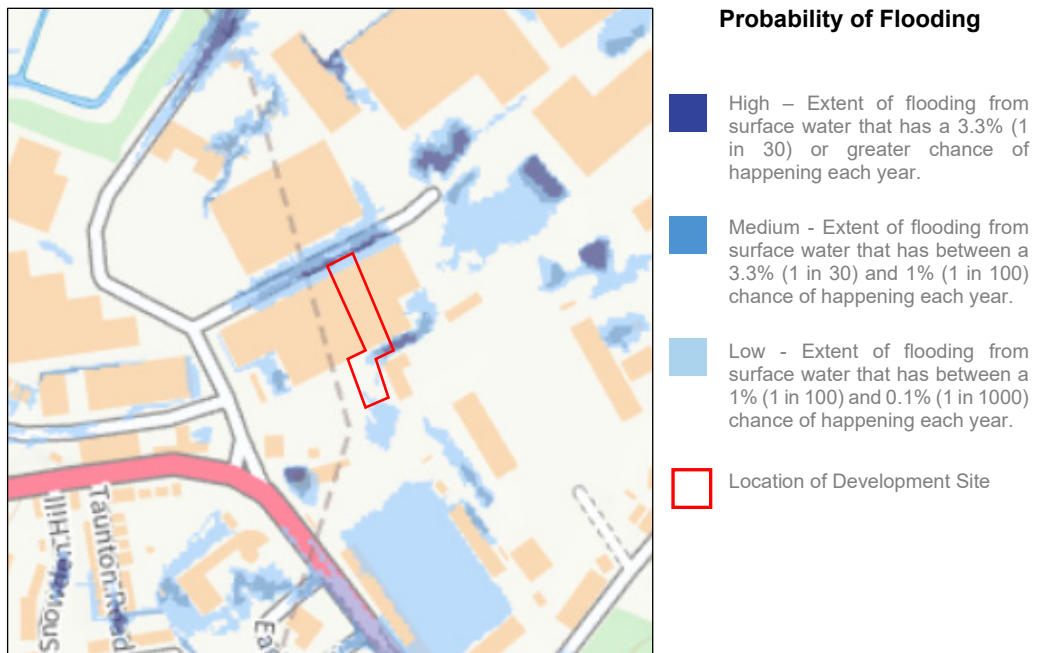


Figure 3.1 – EA's 'Flood Risk from Surface Water' map (© Environment Agency).

Inspection of aerial height data shows that land levels within Lower Road along the northern boundary of the site and the access road to the rear are lower than the surrounding area, thus creating localised depressions. During an extreme rainfall event, there is the potential for surface water to accumulate within these depressions as shown by the EA's map.

Further interrogation of the maps reveals that under an extreme rainfall event (i.e. with a 1 in 1000 year return period), the maximum predicted depth of flooding within these depressions is 0.3m. Nevertheless, the site-specific topographic survey reveals that the existing finished floor level is elevated over 0.35m above the road level to the front and 0.4m to the rear of the building. Therefore, the building would remain dry.

It is only the area of the proposed multi-storey car park which could be subject to minor flooding with depth predicted to not exceed 150mm. Nevertheless, it is recognised that a sustainable drainage system is proposed to be included within the design of the scheme, to ensure that surface water runoff is managed appropriately (refer to Section 8) and does not contribute to the existing flood risk. Consequently, the risk of flooding to the site and surrounding area from this source will not increase as a result of the proposed development. It is therefore concluded that the risk of flooding from surface water is low.

Flooding from Groundwater – Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes' (streams that only flow for part of the year).

The underlying geology in this area is Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated), overlain by superficial deposits of Alluvium (clay, silt, sand, and peat). In certain circumstances groundwater flows can occur within the deposits.

Nearby borehole records show that groundwater has not been encountered up to a depth of 4m below ground level in this area. Nevertheless, the proximity of the site to the river Thames means that the groundwater table is likely to be hydraulically linked to water levels within the river. Consequently, there is the potential for groundwater to fluctuate in this area. Nevertheless, given the relatively urbanised area and based on nearby borehole records, it is concluded that the risk of groundwater emergence at the surface is low.

It is acknowledged that the multi-storey car park includes a basement level which will need to be appropriately designed to prevent groundwater ingress, in the unlikely and unexpected event that high groundwater levels become elevated.

This type of system could comprise a waterproof membrane (tanked design), or alternatively a drained cavity underground waterproofing system. The latter system enables water to pass through walls and floors into a cavity formed by placing an impermeable membrane to the walls and floor. Drainage channels at floor to wall intersections take the water to a sump where it is pumped out to drainage outlets. Either system will ensure that no internal flooding will occur as a result of groundwater.

Flooding from Sewers – In urban areas, rainwater is typically drained into surface water sewers or sewers containing both surface and wastewater known as “combined sewers”. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked, or has inadequate capacity; this will continue until the water drains away.

Inspection of the asset location mapping provided by Southern Water (Figure 3.2) identifies that the sewers in this area are foul only. The absence of combined sewers significantly reduces the risk of the sewer network being overwhelmed during an extreme rainfall event. The site is located at the top of the sewer network with a limited number of buildings flowing into the network, and therefore there is reduced potential for the sewer network to be overwhelmed.

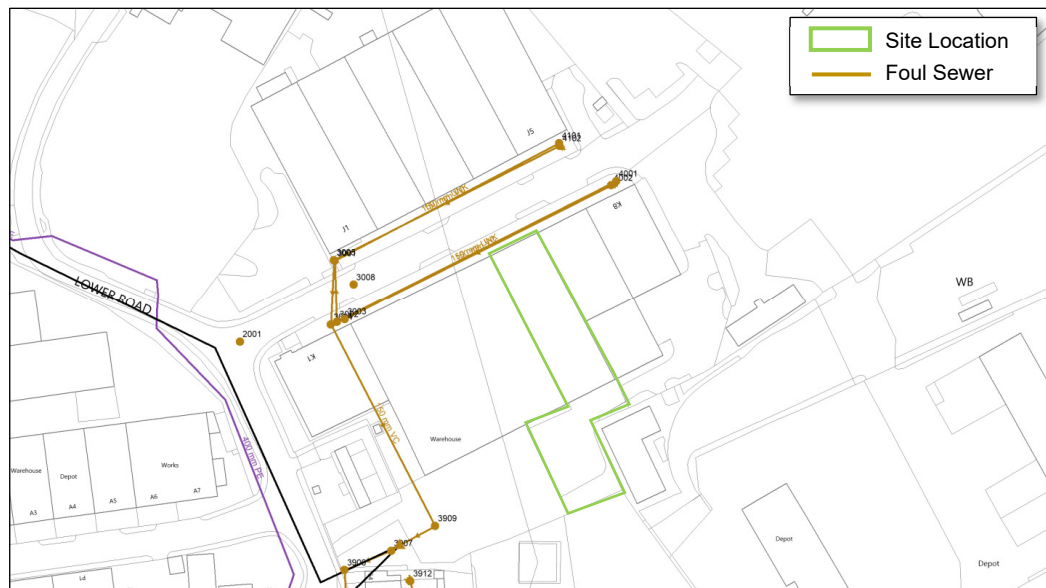


Figure 3.2 - Asset location mapping provided by Southern Water (a full scale copy can be found in Appendix A.2).

In the unlikely event that the sewer network was to become overwhelmed, i.e. as a result of a blockage, water could exit the sewers at the top of the network and flow towards the local depression within Lower Road. The risk associated with water accumulating in this area is comparable to the risk of flooding from surface water which has been identified to be low.

In addition, there are no historic records of flooding from sewers presented within the Kent Thameside SFRA. Con, the risk of flooding from this source is therefore considered to be low.

Flooding from Reservoirs, Canals and Other Artificial Sources – Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. In addition, operational and redundant industrial processes including; mining, quarrying, sand and gravel extraction, may also increase the depth of floodwater in areas adjacent to these features.

The potential effects of flood risk management infrastructure and other structures also needs to be considered. For example; reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

Inspection of the OS mapping for the area shows that there are no artificial sources of flooding within close proximity to the site. In addition, the EA's 'Flood Risk from Reservoirs' map shows that the site is not within an area considered to be at risk of flooding from reservoirs. Therefore, the risk of flooding from this source is considered to be *low*.

A summary of the overall risk of flooding from each source is provided in Table 3.1 below.

Source of Flooding	Initial Level of Risk	Appraisal method applied at the initial flood risk assessment stage
Rivers and the Sea	Appraised further in Section 5	OS mapping and the EA's 'Flood Map for Planning'
Ordinary and Man-Made Watercourses	Low	OS mapping and aerial height data
Surface Water	Low	EA's 'Flood Risk from Surface Water' map, aerial height data, OS mapping and site-specific topographic survey
Groundwater	Low	Site-specific geological data, aerial height data, OS mapping, site-specific topographic survey, historic records in SFRA and BGS Borehole survey records
Sewers	Low	Aerial height data, OS mapping, site-specific topographic survey, asset location data provided by Southern Water and historic sewer records contained within the SFRA
Artificial Sources	Low	OS mapping and EA's 'Flood Risk from Reservoirs' map

Table 3.1 – Summary of flood sources and risks.

3.3 Existing Flood Risk Management Measures

The wider Thames flood defences provide a 1 in 1000 year standard of protection and are all raised, man-made and privately owned. The Environment Agency inspect them twice a year to ensure that they remain fit for purpose. The defences must be maintained by their owners to a crest level of 6.78m AODN (the Statutory Flood Defence Levels along this reach of the Thames). The current condition grade for defences in this area is 3 (satisfactory), on a scale of 1 (very good) to 5 (very poor).

The Thames Barrier forms a significant element of the Thames Tidal Defences and is located between Newham and Greenwich. It became operational in October 1982 and was closed for the first time in February 1983. The Barrier is part of a system of tidal defences that currently protect London to an extremely high standard. However, this level of protection is expected to decline in the future.

The Thames Estuary 2100 project sets out the strategic direction for managing flood risk in the Thames Estuary up to the year 2100. The TE2100 plan is now live and forms the overarching flood management strategy for the Thames Estuary. The TE2100 takes into account operation of the Thames Barrier when considering future levels. The Thames Barrier requires regular maintenance and with additional closures the opportunity for maintenance will be reduced. When this happens, river levels for which the barrier would normally be shut, will have to be allowed through to ensure that the barrier is not shut too often. For this reason, levels will increase, and the tidal walls will need to be heightened to match. The future defence height required in this location is 7.9m AODN.

4 Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential changes in the future and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present, and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary: for the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall could be expected.

These effects will tend to increase the size of Flood Zones associated with rivers, and the amount of flooding experienced from other inland sources. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels. It will also increase the extent of the area at risk should sea defences fail. Changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events are also predicted.

4.1 Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on the extreme flood level that is commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. For commercial development, a 60 year design life is typically assumed. The development that is the subject of this FRA is classified as commercial and therefore a design life of 60 years has been assumed.

4.2 Potential Changes in Climate

Extreme Sea Level

Global sea levels will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west.

Reference to guidance published by the EA specifies allowances for different epochs and regions across England. The predicted rates of relative sea level rise for the 'South East' region, relevant to the subject site, are shown in Table 4.1. These values which correspond with the Higher Central and Upper End percentiles (the 70th and 90th percentile respectively).

Administrative Region	Allowance Category	Net Sea Level Rise (mm/yr) (Relative to 2000)			
		2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2125
South East	Higher Central	5.7	8.7	11.6	13.1
	Upper End	6.9	11.3	15.8	18.2

Table 4.1 – Recommended contingency allowances for net sea level rise.

The development site is not subject to coastal flooding, however, the River Thames is a tidal river and therefore the figures above are still applicable. As outlined in Section 3.3, water levels within the River Thames are depicted by closure rules for the Thames Barrier as depicted in the TE2100 plan. The impacts sea level rise over the next 100 years have been taken into consideration as part of the EA's TE2100 modelling study.

Peak Rainfall Intensity

The recommended allowances for increases in peak rainfall intensity are applicable nationally. There is a range of values provided which correspond with the central and upper end percentiles (the 50th and 90th percentile respectively) over three time epochs. The recommended allowances are shown in Table 4.2 below.

Allowance Category (applicable nationwide)	Total potential change anticipated for each epoch		
	2015 to 2039	2040 to 2069	2070 to 2115
Upper End	+10%	+20%	+40%
Central	+5%	+10%	+20%

Table 4.2 – Recommended peak rainfall intensity allowance for small and urban catchments (1961 to 1990 baseline).

Guidance published by the EA states that the 'Upper End' allowance should be considered when designing a sustainable drainage system. As the development subject to this FRA has a planning horizon of 60 years, a 40% increase in peak rainfall intensity has been applied to the hydraulic model constructed to inform the outline surface water management strategy (refer to Section 8).

All of the above recommended allowances for climate change should be used as a guideline and can be superseded if local evidence supports the use of other data or allowances. Additionally, in the instance where flood mitigation measures are not considered necessary at present, but will be required in the future to account for changes in the climate, a "managed adaptive approach" can be adopted. This approach allows appropriate mitigation measures to be incorporated into the development in the future to combat the impacts of climate change.

5 Probability and Consequence of Flooding

When appraising the risk of flooding to new development it is necessary to assess the impact of the 'design flood event'. Flood conditions can be predicted for a range of return periods, and these are expressed in either years or as a probability, i.e., the probability that the event will occur in any given year, or Annual Exceedance Probability (AEP). The design flood event is taken as the 1 in 200 year (0.5% AEP) event for sea or tidal flooding, including an appropriate allowance for climate change (refer to Section 4.2).

5.1 Actual Risk of Flooding

The EA has previously provided modelled flood levels as part of the Thames Estuary 2100 (TE2100) study. The results take into account the operation of the Thames Barrier into the future and as such, the results provided by the EA do not include a scenario for an extreme event with a 1 in 200 year return period. Instead, water levels from this study have only been provided for an extreme event with a 1 in 1000 year return period event, over a range of epochs. Although these levels represent a scenario that exceeds the design flood conditions, these levels have been referenced to provide a conservative estimate of the maximum water levels. Table 5.1 below shows the maximum water level for the closest node point to the site (i.e. node 3.23).

Epoch	TE2100 Water Levels (m AODN)
Present Day (2005)	5.85
2040	6.06
2070	6.22
2100	6.52

Table 5.1 – Maximum likely water levels (at Node 3.23) showing the highest levels permitted by the Thames Barrier.

From Table 5.1 it can be seen that the present day maximum water level permitted by the Thames Barrier at the closest node point to the subject site is 5.85m AODN. However, when this level is compared to the statutory defence level along this reach of the Thames (i.e. 6.78m AODN), it is evident that the predicted water level would remain below the crest level of the defence.

It is also necessary to consider the impact of climate change over the lifetime of the development. Table 5.1 shows that the highest permitted water level by the Thames Barrier will increase to 6.52m AODN by the year 2100. Nevertheless, the TE2100 Plan sets out that the tidal defence system in this area is to be raised and adapted where required to keep new Barrier closures within operational constraints. It is anticipated that the tidal walls along both banks of the river will be raised to a

minimum of 7.9m AODN. This level is significantly above the water level and therefore, it is concluded that the actual risk of tidal flooding from the River Thames is extremely low.

5.2 Residual Risk of Flooding

Whilst the Thames tidal defences do provide a very high standard of protection, and are also maintained to a safe and serviceable standard, there is always the risk that a small section of this infrastructure could fail; either as a result of structural failure, or through less predictable mechanism such as ship impact or an act of terrorism. This is known as the *residual risk* of flooding.

The only way that the impact of such a scenario can be quantified is through the use of detailed numerical breach modelling. This type of modelling has been undertaken as part of the Downriver Breach Inundation Modelling study completed by Atkins Ltd. in 2019, and the results of this study have been provided by the EA previously.

Inspection of the model results provided by the EA shows that the maximum predicted flood level on site during a breach event with a 1 in 200 year return period is **5.28m AODN** for the future year 2115. Under this scenario, it is predicted that the entire site could be flooded, with floodwater predicted to reach a maximum depth of 1.85m at the lowest part of the site (Figure 5.1).

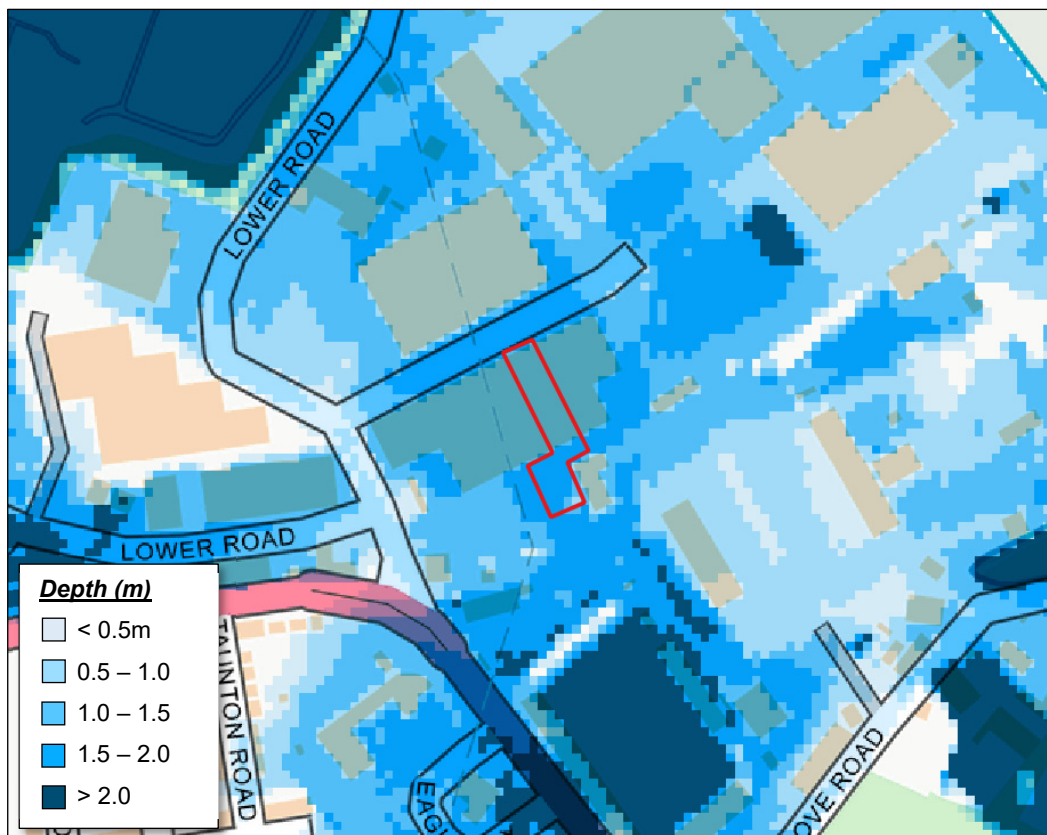


Figure 5.1 – Extract from the Thames Tidal Downriver Breach Inundation Modelling study delineating the maximum flood depth and extent for the year 2115. (contains Ordnance Survey data © Crown copyright and database right 2022 - © Environment Agency).

5.3

Rate of Rise of Floodwater and Time to Inundation

The site has been shown to be defended from flooding under design event conditions by the existing defence infrastructure. However, in the extremely unlikely event that the defences were to breach, the ground floor is predicted to flood. Information regarding the time to inundation in this scenario has not been provided by the EA, however, due to the proximity of the site to the River Thames defences, there is the potential that the onset of flooding could be rapid following a failure of the defences nearby.

6 Offsite Impacts and Other Considerations

6.1 Displacement of Floodwater

The construction of a new building within the floodplain has the potential to displace water and to increase the risk elsewhere by raising flood levels. A compensatory flood storage scheme can be used to mitigate this impact, ensuring the volume of water displaced is minimised.

In this case, the proposals are to extend the existing building upwards (i.e. construction of first and second floor), without altering the existing ground floor footprint. Consequently, the proposed taller building would not result in additional floodwater being displaced. The multi-storey car park to the rear of the site will be designed to be open, allowing water to flow into the building.

In addition to the above, where development is proposed in tidal floodplains such as is the case here, it is generally accepted by the EA that raising the ground or building on the floodplain is unlikely to impact on maximum tidal levels.

6.2 Public Safety and Access

The NPPF states that safe access and escape should be available to/from new developments located within areas at risk of flooding. The Practice Guide goes on to state that access routes should enable occupants to safely access and exit their dwellings during design flood conditions and that vehicular access should be available to allow the emergency services to safely reach the development.

It has been identified that the site benefits from existing defence infrastructure which will protect the site up to and including the design flood event. Consequently, safe and dry access to the site is available under the scenario.

It is only in the unlikely event that the defences were to breach in the future that the site could be affected by flooding. Reference to the Practice Guide shows that in circumstances where it is not possible to provide dry access, the flood hazard to people under the design flood conditions needs to be quantified. As part of the model results, the EA has provided mapping showing the hazard rating for a breach scenario. An extract is provided in Figure 6.1 with the associated hazard classification shown in Table 6.1.

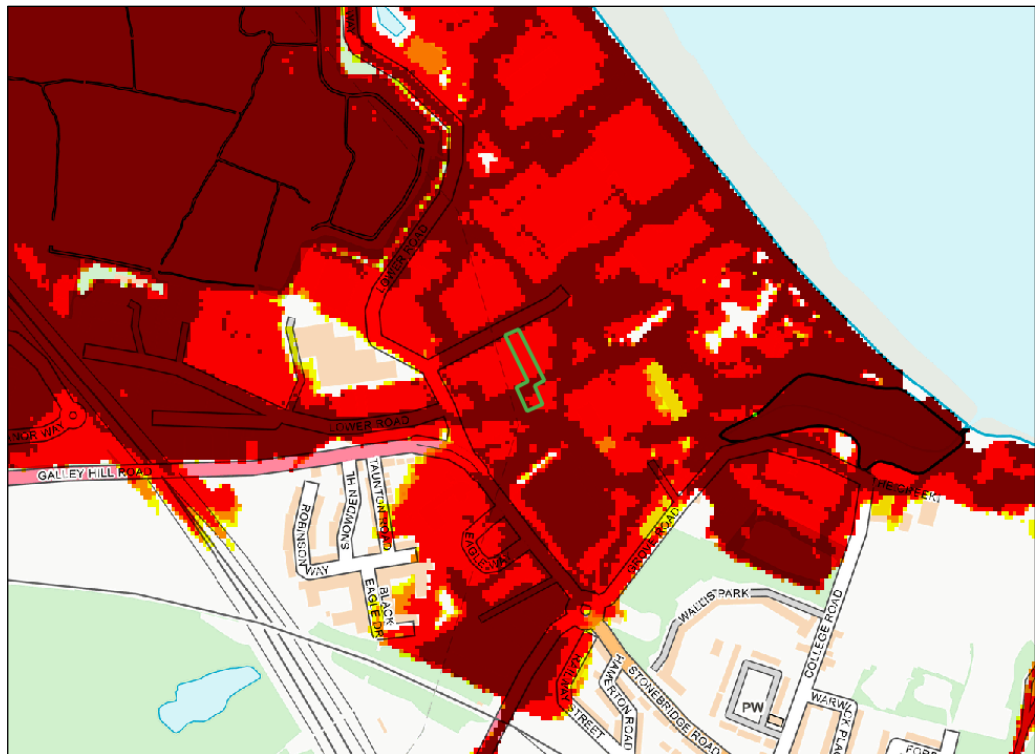


Figure 6.1 – Extract from the Thames Tidal Downriver Breach Inundation Modelling study delineating the maximum flood depth and extent for the year 2115. (contains Ordnance Survey data © Crown copyright and database right 2022 - © Environment Agency).

Hazard Rating (HR)	Degree of Flood Hazard	Description
< 0.75	Low	Caution – shallow flowing water or deep standing water
0.75 to 1.25	Moderate	Dangerous for some, i.e., children – deep or fast flowing water
1.25 to 2.0	Significant	Dangerous for most people – deep fast flowing water
> 2.0	Extreme	Dangerous for all – extreme danger with deep and fast flowing water

Table 6.1 – Classification of Hazard Rating Thresholds.

Safe access and egress to/from the site is not available during the peak of the flood event. Consequently, it is recommended that the manager of the building signs up to the EA's Early Flood Warning Service (refer to Section 7.4). This will enable managers to receive forewarning of a potential flood event and evacuate the site before the onset of floodwater.

In the unlikely event that insufficient time is available to evacuate the site, inspection of the scheme drawings shows that safe and dry refuge is available on upper floors, which are elevated significantly above the maximum predicted flood level.

6.3

Proximity to Watercourse and Flood Defence Structures

Under the Water Resources Act 1991 and Land Drainage Byelaws, any proposals for development in close proximity to a 'main river' would need to take into account the EA's requirement for an 8m buffer zone between the river bank and any permanent construction such as buildings or car parking etc. This buffer zone increases to 16m for tidal waterbodies and sea defence infrastructure.

The development site is located more than 300m from the tidal River Thames and as such will not compromise any of the EA's maintenance or access requirements.

7 Flood Mitigation Measures

The key objectives of flood risk mitigation are:

- to reduce the risk of the development being flooded.
- to ensure continued operation and safety during flood events.
- to ensure that the flood risk downstream of the site is not increased by increased runoff.
- to ensure that the development does not have an adverse impact on flood risk elsewhere.

The following section of this report examines ways in which the risk of flooding at the development site can be mitigated.

Mitigation Measure	Appropriate	Comment
Careful location of development within site boundaries (i.e., Sequential Approach)	✓	Refer to Section 7.1
Raising floor levels	✓	Refer to Section 7.2
Land raising	X	Not required
Compensatory floodplain storage	X	Not required
Flood resistance & resilience	✓	Refer to Section 7.3
Alterations/ improvements to channels and hydraulic structures	X	Not required
Flood defences	X	Not required
Flood warning	✓	Refer to Section 7.4
Surface water management	✓	Refer to Section 8

Table 7.1 – Appropriateness of mitigation measures.

7.1 Application of the Sequential Approach at a Local Scale

The sequential approach to flood risk management can also be adopted on a site based scale and this can often be the most effective form of mitigation. For example, on a large scheme this would mean locating the more vulnerable dwellings on the higher parts of the site and placing parking, recreational land or commercial buildings in the lower lying and higher risk areas.

For the development that is the subject of this FRA it can be seen that this approach has been adopted. Whilst the reception area and warehouse has been located on the ground floor, all main offices have been located on the upper floors. With regard to the multi-storey car park, there is limited opportunity to apply this approach.

7.2 Raising Floor Levels

For less vulnerable development such as commercial or industrial buildings, it is recognised that raising floor levels is not always an appropriate or practical form of mitigation.

Nevertheless, inspection of the scheme drawings shows that all main offices will be situated at a level at 6.54m AODN and above. This is over 1.26m above the maximum predicted flood level and therefore, it is considered that the minimum floor levels have been achieved.

It is recognised that the storage rooms, reception area and car parking is situated below the maximum predicted flood level. Consequently, flood resilience measures should be incorporated (refer to Section 7.3 below).

7.3 Flood Resistance and Resilience

During a flood event, floodwater can find its way into properties through a variety of routes including:

- Ingress around closed doorways.
- Ingress through airbricks and up through the ground floor.
- Backflow through overloaded sewers discharging inside the property through ground floor toilets and sinks.
- Seepage through the external walls.
- Seepage through the ground and up through the ground floor.
- Ingress around cable services through external walls.

Since flood management measures only manage the risk of flooding rather than eliminate it completely, flood resilience and resistance measures may need to be incorporated into the design of the buildings. The two possible alternatives are:

Flood Resistance or 'dry proofing', where flood water is prevented from entering the building. For example, using flood barriers across doorways and airbricks, or raising floor levels. These

measures are considered appropriate for 'more vulnerable' development where recovery from internal flooding is not considered to be practical.

Flood Resilience or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood. Such measures are generally only considered appropriate for some 'less vulnerable' uses and where the use of an existing building is to be changed and it can be demonstrated that no other measure is practicable.

It has been demonstrated that it is only in the unlikely event of a breach scenario that the ground floor of the proposed building and the multi-storey car park could be subject to flooding. Consequently, it is recommended that flood resilience measures are incorporated into the re-design of the ground floor and basement level of the car park to minimise the impact of a flood event.

Details of flood resilience and flood resistance construction techniques can be found in the document '*Improving the Flood Performance of New Buildings; Flood Resilient Construction*', which can be downloaded from www.gov.uk.

In addition, it is recommended that the basement level includes a sump and pump to ensure that any water flowing into the basement, i.e. following a breach scenario can be pumped out after the event.

7.4 Flood Warning

The EA operate a flood forecasting and warning service in areas at risk of flooding from rivers or the sea, which relies on direct measurements of rainfall, river levels, tide levels, in-house predictive models, rainfall radar data and information from the Met Office. This service operates 24 hours a day, 365 days a year.

Whilst a breach scenario cannot be predicted, the likelihood of a breach occurring typically coincides with a tidal surge in the North Sea. Such an event is dependent on meteorological conditions that can be monitored reliably and therefore it is likely that a minimum of 12 hours warning could be given. This forewarning should be sufficient to allow the users of the site to prepare the buildings for a flood event and to evacuate the site themselves.

It is therefore recommended that the managers of the site sign up to the EA's Flood Warning Service either by calling 0345 988 1188, or by visiting;

www.gov.uk/sign-up-for-flood-warnings

The flood warning service should also be used in combination with a robust Flood Warning and Evacuation plan (FEP) for the site. An FEP should be issued to each manager and would need to be reviewed on an annual basis.

A Flood Warning and Evacuation Plan:

- identifies areas of the site that are above the predicted flood level and will therefore be used as a safe haven until floodwaters recede.
- contains detailed site plans that identify emergency access routes through the site.
- provides information to site staff and employees on flood warning procedures.
- includes emergency contact numbers and other site-specific information that will enable managers to manage the impacts of flood event.

8 Surface Water Management Strategy

8.1 Background and Policy

The general requirement for all new development is to ensure that the runoff from the development is managed sustainably and that the drainage solution does not increase the risk of flooding at the site, or within the surrounding area.

In the case of brownfield sites, drainage proposals are typically measured against the existing performance of the site, although it is preferable (where practicable) to provide runoff characteristics that are similar to greenfield behaviour.

The Non-statutory Technical Standards for SuDS (NTSS) specify criteria to ensure sustainable drainage is included within development classified as 'major development' as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2015. It is, however, recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

The proposed development comprises extending the existing building an additional two floors and car park area to the rear with a total floor space greater than 1000m². As a result, the proposals are classified as 'major' development and therefore, the NTSS will apply. Reference to the NTSS has therefore been made throughout the following sections of this report to ensure the principles of sustainable drainage are considered.

8.2 Surface Water Management Overview

The main characteristics of the site that have the potential to influence surface water drainage are summarised in Table 8.1 below.

Site Characteristic	Value
Total area of site	0.23 ha
Impermeable area (existing)	2337m²
Impermeable area (proposed)	2337m ²
Current site condition	Brownfield Site
Greenfield runoff rates (based on existing impermeable area)	Q1 = 0.06 l/s QBar = 0.07 l/s Q30 = 0.17 l/s Q100 = 0.24 l/s
Infiltration coefficient	Assumed to be neglectable due to high groundwater
Current surface water discharge method	Assume a connection into the public sewer
Is there a watercourse within close proximity to site?	No

Table 8.1 – Site characteristics affecting rainfall runoff.

Brownfield and greenfield runoff rates have been calculated using synthetic rainfall data derived using the Flood Estimation Handbook (FEH) online web service and routines within the Causeway Flow+ software. Brownfield runoff rates have been calculated using the Modified Rational Method, whereas greenfield runoff rates have been calculated using the FEH methodology. These values are summarised in Table 8.2 for a range of return periods.

Return Period (years)	Peak Runoff (l/s)	
	Brownfield Rates	Greenfield Rates
2	48.3	0.06
30	141.7	0.17
100	186.1	0.24

Table 8.2 – Summary of peak runoff.

Reference to the tables above show the proposed development will maintain the percentage of impermeable area within the boundaries of the site. Consequently, this will not increase the rate and volume of surface water runoff discharged from the site. Notwithstanding this, it is recognised

that the impacts of climate change should be considered as part of any new development and therefore, it is recommended that SuDS are incorporated into the scheme. This is to ensure that the rate at which surface water runoff is discharged from the site, is not increased over the lifetime of the development.

8.3 Existing Drainage

Southern Water has provided sewer mapping for the site and surrounding area and an extract from this mapping is shown in Figure 3.2. From this figure it is evident that there is only public foul sewer within the area. The existing site drainage has not been surveyed, but it is currently assumed that the existing development discharges surface water runoff via a connection into the public foul sewer. It is recommended to undertake a CCTV survey during the detailed design stage to better understand the existing drainage on site.

8.4 Opportunities to Discharge Surface Water Runoff

Part H of the Building Regulations summarises a hierarchy of options for discharging surface water runoff from developments. The preferred option is to **infiltrate** water into the ground, as this deals with the water at source and serves to replenish groundwater. If this option is not viable, the next option of preference is for the runoff to be discharged into a **watercourse**. Only if neither of these options are possible, the water should be discharged into the **public sewer** system.

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Water Re-Use - Water re-use systems can rarely manage 100% of the surface water runoff discharged from a development, as this requires the yield from the building and hardstanding area to balance perfectly with the demand from the proposed development. Consequently, whilst rainwater recycling systems can be considered for inclusion within the scheme, an alternative solution for attenuating storm water will still be required.

Infiltration – The underlying geology has been analysed using the mappings provided by the BGS. From these mappings it is evident that the proposed development is located on Lewes Nodular Chalk Formation bedrock, with an overlying superficial deposit made up of Alluvium. Borehole logs located close to the proposed development show that there are high groundwater levels within the area. Groundwater levels should be confirmed during the detailed design stage. Due to the high groundwater level discharging surface water runoff from the development into the underlying geology has been considered not viable for this development.

Discharge to Watercourses – There are multiple watercourses in close proximity to the site. However, a connection would require crossing third party land, making a connection into these watercourses not viable.

Discharge to Public Sewer System – With no alternative suitable options available for draining the site, the existing connection to the public sewer system will present the most viable solution for managing the surface water runoff discharged from the development.

8.5 Constraints and Further Considerations

The key constraints that are relevant to this development are listed below:

- There is limited open space to incorporate SuDS that require significant areas of land such as wetland areas.
- If additional surface water runoff is to be discharged into the public sewer system, or if a new connection is required, it will be necessary to gain consent for this connection from the sewerage undertaker (Southern Water).

8.6 Sustainable Drainage Systems (SuDS)

Appropriately designed SuDS can be utilised such that they not only attenuate runoff but also provide a level of improvement to the quality of the water passed on to watercourses or into the groundwater table. This is known as source control and is a fundamental part of the SuDS philosophy.

A range of typical SuDS that can be used to improve the environmental impact of a development is listed in Table 8.3 below along with the relative benefits of each feature and the appropriateness for the subject site.

SuDS	Description	Constraints/Comments	Appropriate for Site?
Rainwater Harvesting Systems	Collection of rainwater and storage for reuse on site	There are no known constraints	Yes
Green/Blue Roofs	Provide landscaping and planting at roof level to reduce surface water runoff rates	Proposed slanted roof	No
Infiltration Systems	Allow water to percolate into the ground at a controlled rate via natural infiltration	Potentially high groundwater and insufficient space	No
Filter Strips	Wide, gently sloping, densely planted areas promoting sedimentation and filtration	Insufficient space	No
Filter Drains	Trenches infilled with stone/gravel providing attenuation, sedimentation and filtration	Limited space, infiltration unlikely to be viable	No
Swales	Broad, shallow channels that convey and store runoff, and allow infiltration	Insufficient space	No
Bioretention Systems / Rain Gardens	A shallow landscaped depression allowing runoff to pond temporarily on the surface	Insufficient space	No
Permeable Pavements	Runoff is allowed to soak into structural paving and stored, potentially being allowed to infiltrate	Limited space	Yes

Underground Storage	Below ground storage which can be used to temporarily store storm water	There are no know contains	Yes
Detention Basins	A landscaped depression for attenuation with a restricted runoff	Insufficient space	No
Ponds and Wetlands	A permanent pool of water which can be used for attenuation and controlled outflows by water levels	Insufficient space	No

Table 8.3 – An assessment into the suitability of SuDS at this site.

From Table 8.3 it can be seen that there are a number of SuDS which could be considered suitable for use at this site. However, at this stage in the planning process it is envisaged that an underground storage tank will be used to discharge the surface water runoff via infiltration.

8.7 Proposed Surface Water Management Strategy (SWMS)

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with the results of a hydraulic drainage model that has been constructed to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF and NTSS can be met at the planning stage.

Geocellular storage crate

Surface water runoff from the roof of the buildings and the areas of hardstanding will be collected via down pipes and gullies and discharged into a geocellular storage crate system located in the front of the property. Surface water will be stored within the crate system until it is discharged using a 150mm diameter pipe. It is recommended to install sediment traps and petrol/oil interceptors onto the inlets of the crate system to reduce the risk of sediment and pollutants reaching the tank. A summary of the Causeway Flow+ analysis for the geocellular storage crates is shown in Table 8.4 below.

Parameter	Value (1:100yr+40%cc event)
SuDS	Geo-cellular Storage Tank
Total area draining to crates, including overflow from other SuDS	2330 m ²
Area of crates	75m ²
Depth of crates	1.2m
Porosity	95%
Flow control device	150mm pipe @ invert level
Overflow device	Pipe Connects directly to the public sewer system

Table 8.4 – Summary of geocellular storage crates.

8.8 Hydraulic Drainage Model

A Hydraulic Drainage model for the proposed drainage system and SuDS has been constructed in Causeway Flow+ and used to confirm that the proposed drainage system will provide sufficient storage and attenuation for runoff draining into the public foul sewer. Table 8.5 below, provides a summary of the pre and post development discharge rates based on the results of this drainage model.

Return Period (years)	Existing discharge rates (l/s)	Proposed discharge rates +40%cc (l/s)	Percentage Reduction
2	48.3	22.2	54%
30	141.7	39.4	72%
100	186.0	45.9	75%

Table 8.5 – Summary of peak runoff.

From the tables above and the included results of the hydraulic model, it is evident that the proposed drainage system will be able to manage all surface water runoff from the development up to and including the design event. Additionally the proposed drainage system will provide a minimum of 50% reduction when compared to the existing discharge rates. This is considered to be acceptable for the LPA and LLFA.

8.9 Indicative Drainage Layout Plan

Figure 8.1 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

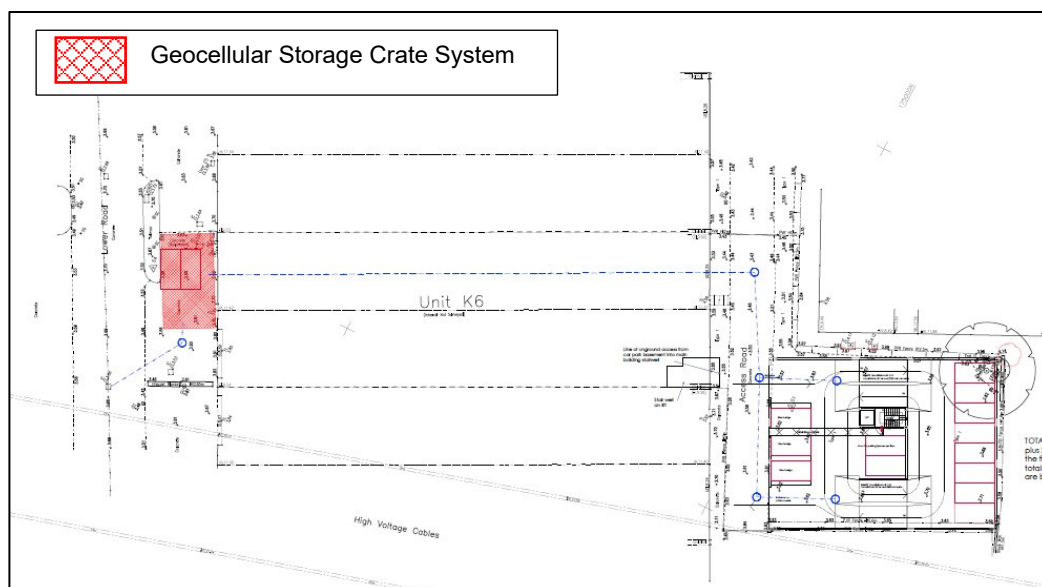


Figure 8.1 - Indicative drainage layout plan showing the proposed location of SuDS.

A full-scale copy of this layout is located in Appendix A.4 of this report.

8.10 Management and Maintenance

For any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime.

The key requirements of any management regime are routine inspection and maintenance. When the development is taken forward to the detailed design stage, an 'owner's manual' will need to be prepared. This should include:

- A description of the drainage scheme.
- A location plan showing all of the SuDS features and equipment, such as flow control devices etc.
- Maintenance requirements for each element, including any manufacturer specific requirements.
- An explanation of the consequences of not carrying out the specified maintenance.
- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS features recommended by this assessment, the most obvious maintenance tasks will be cleaning and de-silting the underground storage crates. For the latter, it is important that the design recognises the need for this operation and thus incorporate silt traps and easy access for emptying.

The maintenance requirements for the various SuDS measures incorporated into the proposed scheme are outlined within the attached maintenance schedules. .

For developments such as this that rely to some extent on the ongoing inspection and maintenance of SuDS, it will be necessary to ensure that measures are in place to maintain the system for the lifetime of the development.

It will be the owners responsibility to ensure the adequate management and maintenance of the proposed SuDS system over their lifetime.

8.11 Sensitivity Testing and Residual Risk

It is necessary to ensure that the drainage proposals will not increase the risk of flooding if the drainage system becomes blocked, or if a rainfall event which exceeds the design rainfall event occurs.

During exceedance events or the blockage of the 150mm pipe, surface water runoff will fill up the storage system until it surcharges and overflows onto the front hardstanding. Overflowing surface water runoff would follow the natural topography towards Lower Road, where it will be intercepted by the highway drainage system. An overflow pipe has been proposed to allow for unrestricted discharge during these scenarios into the public sewer system.

Based on the analysis above it is therefore concluded that with the inclusion of the proposed SuDS discussed within this strategy, the development will not increase the risk of flooding at the site or within the surrounding area.

9 Conclusions and Recommendations

The overarching objective of this report is to appraise the risk of flooding at Unit K6 Lower Road, Northfleet, Kent, DA11 9BL to ensure that the proposals for development are acceptable and that any risk of flooding to the users of the building is appropriately mitigated. In addition, the NPPF also requires the risk of flooding offsite to be managed, to prevent any increase in flood risk as a result of the development proposals. This report has therefore been prepared to appraise the risk of flooding from all sources and to provide a sustainable solution for managing the surface water runoff discharged from the development site, in accordance with the NPPF and local planning policy.

The site lies within Flood Zone 3 of the tidal River Thames. Whilst a Sequential Test has not been prepared as part of this FRA, the proposals are simply for extending the existing unit to provide offices on the first and second floor; and additional car park. Consequently, it is concluded that the requirements of the Sequential Test can be met.

In addition, it is also necessary to consider the application of the Exception Test. In this case, the proposals are for a 'less vulnerable' development in flood zone 3a. For such a combination of vulnerability classification and flood zone, the Exception Test is not applicable. Nevertheless, Paragraph 167 of the NPPF requires all development in Flood Zones 2 and 3 to be subject to a FRA and to meet the requirements for flood risk reduction.

Consequently, the risk of flooding has been appraised across a wide range of sources and it has been identified that the site could be at risk of flooding from the River Thames. When the risk is appraised in more detail, it is evident that the site benefits from existing defence infrastructure which will continue to protect the site up to and including the design flood event. It is only in the extremely unlikely event that these defences were to fail that the site could be subject to flooding, with depths predicted to reach a maximum of 1.85m.

Consequently, it is recommended that the managers of the building sign up to the EA's Early Flood Warning Service. This service will enable them to receive forewarning of a potential flood event and evacuate the site prior to the onset of floodwater. In addition, it is recommended that flood resilience measures are incorporated into the design of the building to minimise the impact of a flood event.

If insufficient time is available to evacuate the site, inspection of the scheme drawings shows that only car parking, storage and the reception area are located on the lower floors which could flood. All main offices are located on upper floors above the maximum predicted flood level.

In section 8 of this report a surface water management strategy for surface water runoff generated by the development has been proposed. This strategy shows that all surface water runoff can be managed by the proposed SuDS and reduce the proposed discharge rate by a minimum of 50% when compared to the existing discharge rates.

With the above mitigation measures incorporated into the design of the development, the proposals will meet the requirements of the NTTS, NPPF and its Planning Practice Guidance and will therefore be acceptable and sustainable in terms of flood risk.

10 Appendices

Appendix A.1 – Drawings

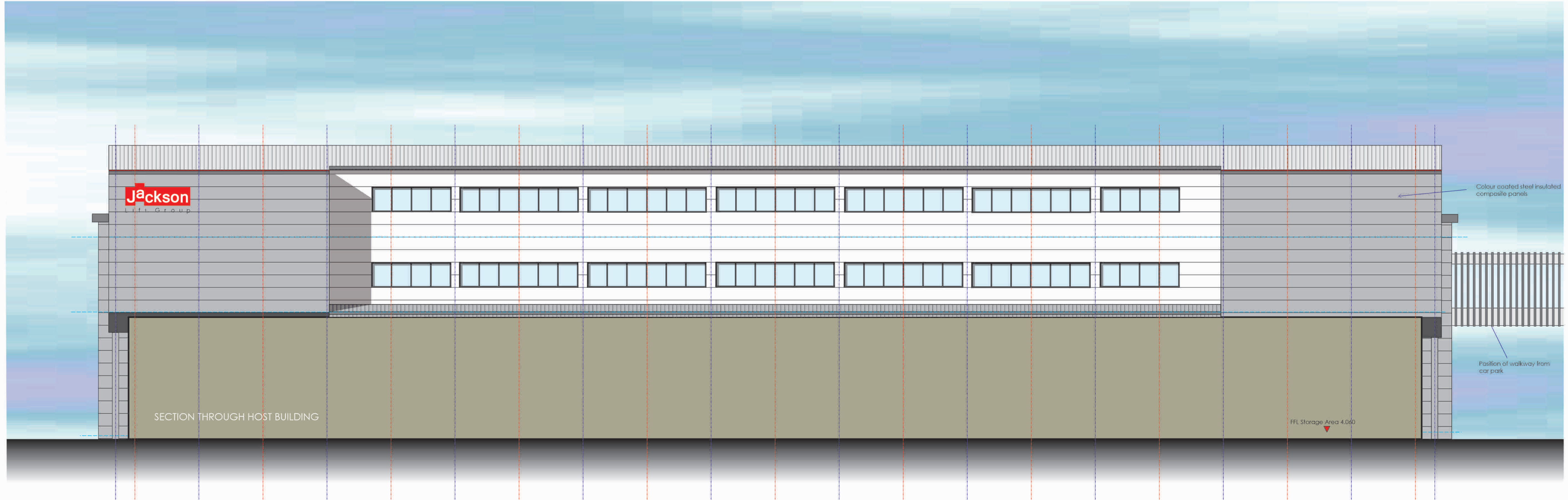
Appendix A.2 – Southern Water Asset Location Data

Appendix A.3 – Surface Water Management Calculations

Appendix A.4 – Indicative Drainage Layout

Appendix A.5 – Maintenance Schedules

Appendix A.1 – Drawings



Proposed Side Elevation - 1:100 SOUTH EAST



Proposed Front Elevation - 1:100 NORTH EAST

Jackson
Lift Group
Units 319, Ripley Business Park
Anchor and Hope Lane, Charlton
London SE7 7RX
Telephone 020 8293 4176
Facsimile 020 8295 0274
E-Mail: info@jacksonlifts.com
Website: www.jacksonlifts.com



F. Elevations only application
E. Minor changes
D. Minor changes
C. New walls ground to first
B. Mezzanine added
A. Elevation added and changes

REVISIONS

SCALE	DATE	REVISION
1:100	March 2022	RFW

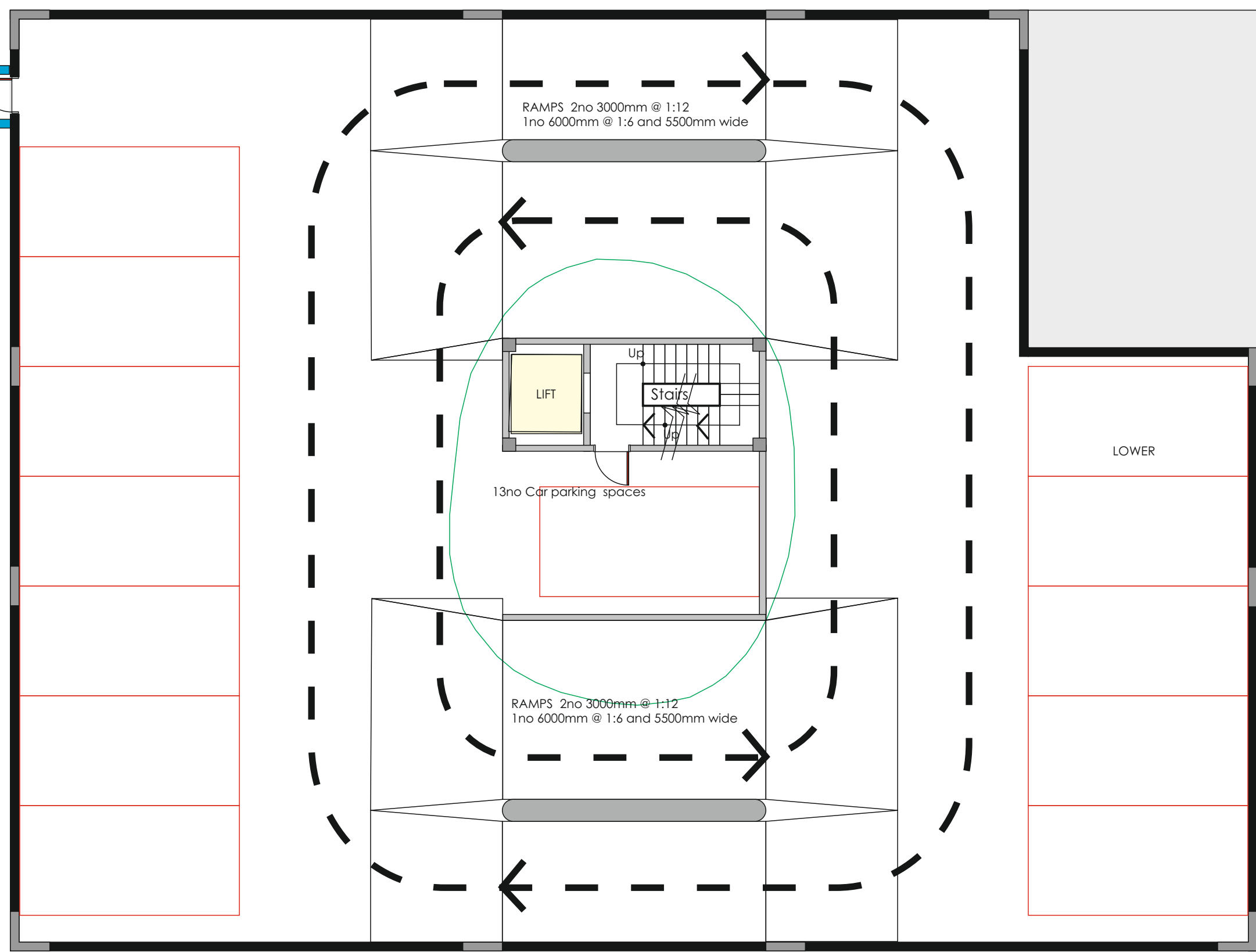
PROPOSED FRONT NORTH EAST AND SIDE SOUTH EAST
Elevations Main Building

PROPOSED NEW WAREHOUSE AND OFFICES
Unit K6 Lower Road
Northfleet Kent DA11 9BL
for: Jackson Family Holdings Limited

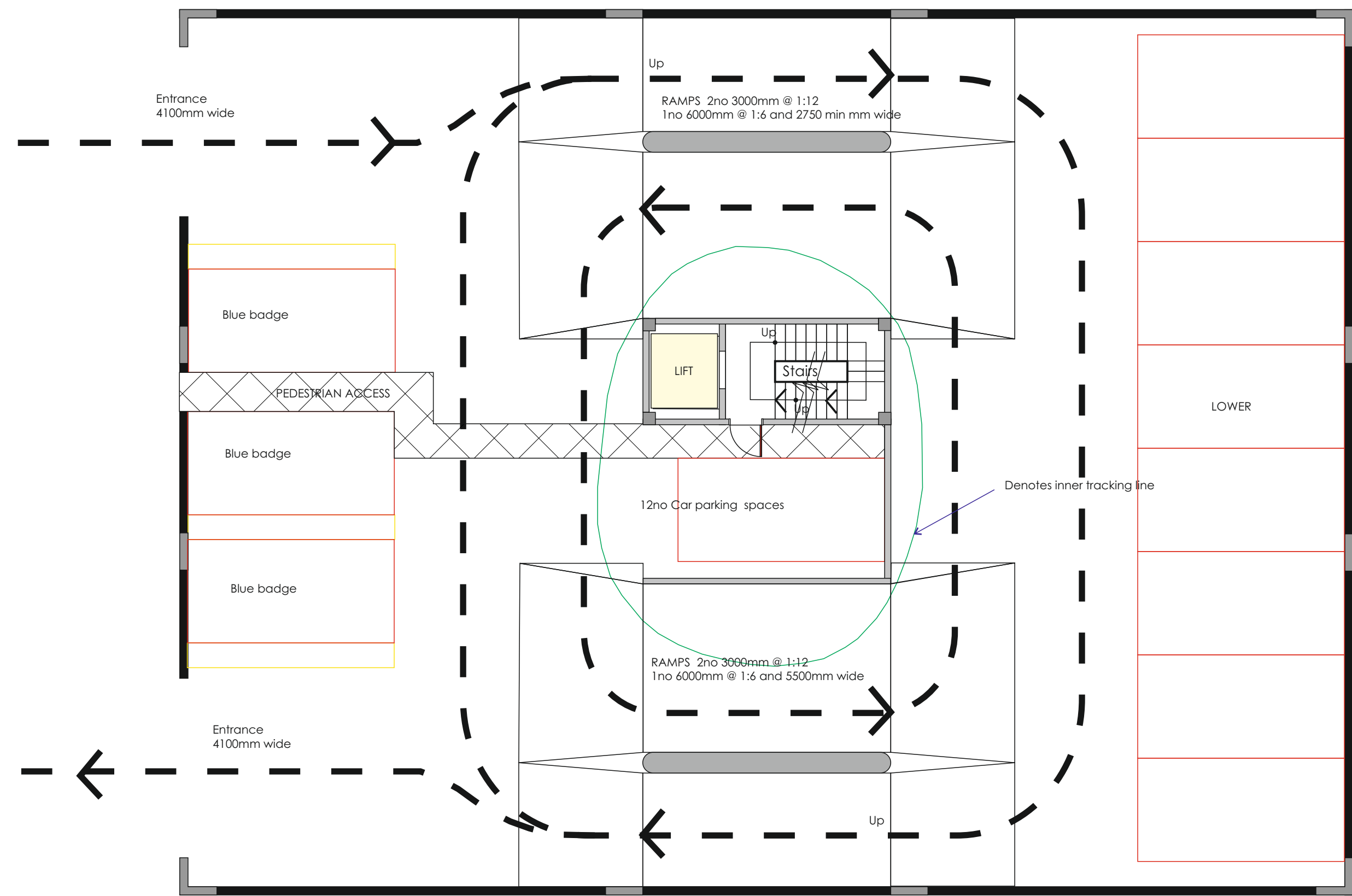
WARD + ASSOCIATES
THE HOO WROTHAM ROAD
MEOPHAM GRAVESEND KENT DA13 0HP
T: 01474 814196 M: 07771 843940
E: admin@wardassociates.co.uk W: www.wardassociates.co.uk
Skype User Name: rogerwardassociates

2521.WD.07F

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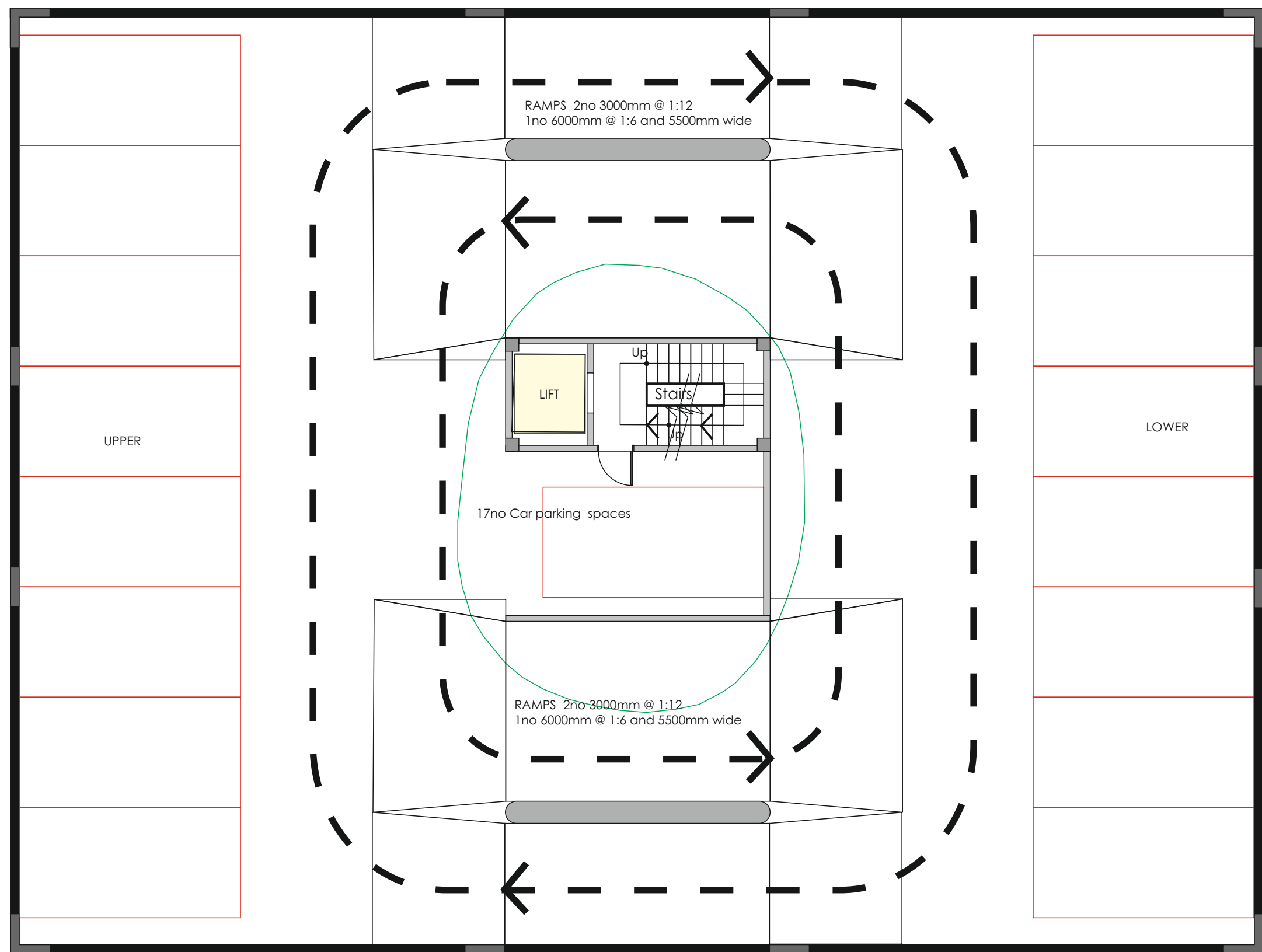


Second Floor Plans - 1:100 Multi-Story Car Park Similar

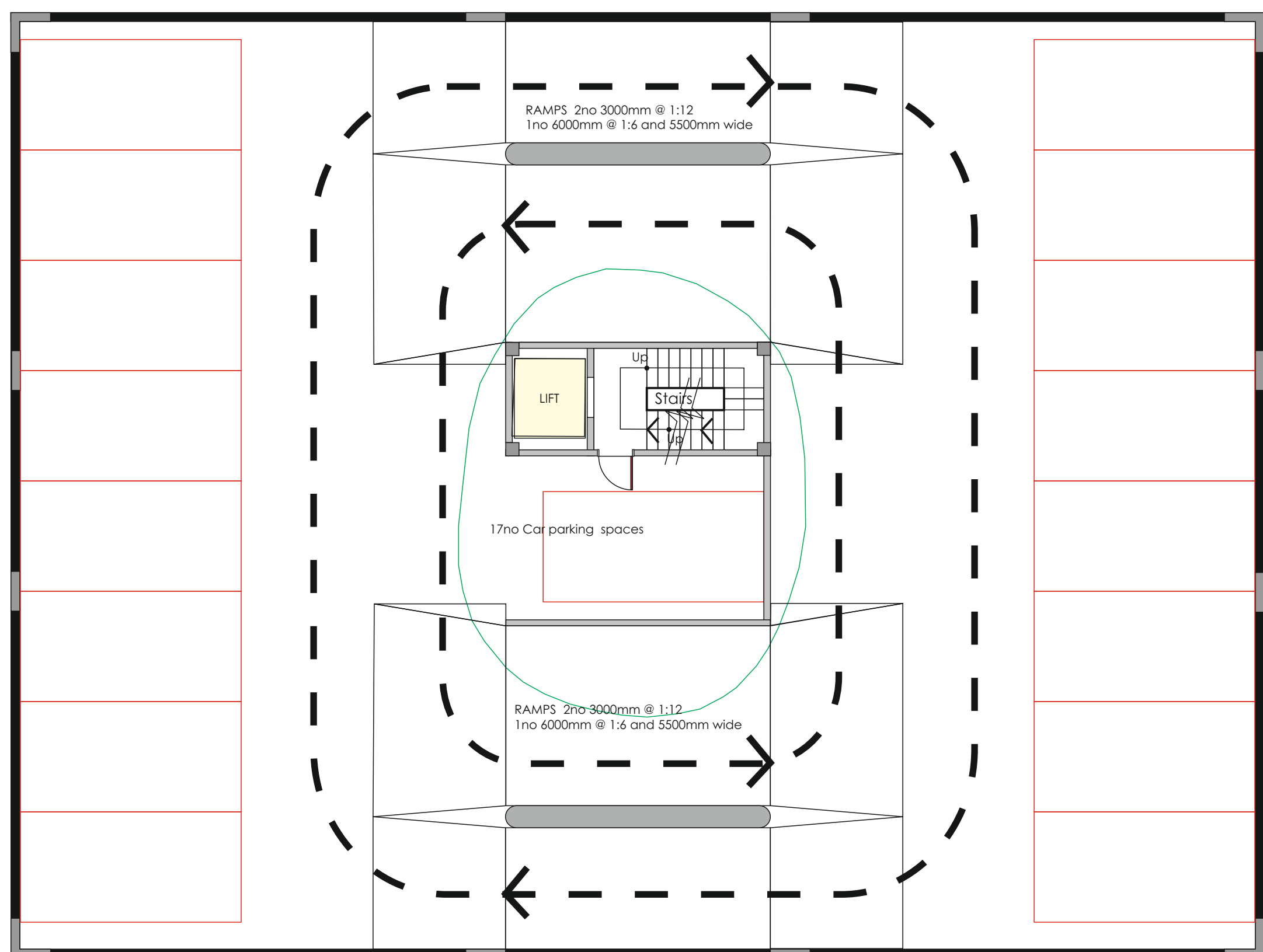


Ground Floor Plan - 1:100 Multi-Story Car Park

TOTAL 59no SPACES
plus 2no spaces at
the front 61no site
total of which 3no
are blue badge



Basement Floor Plan - 1:100 Multi-Story Car Park



First Floor Plan - 1:100 Multi-Story Car Park



E. Layout altered 61 spaces
D. Layout altered 64 spaces
C. Ramped access layout with bridge to main building
B. Ramped access layout altered
A. Ramped access layout

REVISION	DATE	BY	CHKD
1	1:100	RFW	RFW
2	April 2022	RFW	RFW

Multi Storey Car Park - Ramped Split Level Floor Plans
Total four floors and 64 No spaces

PROJECT
Proposed New Warehouse and Offices
Unit K6 Lower Road
Northfleet Kent DA11 9BL
for: Jackson Family Holdings Limited

WARD + ASSOCIATES
THE HOO WROTHAM ROAD
MEOPHAM GRAVESEND KENT DA13 0HP

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2521.WD.09E

- Legend
- LC - Lighting Column
 - LP - Lighting Pole
 - TP - Telegraph Pole
 - SP - Sign Post
 - DP - Downpipe
 - SVP - Soil Vent Pipe
 - PO - Post
 - BO - Bollard
 - SNP - Street Name Plate
 - SC - Stop Cock (Water)
 - SG - Stop Cock (Gas)
 - SV - Stop Valve
 - IC - Inspection Cover
 - BT - British Telecom
 - FIH - Fire Hydrant
 - WM - Water Meter
 - GM - Gas Meter
 - EM - Electric Meter
 - GU - Gully
 - OWH - Overhead Wire
 - OK - Drop Kerb
 - TS - Tree Stump
- Fences
- CB - Closed Boarded
 - CP - Chestnut Paving
 - CL - Chain Linked
 - FW - Post/Wire
 - PVR - Post V/Rail
 - PR - Post/Rail
- Levels
- FL - Floor Level
 - TL - Threshold Level
 - RL - Ridge Level
 - EL - Eaves Level
 - CL - Cover Level
 - SL - Soffit Level
 - ERL - Edge Roof Level
 - TWL - Top Wall Level
 - UCL - Underside Cladding

TOTAL 59no SPACES
plus 2no spaces at
the front 61no site
total of which 3no
are blue badge

Proposed Topographical Site Plan - 1:200
Showing multi storey car park and two parking at the front of Unit K6 61no spaces in total

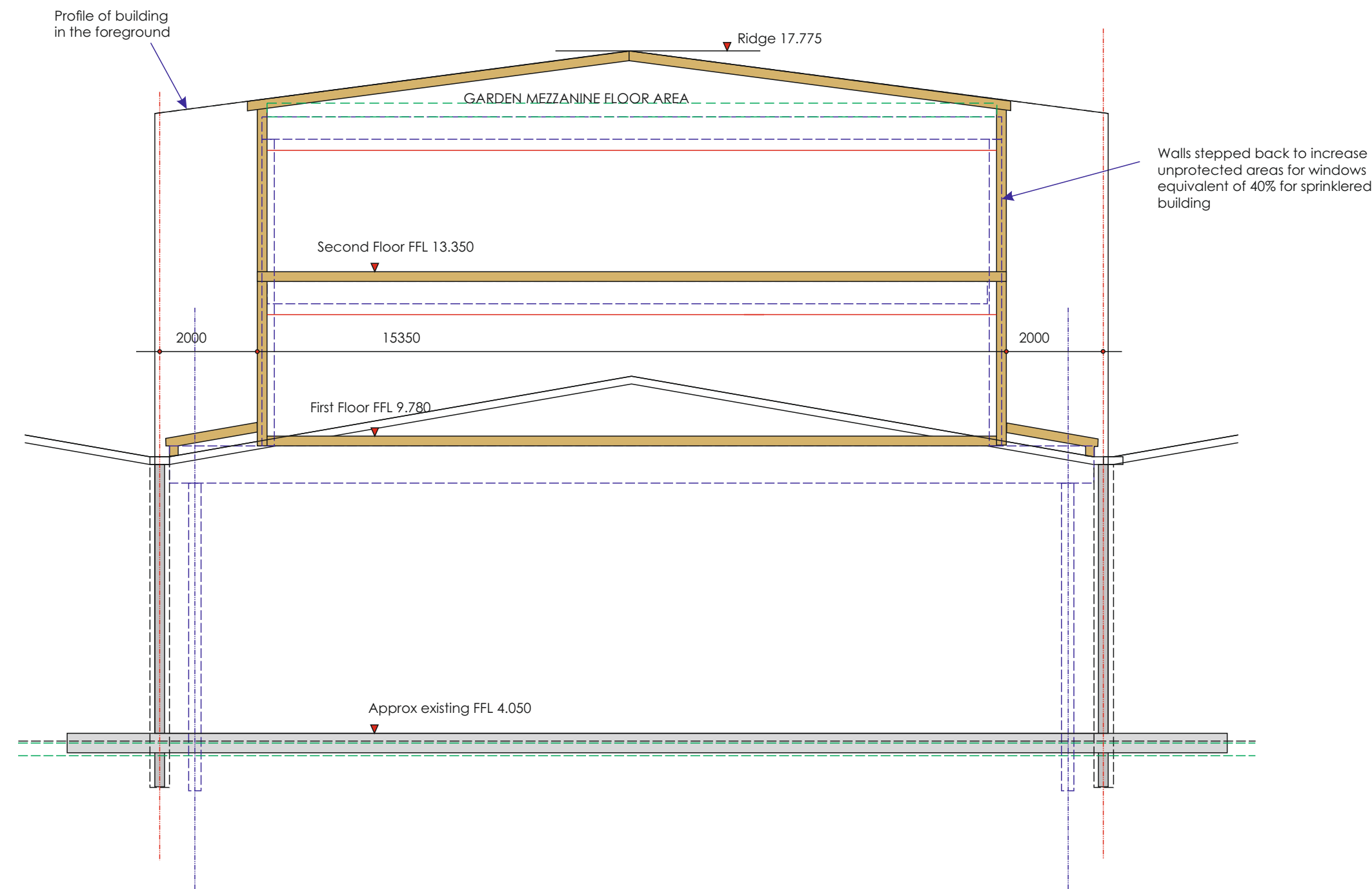
- Notes
- Coordinates to OSGB36(15) Grid established by GPS Observations using the OS Active Network
 - Levels based on OS(ODS) Datum established by GPS Observations using the OS Active Network
 - Tree Circles plotted to scale with approx heights indicated. Species may require expert verification
 - Lowest and Extents of High Voltage Cables Surveyed Remotely

SURVEY STATIONS			
Name	Easting	Northing	Height
S1	561416.022	174995.890	3.640
S2	561462.565	175028.599	3.550
S3	561447.987	175100.639	4.275
S4	561396.835	175070.085	3.675

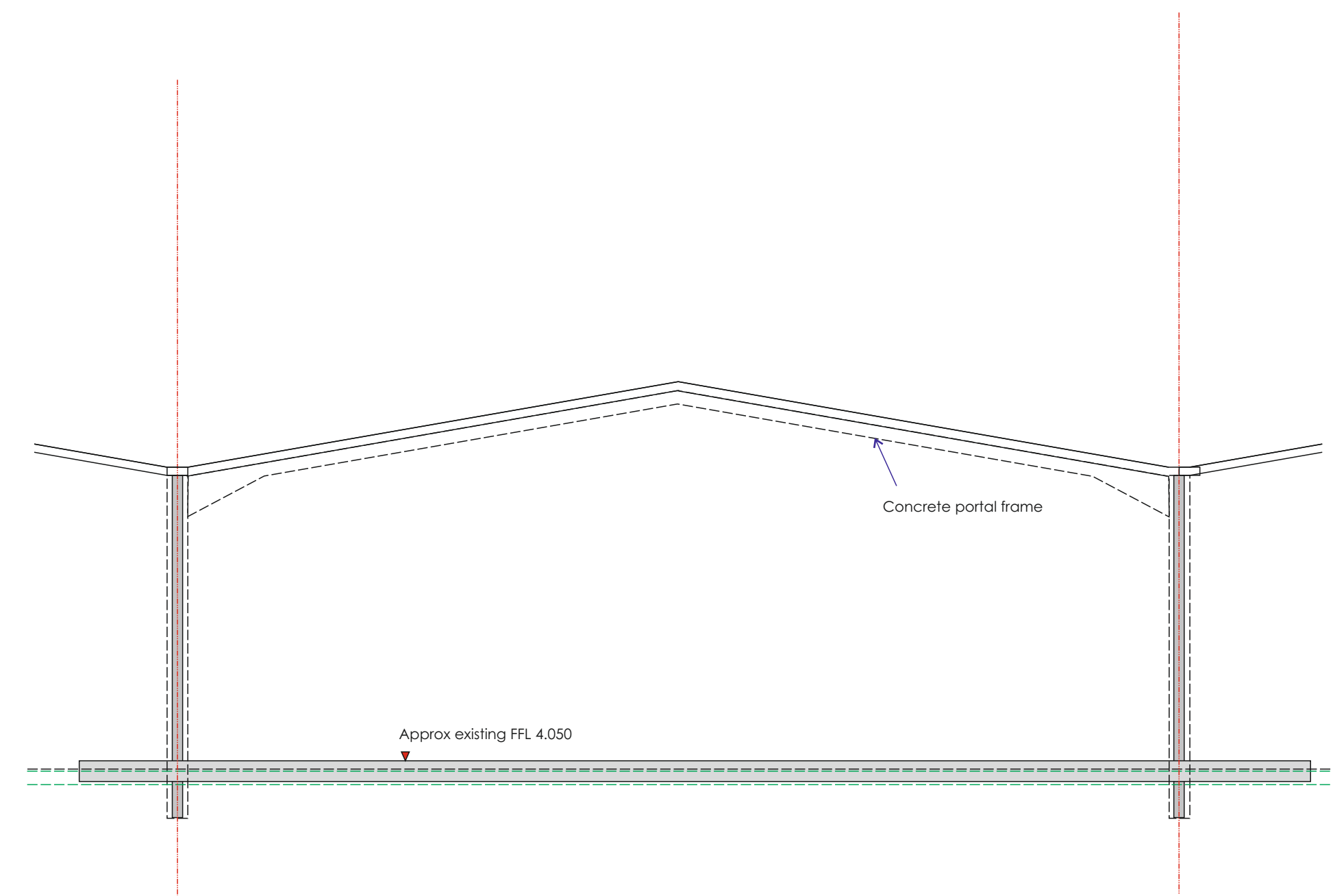


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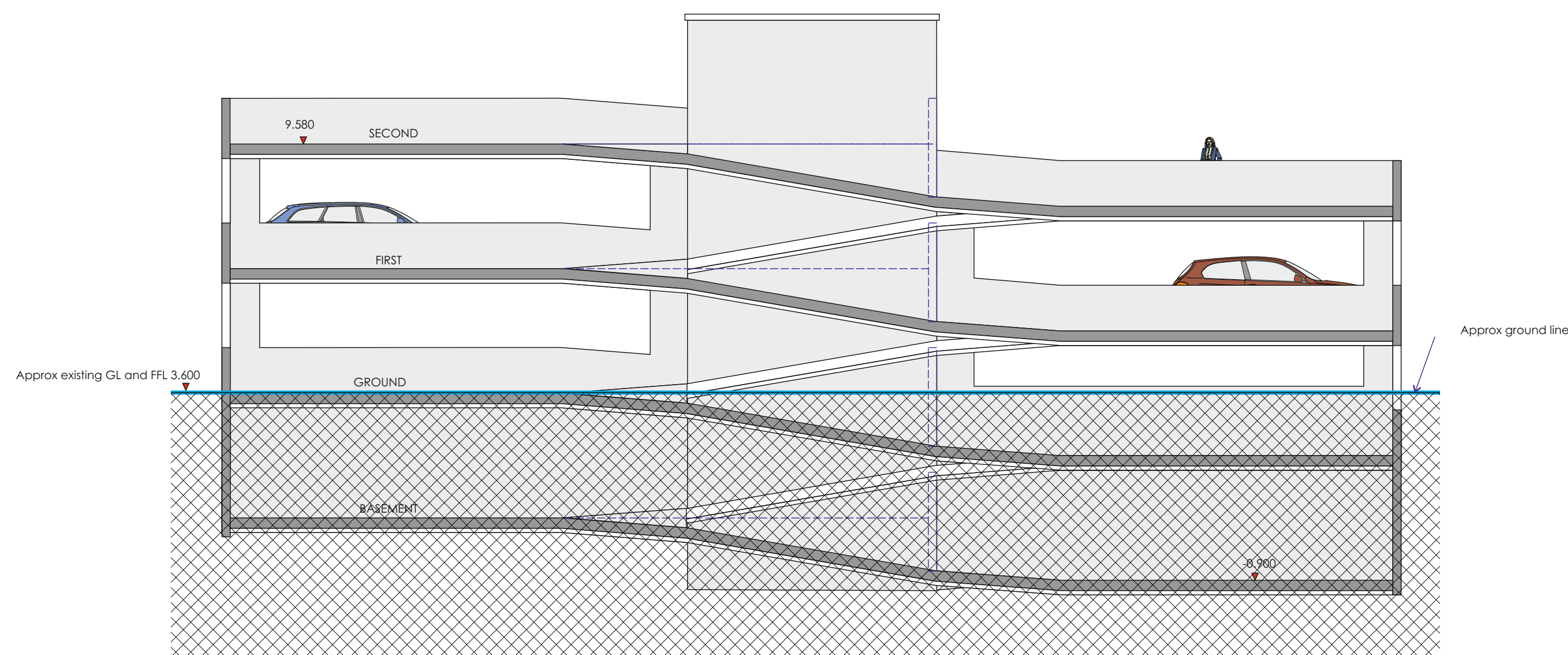
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Proposed Typical Cross Section - 1:100



Existing Typical Cross Section - 1:100





3D Visual - Proposed Frontage-NTS

Jackson
Lift Group
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Anchor and Hope Lane, Charlton
London SE7 7RX
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REVISIONS	
SCALES	NTS
DATE	May 2022
DESCRIPTION	3D Visual Proposed Frontage
PROJECT	Proposed Extension and Alterations Unit K6 Lower Road Northfleet Kent DA11 9BL for: Jackson Family Holdings limited
WARD + ASSOCIATES	
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2521.WD.17	



3D Visual - Contextual Ariel View - NTS



3D Visual - Rear South West View - NTS

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REVISIONS	
SCALES	NTS
DATE	May 2022
3D Visual Rear South West View	
PROJECT	
Proposed Extension and Alterations Unit K6 Lower Road Northfleet Kent DA11 9BL for: Jackson Family Holdings Limited	
WARD + ASSOCIATES	
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2521.WD.19	



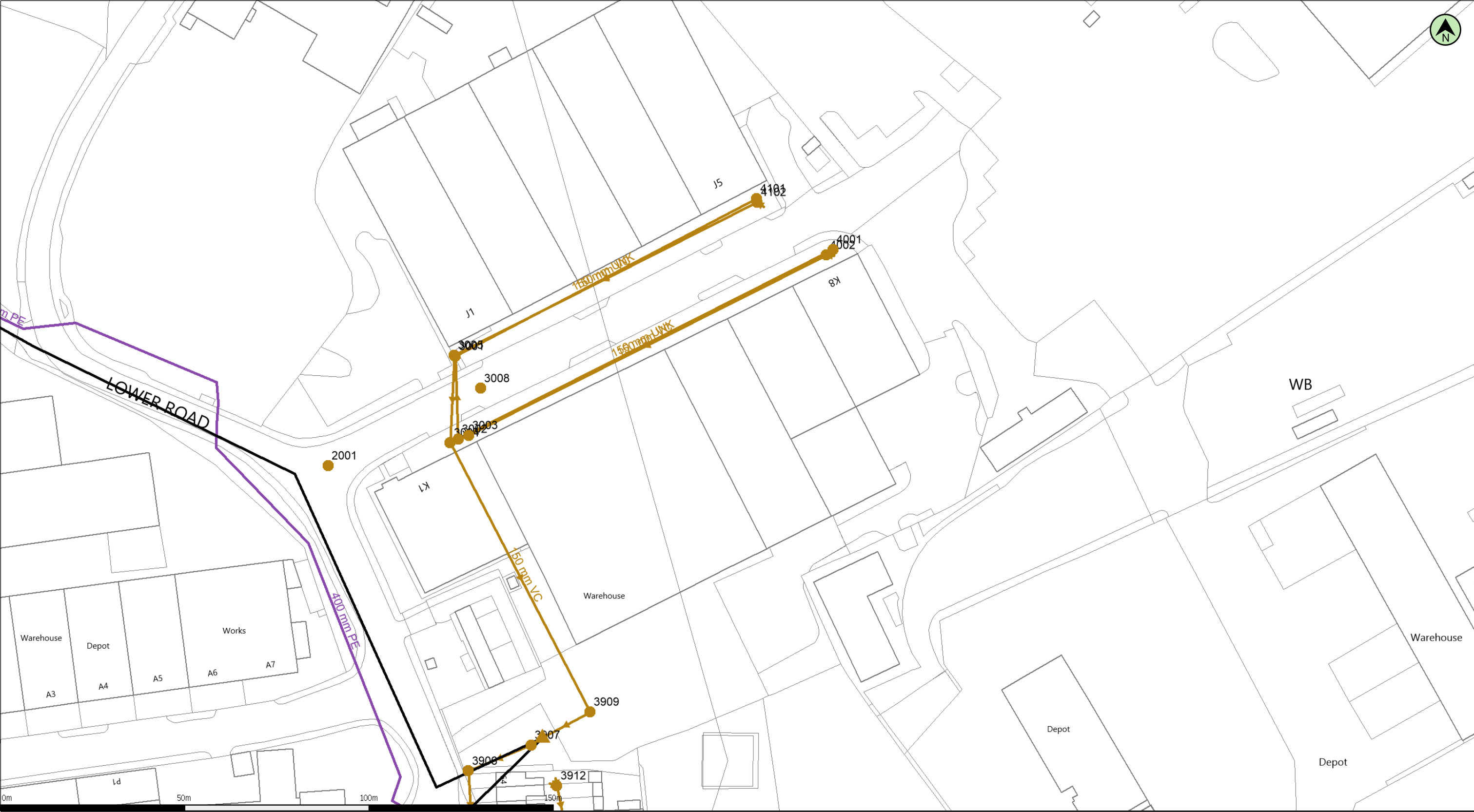
3D Visual - Rear North East View - NTS

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REVISIONS		
SCALES	NTS	DRAWN RFW
DATE	May 2022	
DESCRIPTION	3D Visual Rear North East View	
PROJECT	Proposed Extension and Alterations Unit K6 Lower Road Northfleet Kent DA11 9BL for: Jackson Family Holdings limited	
WARD + ASSOCIATES THE HOO WROTHAM ROAD MEOPHAM GRAVESEND KENT DA13 0HP T: 01474 814196 M: 07771 863940 E: admin@wardassociates.co.uk W: www.wardassociates.co.uk Skype User Name: ragenwardassociates		
2521.WD.20		

Appendix A.2 – Southern Water Asset Location Data



(c) Crown copyright and database rights 2022 Ordnance Survey 100031673

Date: 28/03/22

Scale: 1:1000

Map Centre: 561405,175045

Data updated: 21/03/22

Our Ref: 817669 - 1

Wastewater Plan A3

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2022 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer	Combined Gravity Sewer	Culverted Water Course or Treated Effluent	Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon	Combined Outfall	Surface Water Outfall	Surface Water Inlet
Combined Pumping Station			
Surface Water Pumping Station			
Foul Pumping Station			
Water Treatment Works			
Section 104 Area			
Building Over Agreement Area			
Foul Manhole			
Combined Manhole			
Surface Water Manhole			
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway			

flood@herringtonconsulting.co.uk

EG/3434



Appendix A.3 – Surface Water Management Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	40	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.000
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
MODIFIED RATIONAL METHOD	0.233	4.00	10.000	1900	0.000	0.000	1.000
MODIFIED RATION METHOD OUTLET			9.900	1900	10.000	0.000	1.900
TANK	0.233	4.00	10.000		8.762	7.258	1.500
OUTLET			9.900	1200	22.053	7.047	1.533

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)
1	MODIFIED RATIONAL METHOD	MODIFIED RATION METHOD OUTLET	10.000	0.600	9.000	8.000	1.000	10.0
1.000	TANK	OUTLET	13.293	0.600	8.500	8.367	0.133	100.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1	10.602	8327.0	58.9	0.000	0.900	0.233	0.0	58	3.214
1.000	1.005	17.8	58.9	1.350	1.383	0.233	0.0	150	1.023

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1	10.000	10.0	1000	Circular	10.000	9.000	0.000	9.900	8.000	0.900
1.000	13.293	100.0	150	Circular	10.000	8.500	1.350	9.900	8.367	1.383

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1	MODIFIED RATIONAL METHOD	1900	Manhole	Adoptable	MODIFIED RATION METHOD OUTLET	1900	Manhole	Adoptable
1.000	TANK		Junction		OUTLET	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
MODIFIED RATIONAL METHOD	0.000	0.000	10.000	1.000	1900				
MODIFIED RATION METHOD OUTLET	10.000	0.000	9.900	1.900	1900		0 1	9.000	1000
TANK	8.762	7.258	10.000	1.500			1 1	8.000	1000
							0	1.000	8.500
									150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
OUTLET	22.053	7.047	9.900	1.533	1200	1	1.000	8.367	150



Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	30	0	0	0
2	40	0	0	30	40	0	0
10	0	0	0	100	0	0	0
10	40	0	0	100	40	0	0

Node TANK Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	8.500	Depth (m)	1.200
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	23	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	7.500	Number Required	1
Porosity	0.95	Pit Length (m)	10.000		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD	10	9.057	0.057	48.3	0.4283	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET	10	8.054	0.054	48.3	0.0000	0.0000	OK
30 minute summer	TANK	21	8.656	0.156	40.6	11.5698	0.0000	SURCHARGED
30 minute summer	OUTLET	21	8.493	0.126	18.8	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)		
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET	48.3	0.1684	18.8		
30 minute summer	TANK	1.000	OUTLET	18.8	0.2220	23.4		

Results for 2 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD	10	9.068	0.068	67.6	0.5098	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET	10	8.063	0.063	67.6	0.0000	0.0000	OK
30 minute summer	TANK	21	8.728	0.228	56.9	16.9174	0.0000	SURCHARGED
30 minute summer	OUTLET	21	8.501	0.134	22.2	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)		
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET	67.6	0.2148	26.3		
30 minute summer	TANK	1.000	OUTLET	22.2	0.2274	32.9		

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD	10	9.085	0.085	104.1	0.6338	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET	10	8.077	0.077	104.2	0.0000	0.0000	OK
30 minute summer	TANK	22	8.880	0.380	88.5	28.2880	0.0000	SURCHARGED
30 minute summer	OUTLET	22	8.509	0.142	28.0	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)		
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET	104.2	0.2942	40.6		
30 minute summer	TANK	1.000	OUTLET	28.0	0.2316	51.4		

Results for 10 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD	10	9.101	0.101	145.9	0.7576	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET	10	8.090	0.090	145.9	0.0000	0.0000	OK
30 minute summer	TANK	22	9.061	0.561	123.8	41.6783	0.0000	SURCHARGED
15 minute summer	OUTLET	11	8.509	0.142	33.1	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)		
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET	145.9	0.3777	56.8		
30 minute summer	TANK	1.000	OUTLET	34.1	0.2317	72.0		

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD	10	9.100	0.100	141.8	0.7461	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET	10	8.089	0.089	141.8	0.0000	0.0000	OK
30 minute summer	TANK	22	9.049	0.549	121.7	40.8127	0.0000	SURCHARGED
15 minute summer	OUTLET	11	8.509	0.142	32.5	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)		
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET	141.8	0.3696	55.2		
30 minute summer	TANK	1.000	OUTLET	33.7	0.2317	70.7		

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD	10	9.120	0.120	198.4	0.8959	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET	10	8.104	0.104	198.5	0.0000	0.0000	OK
30 minute summer	TANK	23	9.309	0.809	170.2	60.1636	0.0000	SURCHARGED
15 minute summer	OUTLET	10	8.509	0.142	39.3	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)		
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET	198.5	0.4769	77.2		
30 minute summer	TANK	1.000	OUTLET	41.1	0.2317	99.0		

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD	10	9.115	0.115	186.1	0.8654	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET	10	8.101	0.101	186.2	0.0000	0.0000	OK
30 minute summer	TANK	23	9.258	0.758	160.8	56.3322	0.0000	SURCHARGED
15 minute summer	OUTLET	10	8.509	0.142	38.0	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)		
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET	186.2	0.4543	72.4		
30 minute summer	TANK	1.000	OUTLET	39.7	0.2317	93.6		

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event		US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MODIFIED RATIONAL METHOD		10	9.139	0.139	260.6	1.0422	0.0000	OK
15 minute summer	MODIFIED RATION METHOD OUTLET		10	8.118	0.118	260.7	0.0000	0.0000	OK
30 minute summer	TANK		23	9.616	1.116	225.2	83.0033	0.0000	SURCHARGED
15 minute summer	OUTLET		9	8.509	0.142	45.9	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node			Outflow (l/s)	Link Vol (m³)	Discharge Vol (m³)	
15 minute summer	MODIFIED RATIONAL METHOD	1	MODIFIED RATION METHOD OUTLET			260.7	0.5869	101.4	
30 minute summer	TANK	1.000	OUTLET			48.3	0.2317	131.1	

Appendix A.4 – Indicative Drainage Layout

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GENERAL NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
- ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, EUROPEAN NORMS, CODES OF PRACTICE AND BUILDING PRACTICE.
- ALL DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING THE WORKS ON SITE. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
- ALL DRAINAGE SYSTEMS WILL NEED TO BE INSTALLED AND DESIGNED FOR SUITABLE LOADING REQUIREMENTS.
- THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL AND ALL NECESSARY LICENCES FROM THE THE HIGHWAY AUTHORITY AND/OR SEWERAGE UNDERTAKER BEFORE CARRYING OUT ANY WORKS.

KEY:

- EXISTING FOUL WATER SEWER
- EXISTING FOUL WATER CHAMBER
- SURFACE WATER DRAIN
- SURFACE WATER MANHOLE
- SURFACE WATER PPIC
- GEODELLULAR STORAGE

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SE1 3UD

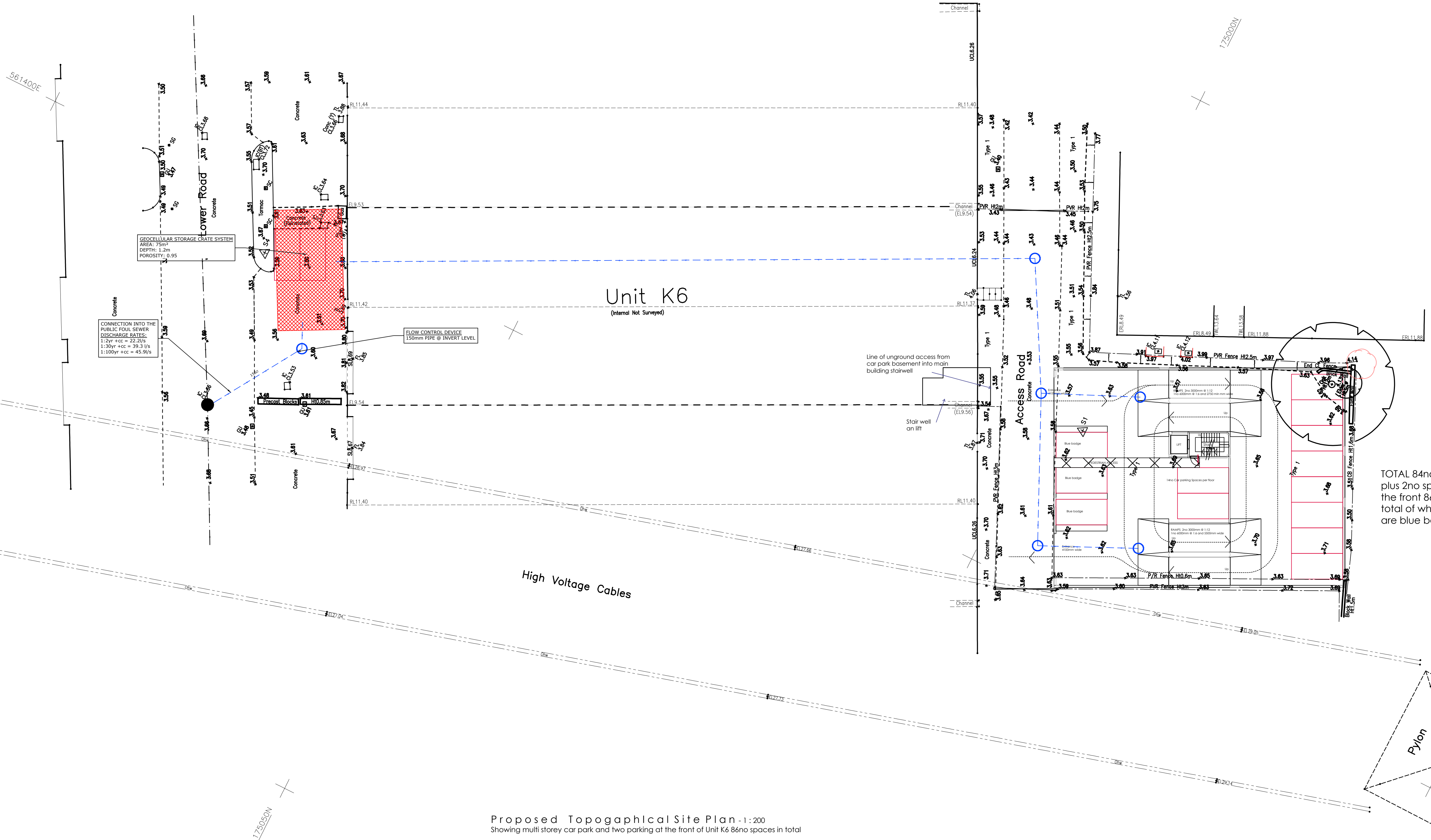
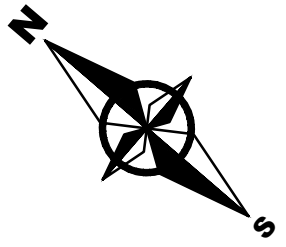
Rev	Description	Author	Checked	Date
P1	First issue	JK	SMB	04/05/22

CLIENT	Jackson Family Holdings Limited
--------	---------------------------------

PROJECT	LOWER ROAD, NORTHFLEET
---------	------------------------

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:200	3434	JK	SMB

DWG REF	DWG No.
INDICATIVE DRAINAGE LAYOUT	HC-3434-501



Proposed Topographical Site Plan - 1:200
Showing multi storey car park and two parking at the front of Unit K6 86no spaces in total

SCALE 1 : 200 @ A1
10 m 0 10 m

Appendix A.5 – Maintenance Schedules

Operation and Maintenance Schedule – Geo-Cellular Storage System

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months then annually
	Remove debris and sediment from the catchment surface, wherever it presents a risk to the performance of the drainage system,	Monthly, or as required based on inspection frequencies.
	Remove sediment from pre-treatment structures (e.g. sediment traps) and from internal forebays	Annually or as required based on inspection frequencies
Remedial Actions	Repair; inlets, outlets, overflow pipes, and vent mechanisms	As required, based on inspections
	Replace tank or geotextile if significant damage is observed or geotextile is torn.	As required
Monitoring	Inspect and check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed.	Following installation, and annually hereafter
	Survey inside of tank, and at any sediment trap mechanisms, for sediment build-up and remove sediment if necessary. Use inspections to develop a regular maintenance and inspection procedure for sediment removal.	Every 5 years, or as required if inspections show high siltation rates.

General Operation and Maintenance Table for Geo-Cellular Storage Systems