

Project Title
Rustington Golf Centre

Report Title
Flood Risk Assessment

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Prepared For
Rustington Investments Ltd

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Consulting Engineers

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EXECUTIVE SUMMARY

- I. This report has been prepared to accompany a planning application for a development consisting of a pub/restaurant, 60-bed hotel, trampoline centre, crèche, forest adventure kiosk, nursery, and retail unit, together with a main car park, service road and staff car park at land within Rustington Golf Centre, Angmering, West Sussex and considers the suitability of the site in terms of flood risk.
- II. The development site lies within fluvial Flood Risk Zone 1 (Low Risk) i.e. land assessed as having a less than 1 in 1000 annual probability flooding from rivers and seas.
- III. The NPPF classifies the proposed development as a combination of :More Vulnerable~and :Less Vulnerable~and confirms that these are permitted in fluvial Flood Risk Zone 1.
- IV. The development site is also at low risk of flooding from fluvial, pluvial, artificial sources, sewer & groundwater and tidal.
- V. A SuDS-based surface water drainage strategy has been prepared that makes use of infiltration in four separate areas with no run-off discharged off site.
- VI. The FRA is considered to comply with the planning requirements of the NPPF and the local planning policies.
- VII. The proposed development does not increase flood risk on or off the site and can be considered to be appropriate.

Site Location:	Rustington Golf Centre, Golfers Lane, Angmering, West Sussex, BN16 4NB. OS Grid Reference TQ 05372 03467
Size and Current Land Use:	3.43ha / Golf course
Proposed Development:	Pub/restaurant, hotel, trampoline centre, cr che, forest adventure kiosk, retail unit, service road and parking areas
EA Flood Zone Classification:	Flood Zone 1
SFRA:	Arun District Strategic Flood Risk Assessment (2009)
Fluvial Flood Risk:	Low risk
Tidal Flood Risk:	Low risk
Surface Water Flood Risk:	Very Low risk
Artificial Sources	Low risk
Sewers	Low risk
Groundwater Flood Risk:	Low risk
Historical Flooding:	No
Flood Defences:	No
Flood Risk Vulnerability Classification:	:More Vulnerable~& :Less Vulnerable~
Exception Test:	N/A
Flood Levels:	N/A
Existing Site Levels:	N/A
Safe Egress:	Yes

Table 1: Summary of Flood Risk

1.0 INTRODUCTION, SITE DESCRIPTION & SCOPE OF REPORT

- 1.1 Rustington Golf Centre has proposals for a mixed use development consisting of a pub/restaurant, 60-bed hotel, trampoline centre, crèche, forest adventure kiosk, retail unit, together with a main car park, service road and staff car park at land within Rustington Golf Centre, Golfers Lane, Angmering, West Sussex, BN16 4NB. The site, its context and relationship with adjoining areas are shown in the Location Plan in Appendix A.
- 1.2 The boundary of the plot forms an irregular shape; is approximately 3.43ha in area; and is located at OS grid reference TQ 05372 03467. It is bounded by land owned by Rustington Golf Centre to the north, east and west and the A259 by-pass to the south.
- 1.3 Robert West Consulting has been commissioned to prepare a Level 2 Flood Risk Assessment (FRA) that conforms to the requirements of the National Planning Policy Framework (NPPF), its associated technical guidance and local council planning policy. The aims of the NPPF are as follows:
 - ☛ Identify the risks of flooding associated with the development of the site from all potential sources
 - ☛ Assess the impact that the proposals would have on these risks
 - ☛ Identify a strategy for managing surface water run-off
 - ☛ Seek to demonstrate that, as part of the development proposals, the overall flood risk can be reduced and/or managed
- 1.4 This report is based on readily-available existing information sources, including the SFRA, Southern Water (SW), British Geological Survey (BGS) website & SuDS GeoReport, the Environment Agency's (EA's) flood mapping & standing advice and a topographical survey. It will be used to inform discussions with the Local Authority to support a planning application.
- 1.5 The existing site, a par-3 Academy golf course located adjacent to the north of the A259, is made up of permeable areas in the form of green-field land.

2.0 ARUN DISTRICT STRATEGIC FLOOD RISK ASSESSMENT

- 2.1 A Strategic Flood Risk Assessment (SFRA) for the district of Arun was carried out in 2009 and a wider West Sussex SFRA was undertaken by West Sussex County Council in 2010. Together, these documents provide base evidence relating to flood risk for the Arun District Draft Local Plan.
- 2.2 A Level 1 SFRA was undertaken for the Arun District, following the guidance set out in PPS25, the Practice Companion Guide and specific EA advice. Arun is affected by all six sources of flooding, although the sources that affect the largest area are rivers (fluvial), the sea (tidal) and groundwater.
- 2.3 The level of detail included in the SFRA depends on the intended use. The Arun District Council SFRA was developed to inform the district-wide Local Development Framework and the scale and detail within the assessment reflects this intended use. A Level 1 (course assessment) was undertaken over the whole of the district, with a Level 2 (intermediate assessment) undertaken in key locations.
- 2.4 The main purpose of the SFRA is to provide sufficient flood risk information to enable an update of any flooding policies within the district. In achieving this, the SFRA will achieve the following objectives:
- ☞ Influencing council policy regarding decisions that are made
 - ☞ Aiding the council's response to proposed developments
 - ☞ Recognising means of reducing flood risk
 - ☞ Inform the emergency flood plans
- 2.5 Although Arun District is affected to varying degrees by all six sources of flooding, the sources affecting most land are from rivers, the sea and groundwater. Flooding from artificial sources is deemed relatively low risk, as no sources of flooding were identified at the strategic level.
- 2.6 Whilst flood risk in Arun is not as significant as in some other districts, several of the initial areas of search investigated in the SFRA were located in areas at higher risk of flooding. It is therefore apparent that more detailed flooding information is required in high probability flood zones.
- 2.7 The River Arun rises on the Weald, flows through the South Downs and across the coastal plain before discharging to the English Channel. The river has a tidal influence up to its confluence with the Western Rother at Pulborough.
- 2.8 The SFRA Fluvial Flood Zone Extents (see Appendix B) indicates that the site does not lie within either fluvial Flood Zones 2 or 3.
- 2.9 The SFRA Historic Flood Events (see Appendix B) indicates that the site does not lie within an area of historic flooding i.e. coastal, tidal, fluvial or surface water.

- 2.10 The SFRA Climate Change Fluvial Flood Zones mapping (see Appendix B) indicates that the site does not lie within an area identified as either Future Flood Zone 3a or 3b.
- 2.11 The SFRA Actual and Residual Flooding from the Sea (see Appendix B) indicates that the site is not at risk from tidal flooding. The SFRA Tidal Flood Zone Extents (see Appendix B) indicates that, even ignoring the presence of flood defences, the site is still not at risk from tidal flooding.
- 2.12 Due to the large chalk bands across the north of the district, there is a significant proportion of land that is more likely to be affected by groundwater flooding. The Indicative Risk of Groundwater Flooding (see Appendix B) map indicates that the site is within a Groundwater Emergence Zone. Most at risk will be deep foundations, basements and underground infrastructure. The location of the emergence points cannot be accurately located. Groundwater can often emerge over a large or diffuse area but can also emerge at single points. The SFRA has therefore only been possible to identify a broad area over which emergence may occur.
- 2.13 The potential for surface water flooding is variable across the district, reflecting the changing geology, soil types and rainfall patterns. A broad scale spatial analysis has been undertaken to assess areas that may be more prone to surface water flooding. The Areas Prone to Flooding from the Land mapping (see Appendix B) identifies the risk of surface water flooding at the site between :Medium to High`. The Historic Incidents of Flooding from Sewers mapping (see Appendix B) indicates that no historic incidents of sewer flooding has occurred at the site.
- 2.14 Artificial sources of flooding include canals, reservoirs, lakes and pumping stations and none was identified in the SFRA.

3.0 BASELINE CONDITIONS

- 3.1 The development site is located on green-field land within Rustington Golf Centre.

Surface Water Drainage

- 3.2 There are no public SW surface water sewers in the vicinity of the site. The existing on-site surface water drainage mechanism for the golf centre is a combination of direct soakaways and attenuation by cellular storage structures, which also act in infiltration. It is understood that the majority of the existing surface water run-off discharges to the lake to the west of the site, which acts as an attenuation feature (and partial infiltration) prior to a discharge to the Black Ditch watercourse.

Foul Water Drainage

- 3.3 There is an existing public SW gravity foul water sewer north-east of the existing car park (i.e. within the golf centre complex but outside the red line boundary), which connects to a pumping station to the east of the site.

Underlying Geology

- 3.4 A ground investigation for the site has been carried out, consisting of six trial pits across the development site. Their approximate location is shown on the site plan (see Appendix H). The soils observed in each pit were as follows:

- € TP1 (set in bunker 500mm below general ground level): 450mm Made Ground over light brown soft clay; terminated at 1.2m depth in soft clay, becoming wetter
- € TP2: 400mm Made Ground over light brown clay; terminated at 1.5m deep in light brown crumbly clay
- € TP3: (set in bunker 500mm below general ground level): 400mm Made Ground over soft clay; at 1.15m depth, clay with fine gravel; terminated at 1.5m deep (2m below general ground level) in sandy orange clay (soft to medium)
- € TP4: 400mm Made Ground over clay; terminated at 1.2 deep in clay containing roots; the clay here was stiffer with a crumbly texture, possibly owing to the removal of moisture by the adjacent trees
- € TP5: 400mm Made Ground over friable clay containing flint gravel; terminated at 1.2m depth in light brown clay; some structureless weathered chalk in base of pit
- € TP6: 400mm Made Ground over clay; terminated at 1.3m depth in medium stiff clay

- 3.5 Infiltration test were undertaken in TP3 and TP; the results are as follows:

- € TP3: 1200mm x 600mm pit was filled with water to a depth of 700mm; the level only dropped 100mm in 2 hours, which indicates a very slow infiltration rate i.e. unsuitable for soakaways.
- € TP5: 1500mm x 600mm pit; the drop in water level was recorded at 150mm in 80minutes, which confirmed that deeper pits, taken down into the chalk, need to be considered for surface water soakaways for the development.

- 3.6 The published geological mapping on the BGS website shows two superficial deposits recorded for the site as River Terrace Deposits (undifferentiated) for the majority of the site and Raised Beach Deposits at the south-western boundary of the site with overlying bedrock described as New Pit Chalk Formation.
- 3.7 A BGS infiltration SuDS GeoReport dated 16/02/16 for the site was received (see Appendix C). This report considers the suitability of the ground conditions for the use of infiltration devices and records the following findings:
- ⊗ The eastern half of the development subsurface presents opportunities for bespoke infiltration SuDS. The western half of the development subsurface has very significant constraints associated with infiltration SuDS
 - ⊗ The south-western boundary of the site has superficial deposits that are likely to be free-draining (with a permeability range between :High~and :Very High~). Superficial permeability for the rest of the site is spatially variable but likely to permit moderate infiltration (with a permeability range between :Low~and :High~)
 - ⊗ The depth of superficial deposits is likely to be less than 3m
 - ⊗ The site, with the exception of the eastern boundary, lies in an area where superficial floodplain deposits are identified and groundwater levels are therefore likely to rise in response to high river levels
 - ⊗ The western part of the site is identified as having a very high likelihood of persistently or seasonally shallow groundwater
 - ⊗ The depth to groundwater is likely to be less than 3m below the ground surface for at least part of the year
 - ⊗ Ground instability varies across the site: increased infiltration is very unlikely to result in ground instability towards the south-western boundary adjacent to the A259. For the rest of the site, increased infiltration may result in ground instability
 - ⊗ The site does not overlie a Source Protection Zone
 - ⊗ The groundwater may be susceptible to a deterioration in quality
 - ⊗ Bedrock deposits are likely to be free-draining (with permeability described as :Very High~)
- 3.8 The EA's :Groundwater Vulnerability Zones~ map (see Appendix D) shows that the site is underlain by a :Major Aquifer Intermediate~, which indicates predominantly lower permeability layers that may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

Topography

- 3.9 A topographical survey for the site was undertaken by Corner Studio (see drawings AC1.01 and AC1.02 dated June 2015 in Appendix E). It indicates that the existing par-3 Academy Golf Course has undulating levels varying between approximately 7.3m and 4.5m AOD. Each green and tee box is elevated with undulating surrounding areas and, overall, the site falls gently from east to west/south-west.

Utilities

- 3.10 A gas main is located on the south side of the development site under the proposed service road. It is understood that the expected depth of the pipe is 1m from the surface level. It has been agreed by the design team that 600mm clearance from the crown of the main to the underside of the road foundation and 5.5m easement on both side of the pipe are required.

4.0 ASSESSMENT OF FLOOD RISK

Fluvial Flooding

- 4.1 Black Ditch, a Main River and a tributary of the River Arun, flows in a north-westerly direction past the development site at an offset to the south-west of approximately 100m.
- 4.2 The EA's website map 'Flood Map for Planning (Rivers and Seas)' (see Appendix D) indicates that the entire site lies within Flood Risk Zone 1 (Low Risk) i.e. land assessed as having a less than 1 in 1000 annual probability flooding from the Rivers and Seas (<0.1%).
- 4.3 The NPPF classifies the proposed development as a combination of 'More Vulnerable' and 'Less Vulnerable' and confirms that these are permitted in Flood Risk Zone 1.
- 4.4 The EA's website shows that the site does not lie within an area where the EA issues flood warnings or flood alerts.
- 4.5 The risk of fluvial flooding to the site is therefore low.

Tidal Flooding

- 4.6 The River Arun is tidally influenced and thus flooding from the sea affects land a significant distance away from the immediate coastline. With sea level rises, this distance will become even greater.
- 4.7 Although Rustington is a coastal town, the site is remote from the coastal boundary, being approximately 2km away to the north of the coastal perimeter at an elevated position and therefore not at direct risk of flooding from the sea. An indirect flood risk exists due to the tidal outflow of the River Arun into the English Channel - the risk of flooding from the sea via increased river levels is derived from the EA Flood Map for Rivers and the sea in (Appendix E) and identified as very low.
- 4.8 The risk of tidal flooding to the site is therefore very low.

Pluvial Flooding

- 4.9 Flooding via overland flows includes water flowing over the ground surface that has not reached a natural or artificial drainage channel and this can occur when intense rainfall exceeds the infiltration capacity of the ground or when the ground is so saturated that it cannot accept any more. Overland flows can originate either from the site or from adjacent sites and it is essential that the development does not increase the risk of flooding to other sites from overland flows.
- 4.10 The EA's website map 'Risk of Flooding from Surface Water' (see Appendix D), which is generated from data on ground levels and drainage assets, indicates that the site is at Very Low Risk i.e. a chance of surface water flooding of less than 1 in 1000 (0.1%).

- 4.11 The risk of flooding from pluvial sources to the site is therefore considered to be very low.

Flooding from Artificial Sources

- 4.12 Flood risk can result from failure of infrastructure that transmits, retains or controls the flow of water (e.g. blockage of a pipe or culvert).
- 4.13 There is no known flood risk to the site from failure of infrastructure.
- 4.14 The EA's website map 'Risk of Flooding from Reservoirs' indicates that the site is not at risk from flooding from reservoirs.
- 4.15 The risk of flooding from artificial sources to the site is therefore considered to be low.

Flooding from Sewers

- 4.16 Flooding from sewers occurs due to sudden high intensity rainfall events that exceed the designed intensity/capacity of the local network and takes place rapidly and with little warning.
- 4.17 The SFRA did not identify any specific historic instances of sewers flooding in the vicinity of the development.
- 4.18 The risk of sewer flooding can therefore be considered to be low.

Flooding from Groundwater

- 4.19 Groundwater flooding is caused by water originating from below-ground permeable strata through a natural process, usually after periods of higher than average rainfall. In particular, rising groundwater can become an issue where main watercourses adjoin aquifers. The risk of groundwater flooding is typically highly variable and heavily dependent on local conditions at any particular time.
- 4.20 The EA's website mapping confirms that there are no ground source protection zones within the development site or the immediate surrounding area.
- 4.21 There is no historic data provided to indicate that groundwater flooding has occurred at the development site.
- 4.22 In the absence of any other evidence to the contrary, the risk of groundwater flooding is considered to be low.

Mitigation Measures

- 4.23 As there are no significant risks of flooding from any sources, no flood mitigation measures are proposed.

5.0 DEVELOPMENT PROPOSALS & RECOMMENDATION

- 5.1 The proposals for the site (see drawing 16-160022-PL36A in Appendix F) consist of a mixed-use development consisting of a pub/restaurant, 60-bed hotel, trampoline centre, crèche, forest adventure kiosk, retail unit together with a main car park, service road and staff car park.

Surface Water Drainage Strategy

- 5.2 The management of surface water is considered an essential element in reducing future flood risk to both the site and its surroundings. In accordance with the NPPF, design proposals should seek to ensure that surface water run-off is managed as close to its source as possible in line with the following hierarchy of appropriate drainage techniques:

- ☞ Store rainwater for later use
- ☞ Infiltration devices
- ☞ Attenuate in open water features
- ☞ Attenuate in sealed water features (tanks)
- ☞ Discharge directly to watercourse
- ☞ Discharge directly to surface water drain
- ☞ Discharge directly to combined sewer

- 5.3 As previously noted, the existing surface of the site is entirely made up of permeable areas. The proposed development inevitably introduces impermeable areas – the total impermeable area is approximately 61% of the whole site area (i.e. 2.09 hectares out of the total 3.43 hectares). In accordance with the NPPF and SFRA, the drainage strategy should be developed to ensure that there is no increase in the surface water run-off from the site as a result of these impermeable areas.

- 5.4 The appropriate application of a SuDS scheme to a specific development is heavily dependent on the topography and geology of the site and careful consideration of the site characteristics is necessary to ensure the future sustainability of the adopted drainage system.

- 5.5 With that in mind, a SuDS-based surface water drainage strategy has been prepared that assumes the use of infiltration; ensures that no surface water flooding occurs for a 1 in 100 (+ 40 c.c.) storm event; and is made up of four areas:

- ☞ Infiltration cellular storage (1,890m²) under the main car park, draining the run-off from the roof of the bar/restaurant, the hotel, the trampoline building, two-thirds of the roof area of the retail unit and the car park
- ☞ One cellular storage area (401m²) to the south of the hotel, taking the run-off from that building
- ☞ Two infiltration cellular storage areas (318.5m² and 165m²) under the staff car park and the grassed area to the south of the retail unit, collecting and draining the run-off from the service road and one-third of the roof area of the retail unit
- ☞ Gullies and kerb drains collect the water from the service road, which will have a cross-fall

- in the direction of the kerb drain
 - € The proposed drainage system complies with the constraint associated with the gas main i.e. 600mm clearance from the crown of the gas main to the underside of the road foundation and 5.5m easement on both sides
 - € In addition, infiltration cellular storage structure to the north of the proposed nursery, draining the run-off from the nursery and adjacent hardstanding areas
- 5.6 The surface water drainage strategy (and the accompanying drainage calculations) are shown on drawings 5555-001-C-100-P4 and 5555-001-C-101-P4 in Appendix G.
- 5.7 A conservative percolation rate of 3.0×10^{-6} m/sec has been assumed for the four infiltration areas to allow initial sizing of the features - it is noted that their locations do not coincide with the positions in the (limited) percolation testing that was carried out, one of which confirming that infiltration was unsuitable. The drainage calculations demonstrate that no surface water flooding occurs for both the 1:30 year and the 1:100 year (+ 40% c.c.) storm events. The strategy will be refined during detailed design, which will include further percolation testing (in accordance with BRE Digest 365) to confirm the adequacy of the ground in the relevant areas; depth to the groundwater table; and to obtain a precise infiltration rate.
- 5.8 The soakaway devices have been provisionally positioned a minimum of 5m from buildings and outside the gas main easement strip.
- 5.9 The drainage strategy demonstrates that there is no increase in surface water flooding as a result of the increase in impermeable surfaces in the proposed development. During detailed design, measures will be put forward to ensure that the quality of groundwater is not affected.

Foul Water Drainage Strategy

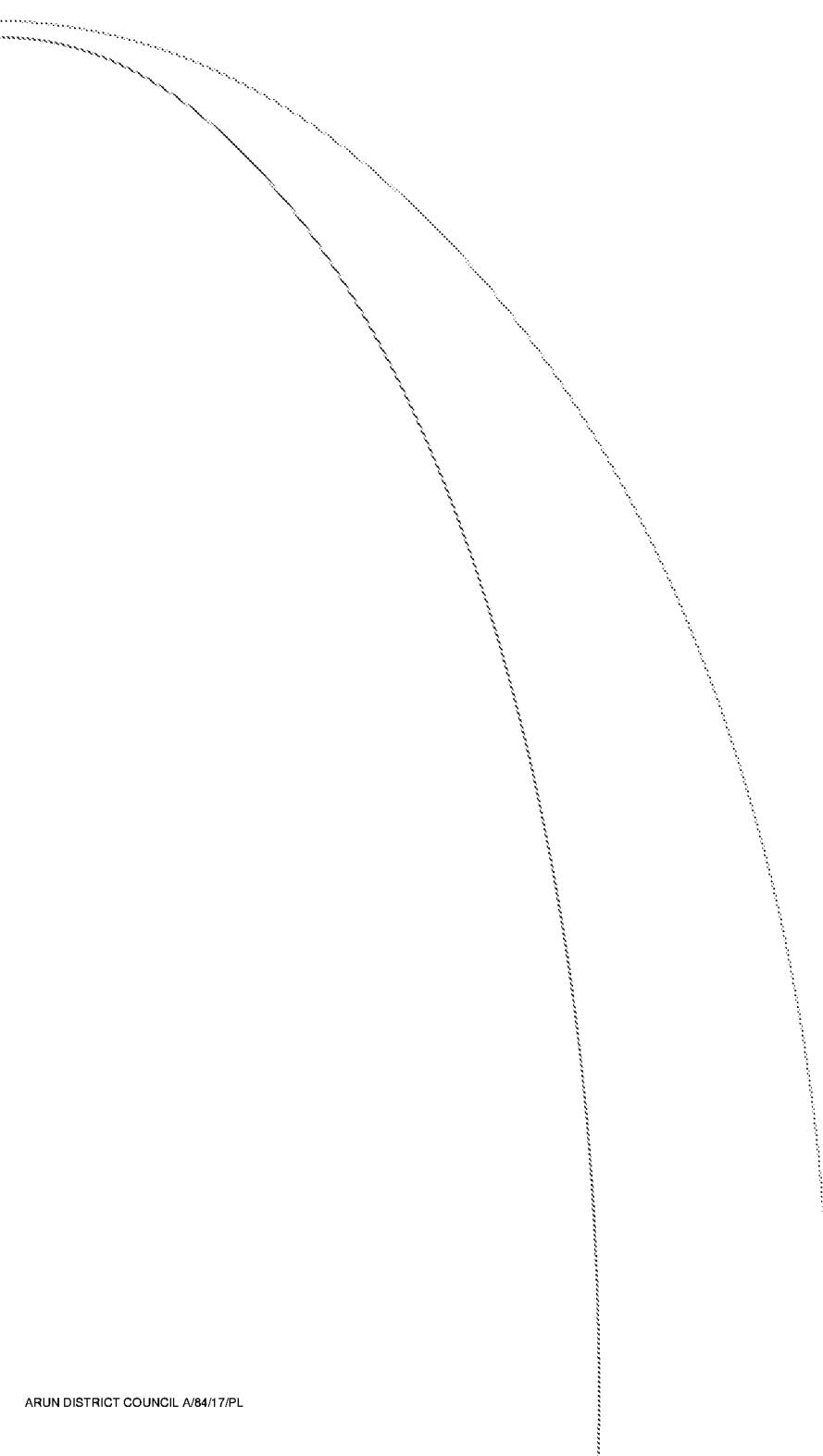
- 5.10 Foul water will connect to the existing gravity foul water sewer to the north-east of the car park, with subsequent connection to the existing pumping station. For the nursery, a new foul water connection is to be made to the existing gravity sewer to the north-east of the car park.
- 5.11 Connections to existing sewers will require agreement from SW.

6.0 CONCLUSIONS

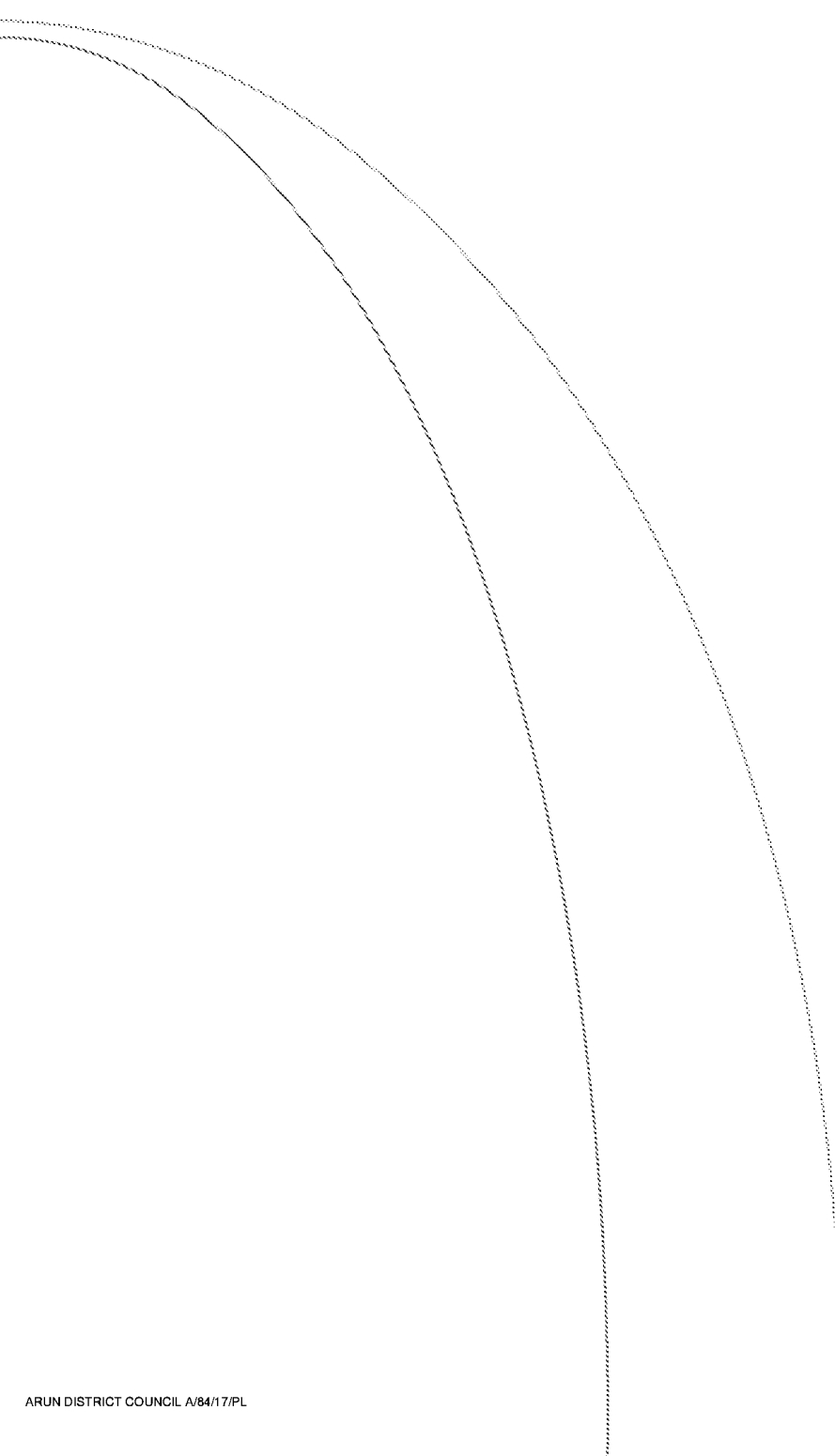
- 6.1 The EA's website mapping indicates that the entirety of the site lies within Flood Risk Zone 1 (Low Risk) i.e. land assessed as having a less than 1 in 1000 annual probability flooding from the Rivers and Seas.
- 6.2 The NPPF classifies the proposed development as a combination of 'More Vulnerable' and 'Less Vulnerable' and confirms that this is permitted in fluvial Flood Risk Zone 1.
- 6.3 The flood risk to the site from tidal, pluvial, groundwater, artificial sources and sewers is assessed as either low or zero.
- 6.4 The proposed development will result in an increase in impermeable area and a SuDS-based surface water drainage strategy has therefore been prepared that makes use of infiltration in three separate areas and devices with no run-off discharge off site.
- 6.5 Foul water drainage flows will discharge to the existing gravity foul water sewer to the north-east of the car park.
- 6.6 As a result of the SUDS measures proposed in the drainage strategy, the proposed development will not increase flood risk on or off the site and there are no residual flood risk issues (taking into account the impact of climate change) that would preclude the development.
- 6.7 This FRA is considered to comply with the planning requirements of the NPPF and the local planning policies.

Appendix A – Site Location Plan

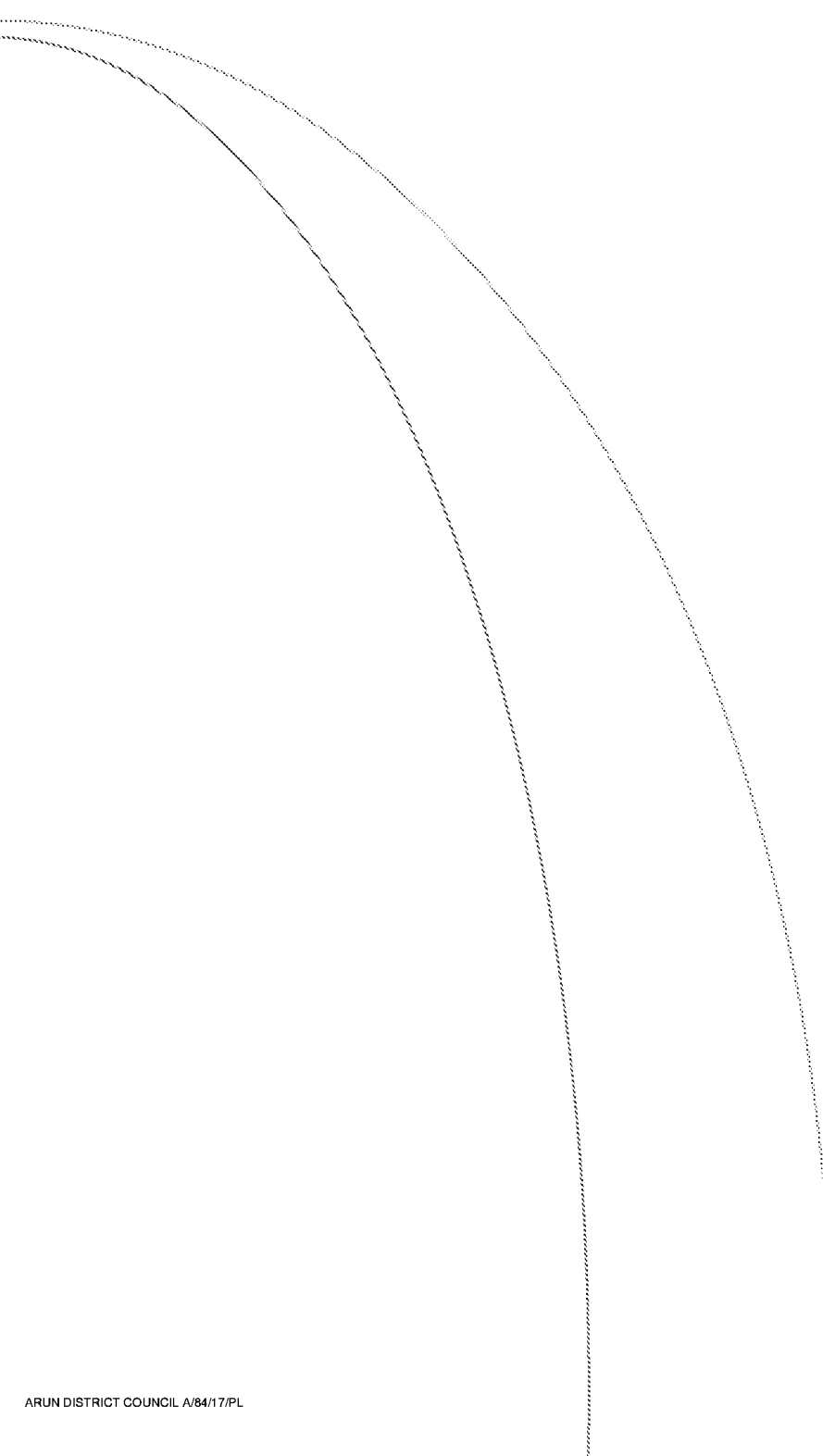
Appendix B – SFRA Evidence Maps



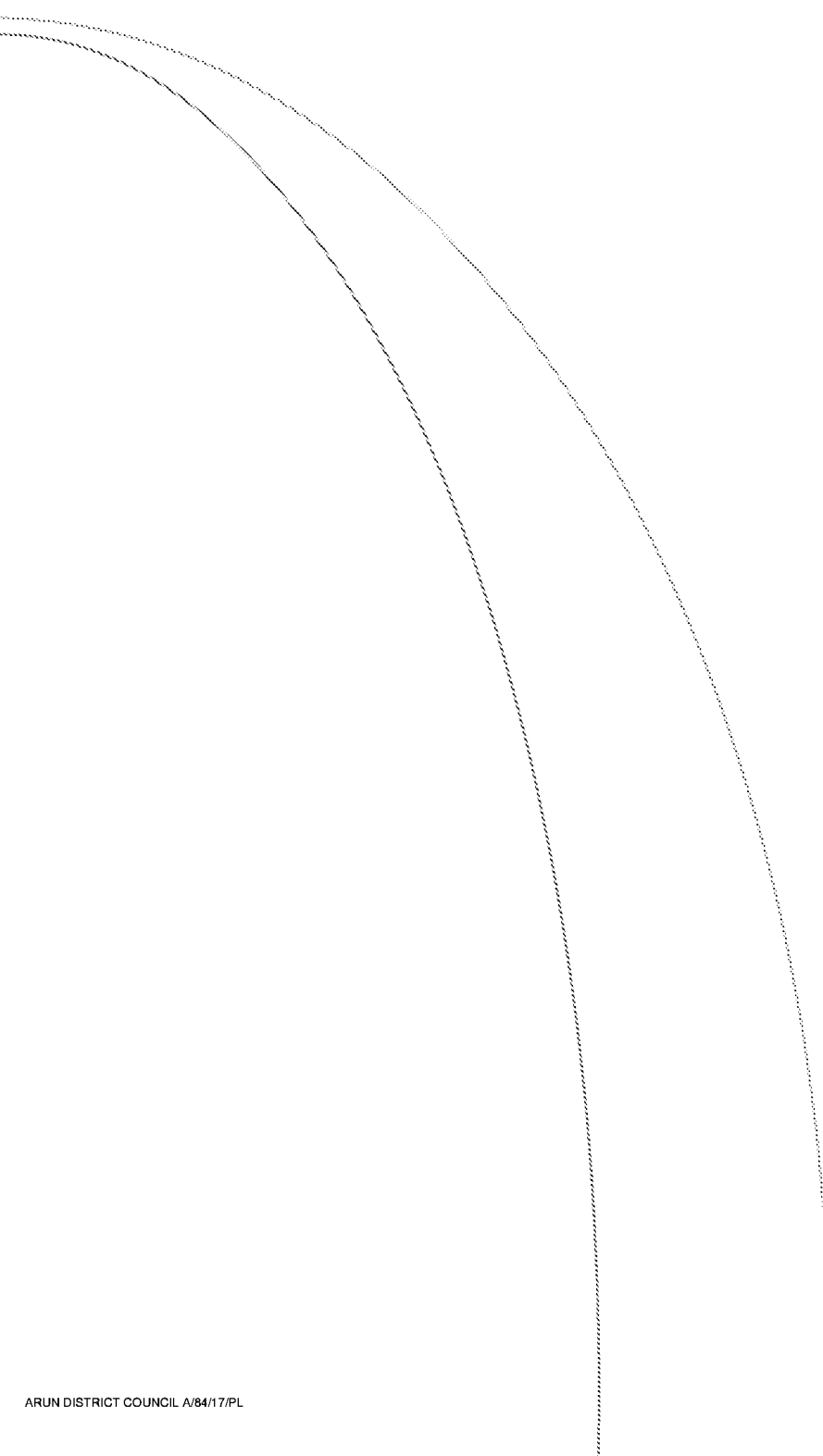
Appendix C ~ BGS Infiltration SuDS GeoReport



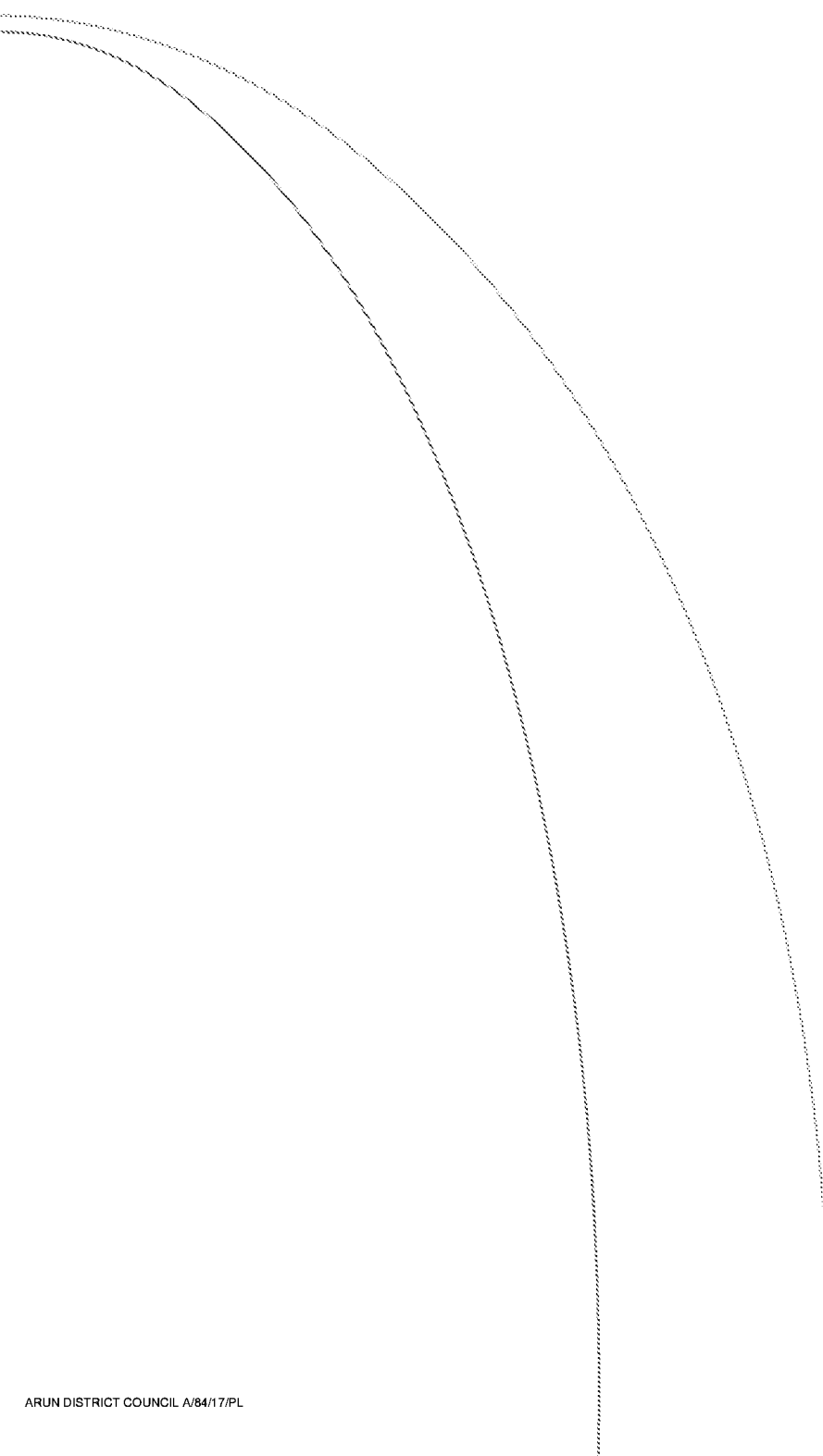
Appendix D ~ EA Flood Maps



Appendix E – Topographical Survey



Appendix F ~ Proposed Site Layout



Appendix G ~ Proposed Drainage Strategy & Micro- Drainage Calculations

Appendix H - Trial Pit Investigation