BETTS HYDRO
CONSULTING ENGINEERS

KIRKBY VALLEY GOLF CLUB
KIRKBY

FLOOD RISK ASSESSMENT AND DRAINAGE MANAGEMENT STRATEGY



For

L32 Trading Ltd
22 Pall Mall
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FEBRUARY 2021

EXECUTIVE SUMMARY

This Flood Risk Assessment and Drainage Management Strategy was commissioned by L32 Trading Ltd referred to hereafter as 'the client'. This report has been prepared to support a planning application for mixed-use development at Kirkby Valley Golf Club in Kirkby. The total site covers over 79ha, however the main development area covers a much smaller 25.545ha.

Flood Risk

The site is located within Flood Zone 1 and 2 based on the Environment Agency Flood Zone Map for Planning. The proposals are 'recreational' in nature and as such is classified as mostly 'Less Vulnerable' in Table 2: Flood Risk Vulnerability Classification, within the Planning Practice Guidance. The Planning Practice Guidance confirms that this type of land-use is appropriate for Flood Zones 1 and Flood Zone 2, providing there is no increase in flood risk elsewhere due to the proposals.

This report has reviewed all sources of flood risk both to and resulting from the proposed development site. The main development area is however at 'very low' to 'low' risk from most flood sources considered including fluvial, tidal, surface water and sewer flooding. Consultations with the Environment Agency, United Utilities and Knowsley Metropolitan Borough Council have been undertaken and have not identified any historical incidents of flooding directly to the site.

The nearest Main River is the River Alt, which flows through the site and splits the Development Area into an eastern and western parcel. The Environment Agency were able to provide in-channel top water levels for the key design events to determine the potential flood risk. In summary, based on the modelling completed by the Environment Agency and the existing ground levels onsite, the main development area remains flood free in both the fluvial undefended and defended scenarios.

The existing EA modelling data has been refined and a more detailed understanding of the potential flood risks to both the existing site and the proposed development has been gained through a detailed hydraulic modelling assessment undertaken in 2019 by Betts Hydro. This modelling shows that the western development parcel remains flood free in all the key design return period events including during the proposed modelled scenarios.

The eastern development parcel is shown to be more susceptible to inundation in the more extreme scenarios (0.1% AEP event), however the proposals in this part of the site will either be course reconfiguration or car parking and maintenance related so would be considered at low vulnerability. When the proposals in the eastern parcel are compared to the predicted low flood depths in this location the potential flood risks overall are thought to be manageable.

Surface water flood risks have also been considered and as the development proposals have the potential to increase the volumes of surface water run-off generated on the site, appropriate mitigation has been considered. The risk associated with surface water run-off will be managed and reduced as part of the proposals through implementation of mitigation proposals; including a sustainable surface water regime, appropriate levels design and permeable surfacing where feasible.

Drainage Strategy

The principle focus of this assessment is on sustainable management of surface water run-off to ensure surface water flood risk does not increase because of the proposals. Surface water management options have been assessed in accordance with the national and local policy to follow the sustainable drainage hierarchy.

Based on the ground conditions noted online infiltration is considered to offer a possible means of dealing with surface water run-off, although the upper soil strata appears to be less favourable towards an infiltration based solution onsite. Soakaway Testing has therefore been commissioned by the client, to be undertaken on the site, in key locations where infiltration methods would likely be used (proposed car parking areas).

The proposals will therefore be to manage surface water run-off generated onsite by discharging to ground via appropriately designed infiltration-based Sustainable Drainage System. The proposals are to utilise permeable surfacing where at all feasible for external hardstanding areas including parking bays, footways and patio areas. Where access roads are being proposed for adoption permeable surfacing is not typically accepted for adoption by the Lead Local Flood Authority and in these cases an alternative management regime would be required to be secured or an alternative surfacing material would need to be incorporated for these areas.

Should infiltration not provide a full or part drainage solution then the proposals will be to form a new formal connection to the River Alt, subject to formal consents and agreements from the Environment Agency's. Detailed design would be required to confirm whether a gravity system can be achieved, although given the existing levels a gravity connection is anticipated.

In accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015), the proposals will be to restrict surface water run-off to mimic a pre-development greenfield situation. The pre-development rate (QBar) for those areas of site being considered as part of this drainage assessment (2.878ha) is 10.8l/s, using the FEH Statistical Method (based on *3.752l/s/ha)*.

Restricting the rate of discharge would however generate a stormwater storage requirement onsite during the extreme storm events. It would be beneficial to implement SuDS features such as a pond or swales, near to the proposed outfall location. If designed appropriately the SuDS features such as ponds/swales can aid in the attenuation and provide added benefits in terms of water quality. In terms of design, the proposed drainage system onsite will be sized to ensure that exceedance up to and including the 1 in 100 year return period event with allowance for climate change is contained within site.

The Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

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Specialist Software

- MicroDrainage WinDES (v.14.1) – Calculation of Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.
- Flood Estimation Handbook FEH – Determination of Catchment Descriptors and depths of rainfall.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability
BGS	British Geological Survey
CC	Climate Change
CSAI	Cranfield Soil and Agrifood Institute
EA	Environment Agency
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FZ	Flood Zone
KMBC	Knowsley Metropolitan Borough Council

LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	Metres Above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
NSRI	National Soil Resources Institute
OS	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
QSE	Quick Storage Estimate
QBAR	Mean Annual Flood
SfA	Sewers For Adoption
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
UU	United Utilities

1.0 INTRODUCTION

1.1 Planning Policy Context

1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The revised National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the revised NPPF and the supporting Planning Practice Guidance (PPG) (refer to extracts in **Appendix A**).

1.1.2 A Flood Risk Assessment and Drainage Management Strategy (FRA&DMS) has been completed in accordance with the revised NPPF and the PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage management options including the implementation of Sustainable Drainage Systems (SuDS) in line with national policy.

1.1.3 The proposals are 'recreational' in nature and as such is classified as 'Less Vulnerable' in Table 2: Flood Risk Vulnerability Classification, within the Planning Practice Guidance. There will be some accommodation for visiting trainers although this is to be provided as part of the enhanced existing golf club building which previously housed managers accommodation therefore there would be no change of vulnerability here. The PPG confirms that this type of land-use is appropriate for Flood Zones 1 and Flood Zone 2, providing there is no increase in flood risk elsewhere due to the proposals.

1.2 Site Context

1.2.1 This FRA&DMS has been prepared to support a full planning application for the enhancement, re-development and improvement works to the existing Kirkby Valley Golf Club. The proposals include a new club house, driving range and multi-function sports centre with associated car parking. In terms of the other proposed works, this includes alterations to the existing clubhouse and managers accommodation, a new adventure golf course, enhancements to two of the existing 18-hole golf course tees (no's 1 and 18) along with a band new academy 9-hole golf course.

1.3 Consultation

1.3.1 The preparation of this report has been undertaken in consultations with the Environment Agency (EA), United Utilities (UU) and Knowsley Metropolitan Borough Council (KMBC). Consultation responses can be seen in **Appendix B, C** and **D** respectively. The NPPF advises that KMBC as the Local Planning Authority (LPA) should consult with the EA who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.

2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The site is located to the west of Kirkby. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 339329, N: 397949 and the nearest postcode is L10 8LQ. The total site covers over 79ha, although the development area covers a smaller 25.545ha and is edged in red in **Figure 1** (see location plan in **Appendix E**). The overall site is bounded to the north by the Wigan to Liverpool Railway and to the east by the M57, Ingoe Lane and some undeveloped land. To the south of the site is the A506 and a residential estate beyond. To the west the site is bounded by Aintree Lane with undeveloped land beyond.



Figure 1: Aerial Photograph of site (Google Maps, 2021)

2.2 Existing and Historical Land Use

2.2.1 The wider site mostly comprises of the Kirkby Valley 18-hole golf course, which includes existing tees and greens, access tracks and pedestrian access, land drainage ditches and the existing clubhouse which is located to the east of the River Alt. As illustrated in **Figure 1**, the River Alt flows through the wider site, however the development proposals being considered as part of this assessment do not include the entire site and will focus on a much smaller area referred to as the Development Area within this assessment.

2.2.2 The development area is split into two parcels by the River Alt and to the west is mostly unused undeveloped green land considered to be 100% permeable. To the east consists of the existing clubhouse, managers accommodation, shop and car park, the

rest of this parcel is green or permeably surfaced. There are currently 3no. bridge crossings over the River Alt, within the extents of the wiser site, as illustrated in **Figure 1**. No other historical uses onsite have been determined as part of this assessment.

2.3 Topography

2.3.1 Topographically the site varies due to the existing land use, the levels within the wider site gently slope towards the River Alt directly or to the existing land drainage features located within the golf course which ultimately discharge into the River Alt. **Figure 1** illustrates the general falls across the wider site.

2.3.2 Ground levels at the western and eastern boundaries are at approximately 16mAOD, falling to approximately 10mAOD towards the banks of the River Alt. The existing car park and club house are at a level of around 13mAOD. The lowest area of the site is the land to the north of the site adjacent to the River Alt at 11mAOD. A full topographical survey has been provided and is included in **Appendix F**; an extract is shown in **Figure 2**.



Figure 2: Contour Plan based on the Detailed Topographic Survey (L32 Trading, 2021)

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This assessment is to support a mixed-use planning application at Kirkby Valley Golf Club for various works as outlined in the masterplan, seen in **Figure 3**. The main aspects can be divided into three principle areas; new development frontage along the A506 (Valley Road), new landscaping/ golf tee works and enhancement of the former clubhouse building. The focus of these proposals is to look at improving and enhancing the existing facilities and adding new golf related facilities. The proposals do not include any long-term residential type of development but do include temporary overnight accommodation for visiting trainers associated with the golf club.



Figure 3: Proposed Planning Layout (RGP, 2021)

3.1.2 The new hardstanding and buildings being proposed as part of the main development at the site will include car parking, a new golf clubhouse/pavilion (to replace the existing clubhouse) and a new driving range with associated building. A new indoor multi-functional sports centre is also proposed, with separate outdoor sports pitches. A new greenskeepers maintenance compound is also shown in the western development parcel. A new Academy 9-hole golf course and new Bowling Green are also proposed, along with an adventure golf facility, all of which will be located within the western development parcel as illustrated in the full masterplan (**Appendix G**).

3.1.3 Other proposals include alterations to two of the existing golf tees (no.1 and no.18) which are nearest to the main development, this is to ensure the course can more flow more coherently once the new facilities are constructed. A new bridge crossing over the River Alt is also proposed and this will allow users to access the starting and finish tees in relating to the clubhouse with more ease. Two new lakes are also proposed for irrigation purposes and to assist with land and golf course drainage.

3.1.4 Finally, in the development parcel to the east of the River Alt, the existing clubhouse will remain and converted into a golf training academy building and visiting academy trainer's accommodation. This existing building footprint will remain the same as the current building, but internal alterations will take place to include classroom space, cafeteria and overnight accommodation for golf professionals / teachers / trainers (existing access and car park retained / unchanged).

3.1.5 As the River Alt is designated as a main river by the EA, there will be a requirement to provide an 8m offset from the top of bank, into each development parcel to allow for any future maintenance requirements by the Environment Agency. The developer has confirmed that this 8m offset will be maintained, the nearest building proposed will be the new clubhouse which is located over 10m from the top of bank. The existing club house car park within the eastern development parcel, is within 8m of the top of bank, however the proposals are to only resurface this car park where it is located close to the watercourse and the extents will not encroach closer than they currently exist.

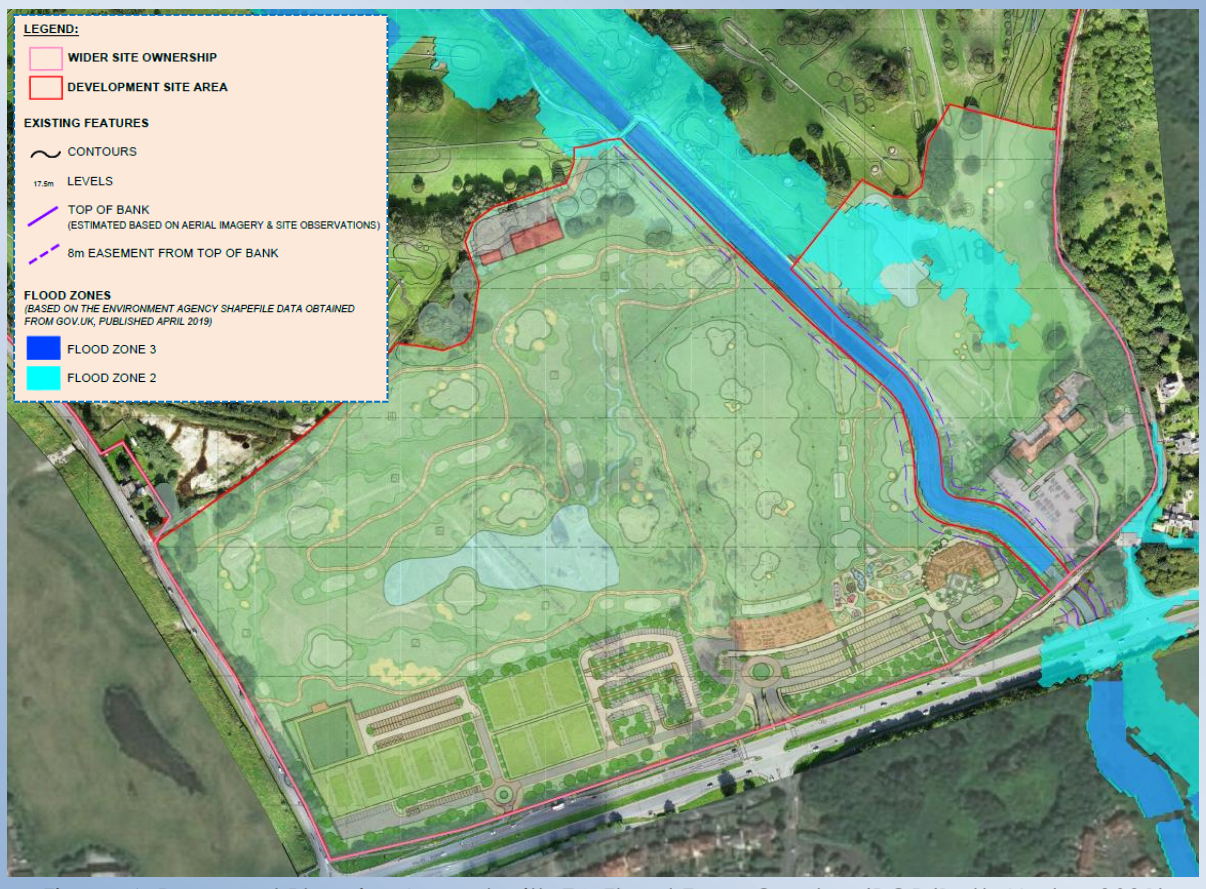


Figure 4: Proposed Planning Layout with EA Flood Zone Overlay (RGP/Betts Hydro, 2021)

3.1.6 Review of the Flood Zone Maps indicates that most of the proposed development will be located within Flood Zone 1 and outside of the predicted Flood Zone 2 and Flood Zone 3 extents. The Flood Zones extents are mostly contained within the main river channel, although Flood Zone 2 is shown to encroach out of channel and into the eastern development parcel (**Figure 4**), the development proposed within this area is golf course improvements to the tee at Hole 18 and a new lake, which is considered as water compatible development. Any reprofiling associated with the lake will be minimised where practical, although levels changing within Flood Zone 2 does not require the provision of compensatory flood storage.

3.1.7 The new proposed bridge crossing will technically be within an area shown to be within Flood Zone 2 and 3 however the structure will be designed to standard guidance and practice to minimise the potential for floodplain displacement. It is understood that open deck structure will be proposed with foundations on either side of the River Alt that span safely outside of the predicted floodplain extents. Some initial illustrations have been prepared by others and a snippet of these has been shown in **Figure 5**.

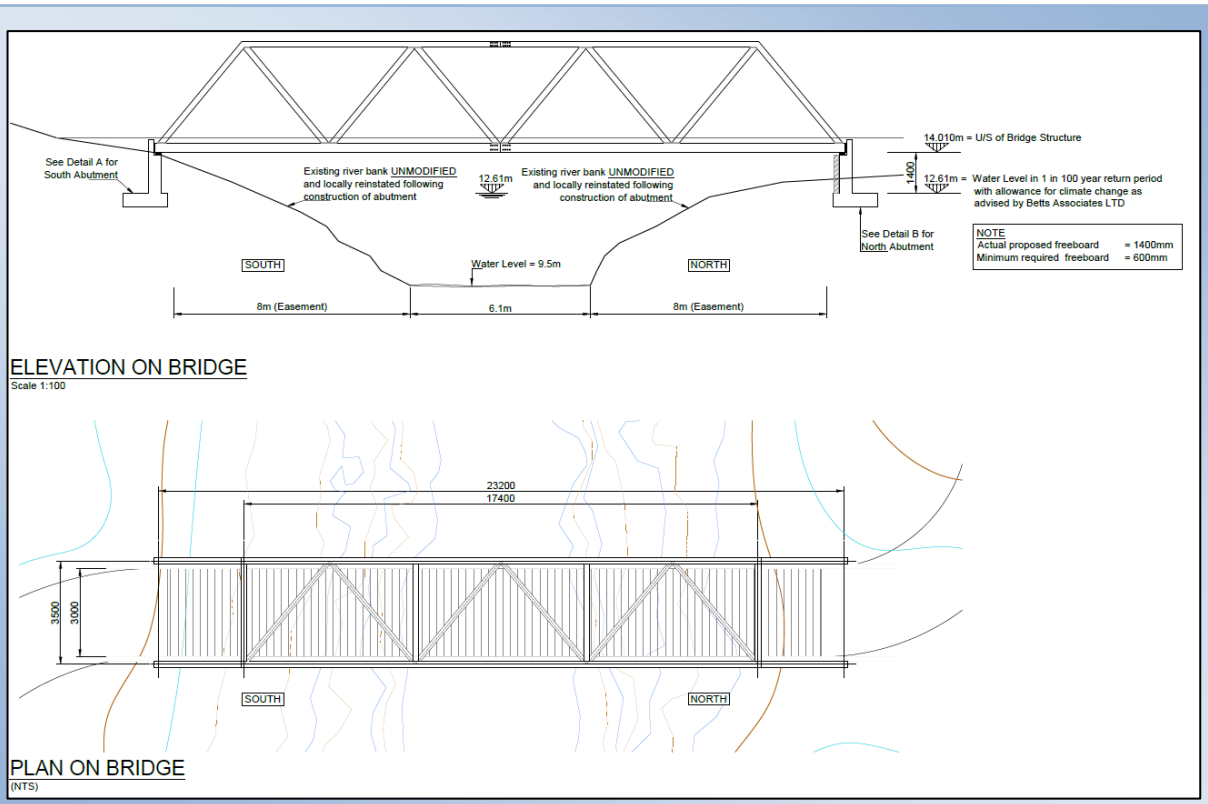


Figure 5: Initial Bridge Design Concept Plans (International Design Group 2021)

3.1.8 Formal design work has not been completed yet, but the bridge will be designed to have a soffit level set above the predicted in-channel top water level, at its location, in the design event. The design event will be the 1 in 100yr plus climate change event, given its fluvial nature and a freeboard of 600mm is to be added to safeguard for the residual extreme scenarios. The top water level in channel, during the design event is anticipated to be 12.611mAOD, based on the hydraulic modelling completed and as a minimum the soffit level will need to be set at level of 13.211mAOD.

3.1.9 Pre-application discussions with the Environment Agency have been initiated to discuss the development proposals that are in proximity of the Main River network including the new bridge crossing. However due to unforeseen circumstances, the Environment Agency are unable to assist with pre-application discussions currently. Further discussion with the EA will need to be carried out as part of the planning process as they will be statutory consultees given the location of the Main River network in relation to the development proposals.

3.1.10 Due to the nature of the proposals, the areas of hardstanding onsite will increase because of development. Hardstanding includes car parking, external footways and access, along with new building roof areas. To minimise the potential increase in surface water run-off generated by this increase, the proposals are to utilise permeable surfacing and Sustainable Drainage Systems where at all possible across the site (including the greenskeepers maintenance compound). Where discharge to ground is not practical a formal surface water management regime will be put in place to ensure no increased flood risk will result from the new development. There will be separate golf course/tee drainage systems implemented to deal with the proposed golf course alterations, landscaping and tee areas.

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency and from the Gov.uk website. An extract of the EA's Flood Zone Map for Planning is shown in **Figure 6**, which illustrates that the wider site is located within Flood Zones 1, 2 and 3. The proposed Development Area is however located mainly within Flood Zone 1, a small part of the eastern parcel is located within Flood Zone 2, although as discussed the proposals within this Flood Zone 2 area will consist of water compatible development only (landscaping and an irrigation lake).

4.1.2 Flood Zone 1 is an area considered to be at little or no flood risk from fluvial or tidal sources. Flood Zone 2 is an area at fluvial or tidal risk of flooding in the 1 in 1000yr return period (0.1% Annual Exceedance Probability) event. Finally, Flood Zone 3 is an area at fluvial risk in the 1 in 100yr return period (1% AEP) event and/or tidal risk the 1 in 200yr return period (0.5% AEP) event.

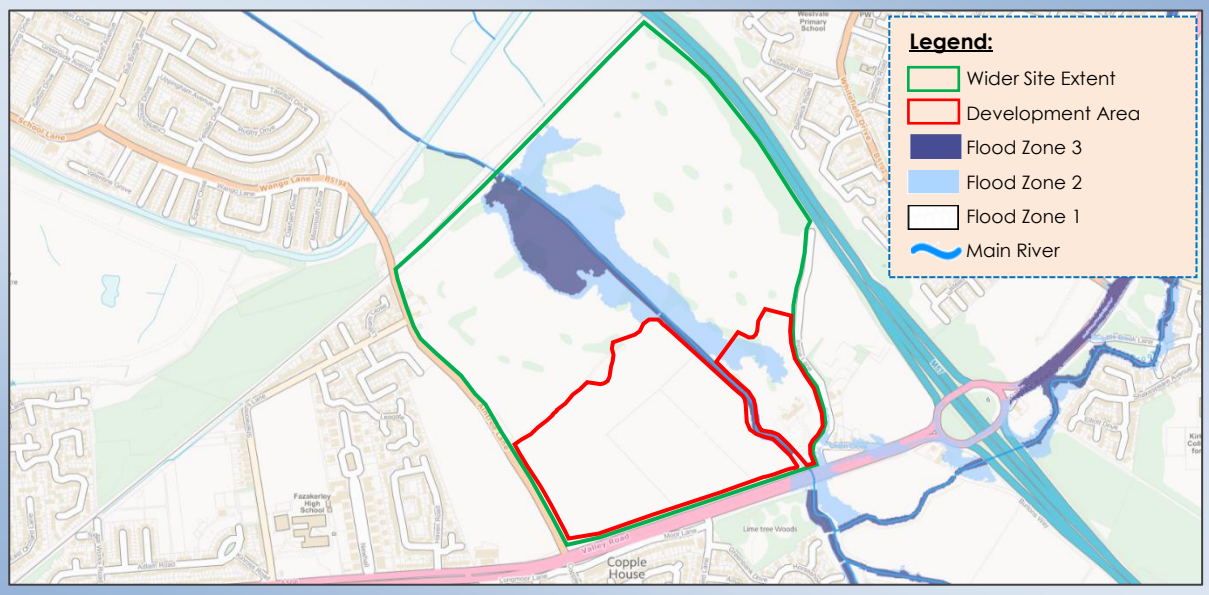


Figure 6: Fluvial/Tidal Flood Zone Map for Planning Extract (GOV.UK 2021)

4.1.3 The nearest Main River to the site is the River Alt, which flows through the wider site and divides the Development Area into an eastern and western parcel. The River Alt flows in a northerly direction from the south via an existing stone bridge crossing under Valley Road. A second bridge crossing is present within the site extents, this is a brick arch culvert and was historically used for vehicles to cross the river and access the development area to the west of the river (see photographs in **Appendix H**).

4.1.4 The River Alt is then culverted in two locations within the wider site for crossings and on the northern boundary directly under the neighbouring railway which is raised relative to the site level. Upstream of the development area (to the south) two other Main Rivers, known as Kirkby Brook and Knowsley Brook both outfall into the River Alt.

4.1.5 The online mapping shows that there are Ordinary Watercourses located in proximity of the development site. Furthermore, there are existing onsite land drainage ditches

present to drain the existing golf course. Due to the scale and nature of these features, the potential flood risks associated would be minimal. Given the sites location and nearby Main River, the primary flood risks to the development are understood to relate to fluvial flood sources; specifically, the River Alt and its tributaries.

Flood Modelling Data Review

4.1.6 Consultations with the EA have been undertaken to determine the potential flood risks associated with the Main River network. We have requested the EA's flood modelling to review against the onsite ground levels to determine whether any specific mitigation measures will need to be implemented to safeguard the proposed buildings for their design lives in the extreme and/or residual return period events.

4.1.7 The Environment Agency have provided the model outputs for both undefended and defended fluvial scenarios based on the Upper Alt Study from 2013 (full details included within **Appendix B**). **Figure 7** indicates the locations of the in-channel nodes and the peak flood levels at the most relevant node locations are shown in **Table 1**. The Environment Agency have also provided model outputs for all the events noted in **Table 1**, these are appended, and the key scenarios discussed subsequently.

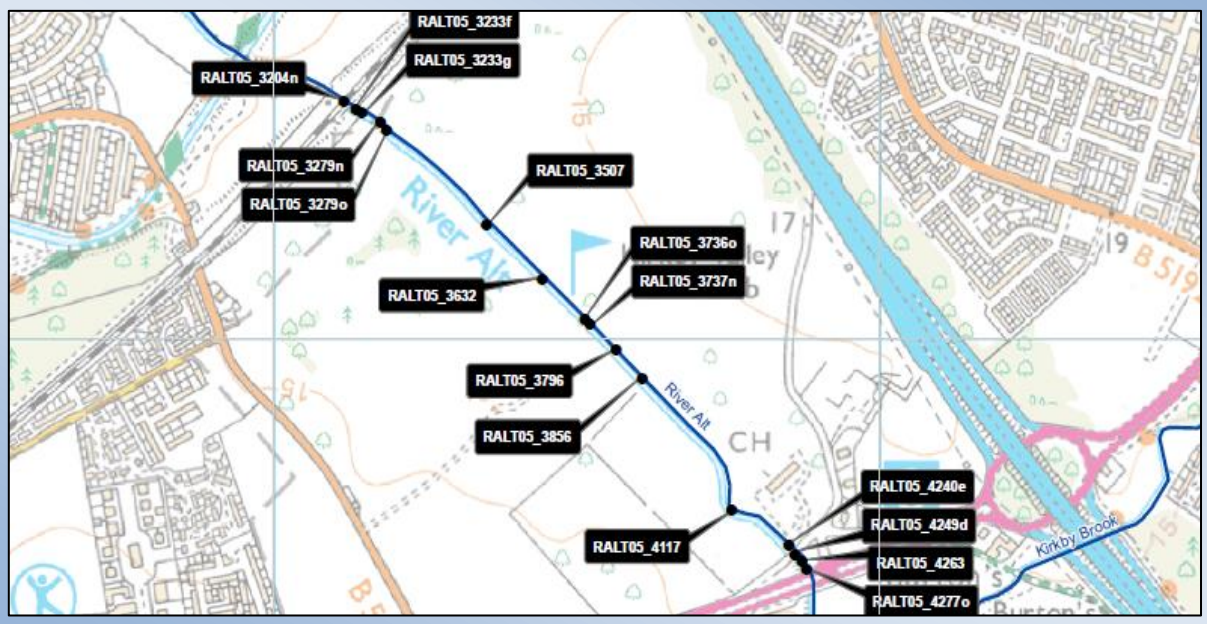


Figure 7: Modelled In-Channel Node Locations in the River Irwell (EA, 2019)

MODELLED NODE LOCATION REF.	TOP WATER LEVEL IN THE KEY RETURN PERIOD EVENTS (mAOD)					
	Undefended			Defended		
	1 in 100yr	1 in 100yr + 20%CC	1 in 1000yr	1 in 100yr	1 in 100yr + 20%CC	1 in 1000yr
RALT05_4249d	12.22	12.53	12.94	12.22	12.53	12.94
RALT05_4240e	12.20	12.49	12.86	12.20	12.49	12.86
RALT05_4117	12.08	12.38	12.76	12.08	12.38	12.76
RALT05_3856	11.93	12.53	12.61	11.93	12.53	12.61

Table 1: Modelled In-Channel Top Water Levels for the River Alt (EA, 2019)

4.1.8 Review of the site topographic survey has been carried out and this confirms that the ground levels in the western and eastern development parcels generally range from 16mAOD at their highest and fall towards the River Alt, which at its lowest along the top of bank is at 10mAOD. In terms of the main Development Area, the new proposals will take place to the west of the River Alt where the existing ground levels generally range from 16mAOD to 15.5mAOD.

4.1.9 Where the proposed development is located the ground is approximately 2.97m raised above the top water levels in the 1 in 100yr plus 20% return period event in both the defended and undefended scenarios at node location RALT05_4249d (**Table 1**). The 1 in 1000yr return period event is also shown to impact the wider development area but not near the proposed buildings or western development parcel itself. The proposed buildings in the western development parcel are generally around 2.56m above the Top Water Level's (TWL) in the 1 in 1000yr plus return period event in both the defended and undefended scenarios (at the nearest node location RALT05_4249d). The proposed development would therefore remain flood free in the key design events.

4.1.10 The data provided by the EA only includes an increase for 20% Climate Change in the 1 in 100yr return period event. The current level of climate change that should be considered for Flood Zone 2 has increase to 30% as outlined within the Greater Manchester, Merseyside & Cheshire, Flood Risk Assessments: Climate Change Allowances guidance document that is provided by the EA.

4.1.11 In summary, based on the modelling completed by the EA and the existing ground levels onsite, the development area remains flood free in both the fluvial undefended and defended scenarios for the 1 in 100yr and 1 in 1000yr return period events, based on the in-channel top water levels. The wider site extents are however at risk from flooding in the low-lying areas located directly adjacent to the railway embankment to the north of site which is located outside of the Development Area. This assessment is based on the current available EA data and additional hydraulic modelling has been undertaken to consider the up-to-date climate change factors, residual risks from blockages and the potential implications of new bridge crossings over the River Alt.

Hydraulic Modelling Summary

4.1.12 A Hydraulic Modelling exercise has therefore been undertaken by Betts Hydro which considers the River Alt where it flows adjacent to the development proposals. A separate report has been produced which details the full methodology and all model outputs (ref: HYD444_KIRKBY_VALLEY_HA_DRAFT_CON_02). The full assessment has been appended to this report for reference (**Appendix I**). Betts Hydro obtained the EA ISIS-TUFLOW model of the River Alt, produced in 2013 by JBA, which covered a reach of the upper River Alt from Huyton to the railway line embankment just north of Kirkby Valley Golf Course. The model has been run for the 1% AEP, 1% AEP + 35% CC and 0.1% AEP fluvial events for the existing scenarios.

4.1.13 The model has also been used to assess the development proposals which for this planning application involve the addition of a new bridge crossing. There are other development proposals within the wider Golf Course extents that are being considered as part of a separate planning application. These reprofiling works were also considered within the proposed model scenarios but will not be assessed within this

report as it will not be used to support those separate proposals; a summary document will be produced.

4.1.14 During the existing model runs the flood extent correlates with that of the published flood map for the 1% AEP event with flooding concentrated to the west bank of the river but outside of the main development areas. When climate change is considered, predicted extents of flooding mainly occurs to the north of proposed development areas, although some flooding into the eastern development parcel (where mostly landscaping and the irrigation lake will be constructed). The potential flood depths within the eastern development parcel would be from 0.1m to 0.4m based on the model outputs (refer to **Appendix I**).

4.1.15 The 0.1% AEP event modelled flood extent is however different to the map outputs on the published Flood Map for Planning. The flood extents are predicted to extend further south (see **Figure 8**), into the eastern development parcel where the existing clubhouse (for conversion) and car parking areas are located. The potential flood depths to this existing building and car park range from 0.01m to 0.6m, with greater depths predicted on the green areas (up to approximately 0.8m). The western development parcel however remains flood free as illustrated below.

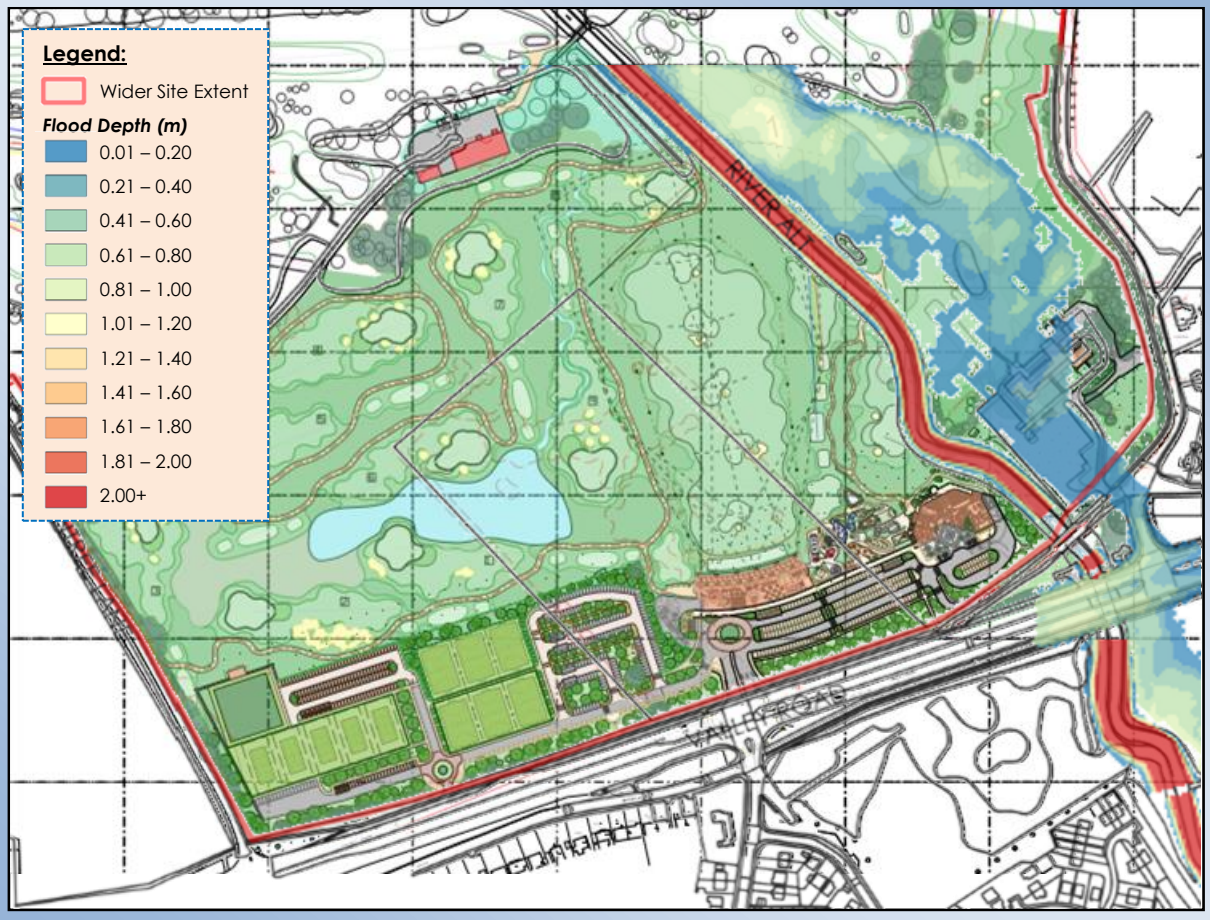


Figure 8: Existing Flood Depth overlay Plan for the 0.1% AEP event (Betts Hydro, 2021)

4.1.16 The Hydraulic Modelling Exercise also considered the proposed scenarios, including the new bridge crossing to link the western and eastern parcels. The proposed bridge was

added at the location shown on the planning layout. The soffit of the bridge was based on the minimum required level of 600mm above the in-channel top water level at that location in the 1 in 100 year plus 35% climate change return period event. As this design level (13.211mAOD) was below the existing top of bank level at this location, a level of 13.5mAOD was chosen to be used as the Soffit level in the simulations.

4.1.17 The bridge was represented in the model using an arch bridge unit which was clear span, two new cross sections were interpolated either side of the bridge and a spill unit was added within the 1d domain to represent the functioning structure as there was little risk of overtopping given the levels involved. In these proposed bridge crossing scenarios, the predicted extents of flooding in the 1% AEP event and the 1% AEP plus 35%CC event were like that of the existing predictions. However, during the 0.1% AEP event the additional of the bridge crossing is shown to increase the potential flood extents beyond that shown in the existing scenario (overlay in **Figure 8**).

4.1.18 There is still no out of channel flooding predicted to the main development areas to the west of the River Alt, however the extent of flooding in the eastern parcel is seen to be more extensive, almost covering the existing car parking areas and former clubhouse/managers accommodation building. The predicted flood depths remain low and range from 0.01m to 0.2m. To summarise, the existing EA modelling data has been refined and a more detailed understanding of the potential flood risks to both the existing site and the proposals (following the introduction of the new additional bridge crossing) has been provided.

4.1.19 Although the eastern development parcel is shown to be more susceptible to inundation in the more extreme scenarios (0.1% AEP event) the proposals in this part of the site will either be landscaping, or reconfiguration related. The development proposals in this eastern parcel will be mostly classified as less vulnerable, although the existing managers accommodation will be re-confined to provide trainer/residents overnight accommodation associated with the new Academy use for the building. When the overall proposals are compared to the predicted low flood depths in this location the risks overall are thought to be appropriate.

4.1.20 The more detailed hydraulic modelling has shown that the western development parcel is not at flood risk in the existing or the proposed scenarios and it is this development parcel that will encompass most of the proposed development and associated buildings.

Safe Access and Egress

4.1.21 The proposed access to the new development on the western part of the site will be via the A506 (Valley Road), to the south, which is shown to be located within Flood Zone 1 at the points of access. Safe access and egress will therefore be maintained. Inundation of Valley Road is shown to occur in the extreme scenarios that have been modelled however the potential depth of flooding here is relatively minor (up to 0.6m) and this is considered acceptable given that the site can be closed for operation during a potential extreme flood event.

4.1.22 The access for the former clubhouse/proposed academy and car park will continue to be via Ingoe Lane, which is shown to be in Flood Zones 1 and 2 on the Flood Zone

Mapping. The hydraulic modelling work undertaken shows that this section of Ingoe Lane is susceptible to potential flood depths of between 0.01m and 0.4m in the 1 in 1000yr return period event (which delineates the extents of Flood Zone 2). This flood depth is appropriate for the nature of use in this case.

Flood Alerts & Warnings

4.1.23 The Environment Agency provides a flood warning and alert service in those areas that are at medium or high risk of flooding from rivers or the sea. Flood Alerts are provided to geographical areas where it is possible for flooding to occur from rivers sea. Flood Warnings are provided to geographical areas where flooding from rivers or the sea is expected to occur.

4.1.24 A Flood Alert is issued to warn people of the possibility of flooding and encourage them to be alert stay vigilant and make early / low impact preparations for flooding. The purpose of Flood Warnings is to alert people that flooding is expected, and they should take action to protect themselves and their property. Flood Alerts are issued earlier than Warnings to provide advance notice of the possibility of flooding. Flood Warnings are issued when flooding is expected to occur, Severe Flood Warnings are issued to similar areas when there is a danger to life or widespread disruption is expected.

4.1.25 The areas within the wider golf club are shown on the mapping to be located within an Environment Agency Flood Alert Area (as illustrated in **Figure 9**). The EA will provide alerts for those who sign up to the service when the downstream catchment or river levels are showing signs of capacity. The receipt of information and response to issued flooding warnings is an essential element in preparing for flooding.

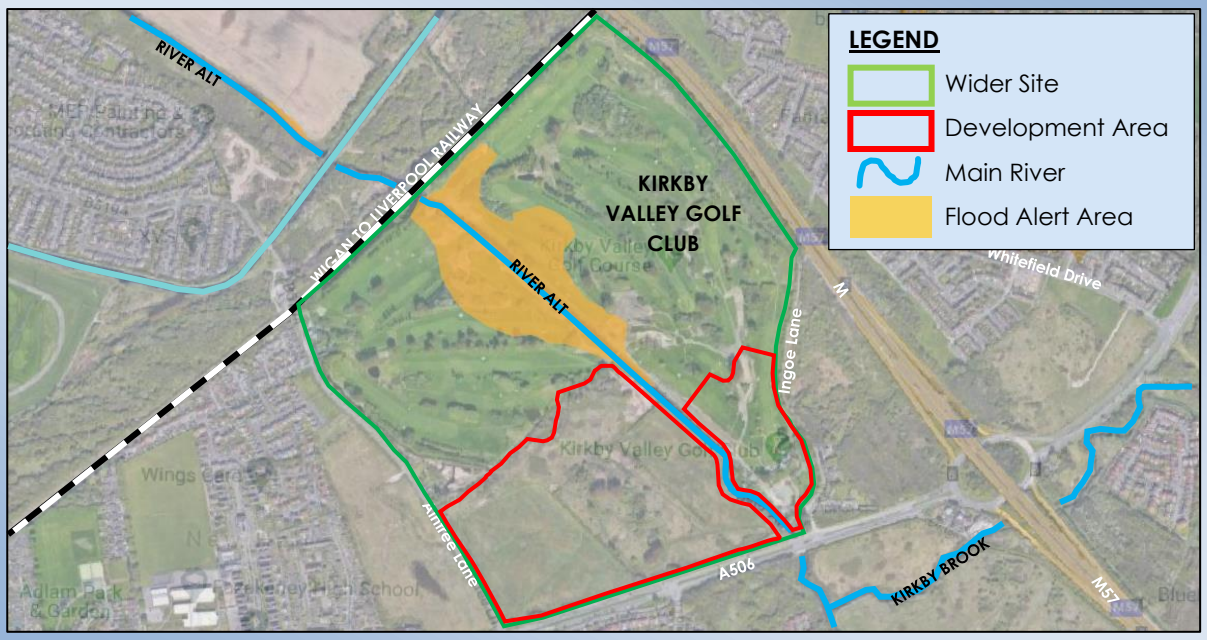


Figure 9: Flood Alert Extents (Environment Agency, 2021)

4.1.26 Although the main development area is not shown to be covered by the Flood Alert, because it is not predicted to flood in the key events reviewed, it would still be recommended that the business management sign up to this flood alert service to provide them with the best information prior to a future flood event.

4.1.27 Floodline is a 24hr service which provides constant coverage to the signee and will inform the business management team(s) of any possible upcoming flood event, by phone, email, or text. Further information can be obtained from *https://www.gov.uk/sign-up-for-flood-warnings*. Those that sign up to the floodline service can generally expect to see the following advice provided, depending on the nature and severity of flood risk anticipated. When each level of alert/warning is issued, there are a range of procedures or actions that are advised to be taken by the business to ensure they are prepared for the upcoming level of event.



FLOOD ALERT: FLOODING IS POSSIBLE
BE PREPARED

Issued when rivers are running full and further rainfall is expected. The alert is issued to advise the public, the emergency services and civil authorities of the increasing chance of flooding, so that they can take appropriate preparatory action.

Time of Issue: Two hours to two days ahead of anticipated flooding

Advised Actions:

- Monitor local news and weather forecasts.
- Be aware of water levels near you
- Be prepared to act on the business flood plan
- Call Floodline for up to date information



FLOOD WARNING: FLOODING IS EXPECTED.
IMMEDIATE ACTION REQUIRED.

Issued when flooding of homes and businesses is expected. Property owners, the public at risk, the emergency services and the civil authority should act to protect life and property.

Time of Issue: Half an hour to one day in advance of flooding

Advised Actions:

- Turn off gas, electricity and water supplies
- Move stock and valuables to safe place
- Be prepared to evacuate customers and staff if safe
- Act on your business flood plan/evacuation plan



SEVERE FLOOD WARNING: SEVERE FLOODING.
DANGER TO LIFE.

Issued when severe flooding is expected and there is extreme danger to life and property. This could relate either to extreme water depths or velocities, or when 100 or more properties are expected to be flooded in a particular flood warning area.

Time of Issue: When flooding poses a significant risk to life.

Advised Actions:

- Monitor social media and local news
- Find refuge in second floor areas
- Avoid electricity sources
- If in danger call 999 immediately
- Listen to emergency services
- Act on your business flood plan

4.1.28 During a large-scale emergency, telecommunications are likely to be disrupted, and telephoning may not therefore be an option. The mobile network may also be closed to give precedence to emergency services. Television, radio, and social media are alternative sources for flood announcements. Every business within proximity of predicted flood extents should have emergency kits available for their management/staff to utilise in the event of a flood impacting the site with little warning and a Business Flood Plan for action on during such a flood event.

Business Flood Plan

4.1.29 Personal perception and preparedness are key factors in reducing risk and in addition to adequate Flood Alerts/Warnings, individual premises should also look to produce a specific Business Flood Plan to act on in an emergency. It may be that a single flood plan is prepared for the entire Golf Club or that individual elements prepare their own depending on the management of the business. There are various templates available online for each premises to create their individual business flood plans.

4.1.30 A Flood Plan ensures that when flood alerts are issued, the management/staff know what actions and procedures to take in what order of importance. It should note key contact information, locations of incoming utilities/off-switches, information on any temporary flood resilience measures to be implemented and identify key items to be included in the Emergency Kit. The key purpose of a Flood Plan is to ensure the staff/management are well informed and know how to prepare the premises for a potential upcoming flood event and how to advise patrons of the potential risks/closure of the premises.

4.2 Tidal Flood Risk

4.2.1 The coastline is located approximately 8km east of the site and the Mersey Estuary is located 7km to the south-west of site. Due to the distance from these tidal sources, the associated flood risk is 'very low'. This is supported by the long-term government flood risk mapping which shows the site is mostly at low risk from tidal sources.

4.3 Flood Risk Vulnerability Classification and Flood Zone Compatibility

4.3.1 The proposals are mixed-use in nature and mostly include 'less vulnerable' type development as referenced in Table 2: Flood Risk Vulnerability Classification within the PPG. There will be some overnight residential development for trainers to utilise, although these will take place in the existing building which already houses residential managers accommodation, so there is no change in classification for that element. Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the PPG confirms that this type of land-use is appropriate for Flood Zone 1 and Flood Zone 2, providing there is no increase in flood risk elsewhere due to the proposals.

4.4 Surface Water Flood Risk

4.4.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead. The risk associated with surface water run-off is indicated by the long-term

flood mapping (extract shown in **Figure 10**). The wider site is at varied flood risk from surface water. Those areas at highest flood risk correspond with the existing watercourse route through the site and low-lying parts of the golf course which are more susceptible to ponding in prolonged extreme, rainfall events.

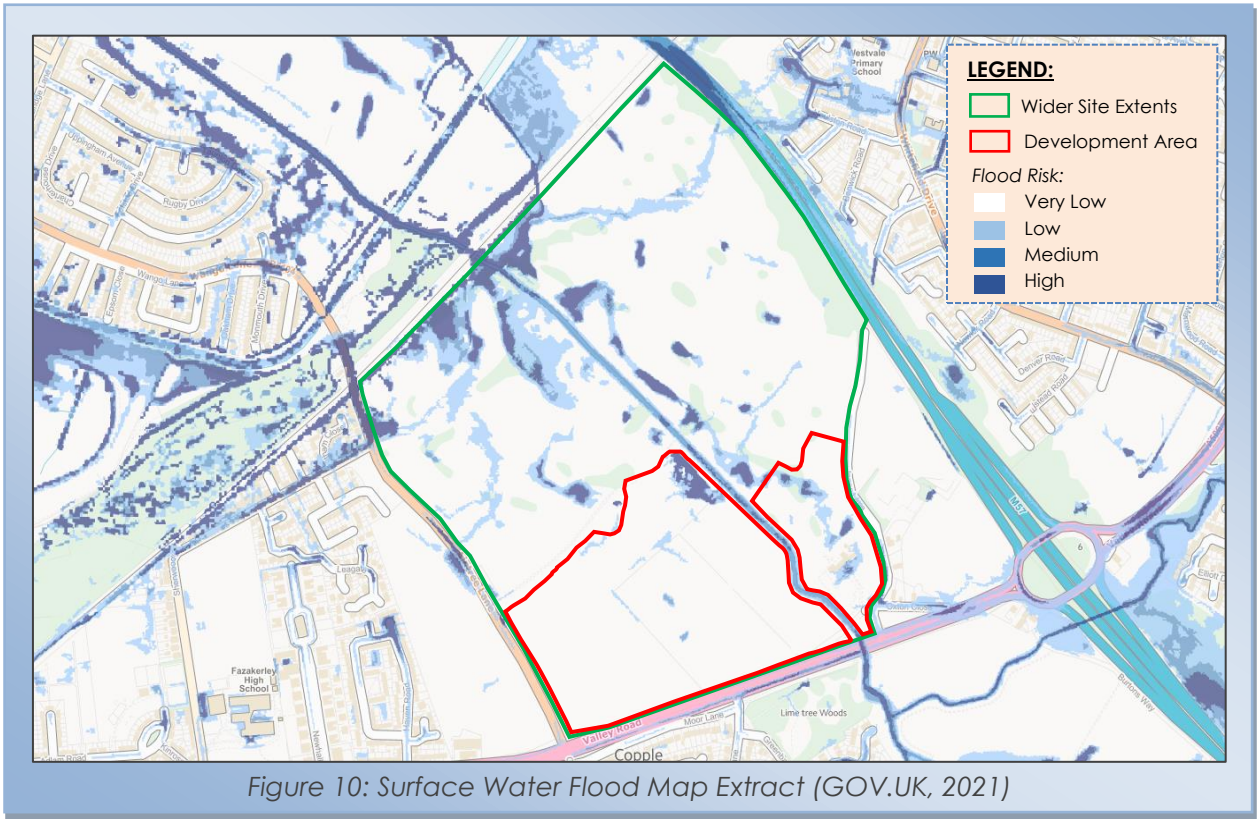


Figure 10: Surface Water Flood Map Extract (GOV.UK, 2021)

4.4.2 Based on the long-term government surface water flood mapping most of the development area to the west of the River Alt is at very low or low risk from surface water flooding based on **Figure 10**. There are some isolated areas adjacent to the north-eastern boundary of this parcel, nearest to the River Alt shown to be at higher risk from surface water. Those areas at greater risk are low-lying and near drainage features/waterbodies which account for the level of flood risk here.

4.4.3 In terms of the eastern development parcel, there are more locations here that are shown to be at higher risk from surface water (see **Figure 10**). When compared to the topographic survey for the site, these areas at risk mainly form a natural bowl like feature within the existing golf course grounds and would be susceptible to flooding due to ponding water when flow is unable to convey safely away and drains to ground over an extended period of time.

4.4.4 The long-term government flood risk mapping also provides indicative flood depths and velocities when looking at potential surface water flood risks. Those areas within the development area to the east of the River Alt, which are shown to be at low risk, are estimated to have depths of flooding from 300mm to 900mm. There is a similar estimation for those areas to the west of the River Alt that are shown to be at low risk from surface water flooding.

4.4.5 In terms of velocities of flow, these are estimated to be generally low (<0.25m/s) on both sides of the river channel, flows shown in the river are greater (0.25m/s) although no development will take place in these areas. When those areas at higher flood risk from surface water (medium and high) are considered, the potential flood depths are estimated to range from 300mm to 900mm, with velocities in these higher risk areas would generally be less than 0.25m/s.

4.4.6 In terms of the proposed development, the potential surface water flood risk areas have been overlaid onto the planning layout to understand the potential risks to the proposals (see **Figure 11**). When we look at those areas to the west of the River Alt, that are at risk from surface water, the planning proposals in those areas are for golf course tees or landscaping. Appropriate golf course/tee drainage will be implemented to manage surface water run-off in landscaped and green areas.

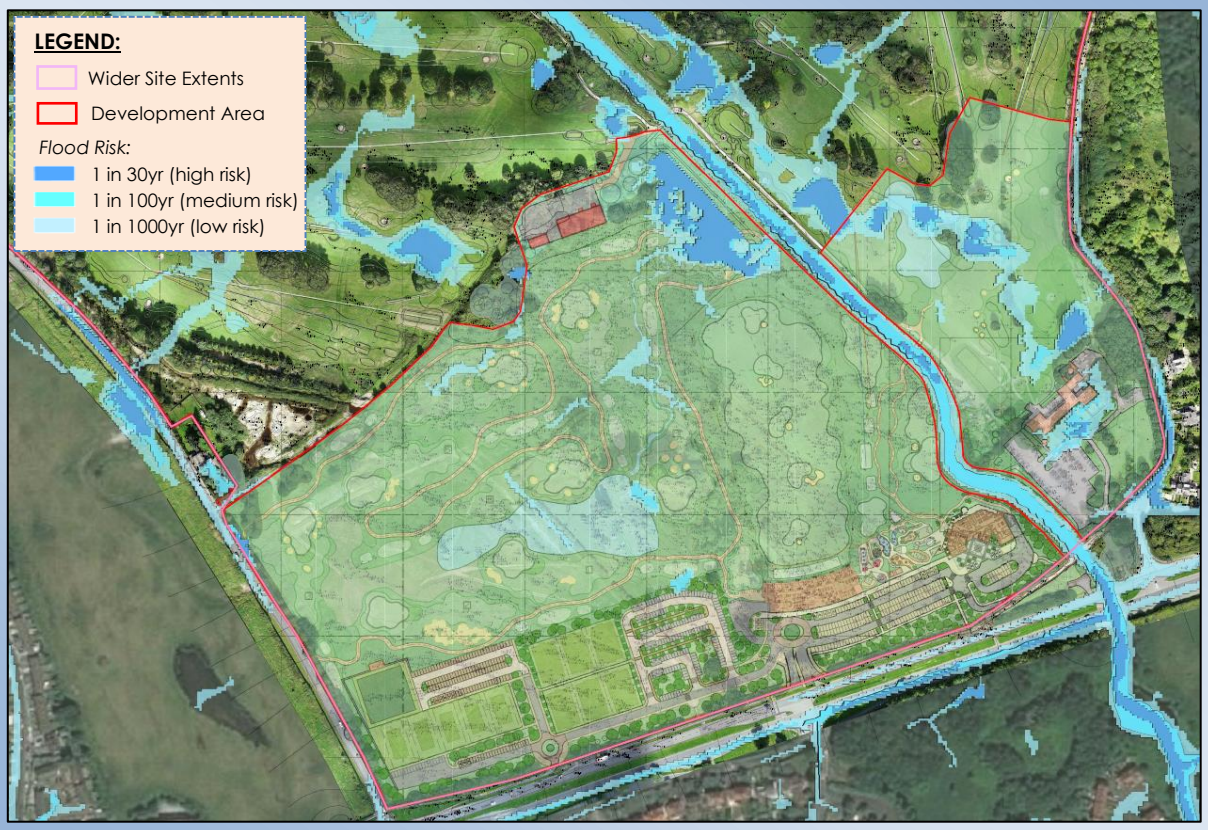


Figure 11: Surface Water Flood Map Overlay Extract (GOV.UK, 2020)

4.4.7 When you look at those areas at risk from surface water to the east of the River Alt, the mainly correspond with the proposed lake or greens and the car park areas. Again, these areas will incorporate formal management techniques to deal with run-off so the potential flood risks to the proposals can be appropriately managed. The risk to the proposals from surface water flooding will be reduced, post-development, through the implementation of mitigation measures proposed within this assessment.

4.4.8 The primary means of managing surface water flood risks not only to the proposals but also to others is to ensure the run-off generated by any proposed hardstanding is appropriately managed. A sustainable drainage regime is therefore proposed to be implemented to cater for the additional surface water run-off generated by the

proposed impermeable areas. As with all development, appropriate ground and external levels design and inclusion of permeable surfacing where at all practicable will also be considered. Any proposed or remaining landscaping (golf course tees) will also have a formal means of managing run-off generated in these areas, to ensure there is no increased flood risk elsewhere.

Pluvial (Overland run-off) Flood Risk

4.4.9 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. Review of the site topographical survey shows overall there is limited risk from pluvial flows. If the existing highways drainage on the A506 were to surcharge there would be a possibility flows could impact the car park to the east of the River Alt (based on the existing ground levels), although this is considered to be a low risk scenario.

4.4.10 The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area. Any overland flows generated by the development must be carefully controlled, safe avenues directing overland flow away from adjacent proposed development being advised.

Sewer Flood Risk

4.4.11 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and wastewater known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away.

4.4.12 UU sewer records identify a 900mm dia. public surface water sewer to cross the northern part of the wider site extent running from Westfield Walk to the east and out falling into the River Alt within the site. Two private surface water sewers (300mm dia.) are understood to cross the site and outfall to the River Alt from Aintree Lane highway drainage and the Haven Road housing estate.

4.4.13 UU have been contacted regarding the possibility of historical sewer flooding and they have confirmed they do have records of sewer flooding in the vicinity of the Golf Course noted on their DG5 register (refer to **Appendix C** for correspondence). Correspondence with KMBC highlighted flooding issues on Aintree Lane but not on the immediate site (refer to **Appendix C** for correspondence).

4.5 Groundwater Flood Risk

4.5.1 High groundwater levels are usually the key source of groundwater flooding, which occurs when excess water emerges at the grounds surface (or within manmade underground structures such as basements). Groundwater flooding is often more insistent than surface water flooding and would typically last for weeks/months rather than days meaning the result to property is often more severe. In general terms groundwater flooding can occur from three main sources:

- If groundwater levels are naturally close to the surface, then this can present a flood risk during times of intense rainfall.

- Seepage and percolation occur where embankments above ground level hold water. In these cases, water travels through the embankment material and emerges on the opposite side of the embankment.
- Groundwater recovery/rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the watertable makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level.

4.5.2 Review of the Knowsley Metropolitan Borough Council's Strategic Flood Risk Assessment (SFRA) and Preliminary Flood Risk Assessment (PFRA), identify that parts of the wider site are at low risk from flooding associated with groundwater. See SFRA mapping in **Appendix J**. The Preliminary Flood Risk Assessments identifies that the Knowsley area only has a minimal groundwater level rise likelihood (as a result of the cessation of mining, levels), over the next few years.

4.5.3 The EA mapping data for groundwater shows that the site is underlain by a Principal Bedrock Aquifer with Secondary A Superficial Deposits. The site is also located within a High Groundwater Vulnerability Zone to a Minor Aquifer.

4.5.4 No historical groundwater flooding has been identified at the site during consultation with interested parties. Irrespective, it is advised that external levels fall away from the proposed buildings (where feasible) to minimise the flood risk from a variety of sources. By ensuring external levels fall away from any proposed buildings this will provide safe overland flow routes away from buildings in potential exceedance events.

4.6 Artificial Sources of Flood Risk

4.6.1 National policy states that an FRA should consider the potential risks from a variety of other flood sources including artificial sources, such as risks from reservoirs and canals.

Reservoirs

4.6.2 The EA recognises reservoirs as bodies of water over 25,000cu.m and the long-term flood mapping is included in **Appendix B**. The mapping shows the potential worst-case extents of flooding associated with a possible breach/failure in a nearby reservoir. Based on this mapping the wider site is shown to be partly at risk in a possible reservoir failure (refer to **Figure 12**).

4.6.3 The nearest identified reservoir is White Man's Dam located approximately 6km of the development site. The Reservoirs Act 1975 means that the EA ensure reservoirs (over 25,000cu.m) are regularly inspected and safety work is carried out thus meaning a failure or breach in one of these assets is highly unlikely. Although reservoir flooding is 'extremely unlikely', if a failure was to occur there would be little or no warning therefore preparedness is key.

4.6.4 The long-term government flood risk mapping shows that part of the wider site would be susceptible to receiving flood depths between 300mm and 2m. The potential velocities are anticipated to generally be less than 0.5m/s based on the long-term government flood risk mapping data. As the estimated depths and speed of flooding

are based on the worst-case scenario (a reservoir failing and releasing all its content) it is considered unlikely that any flooding due to a reservoir would be this great.

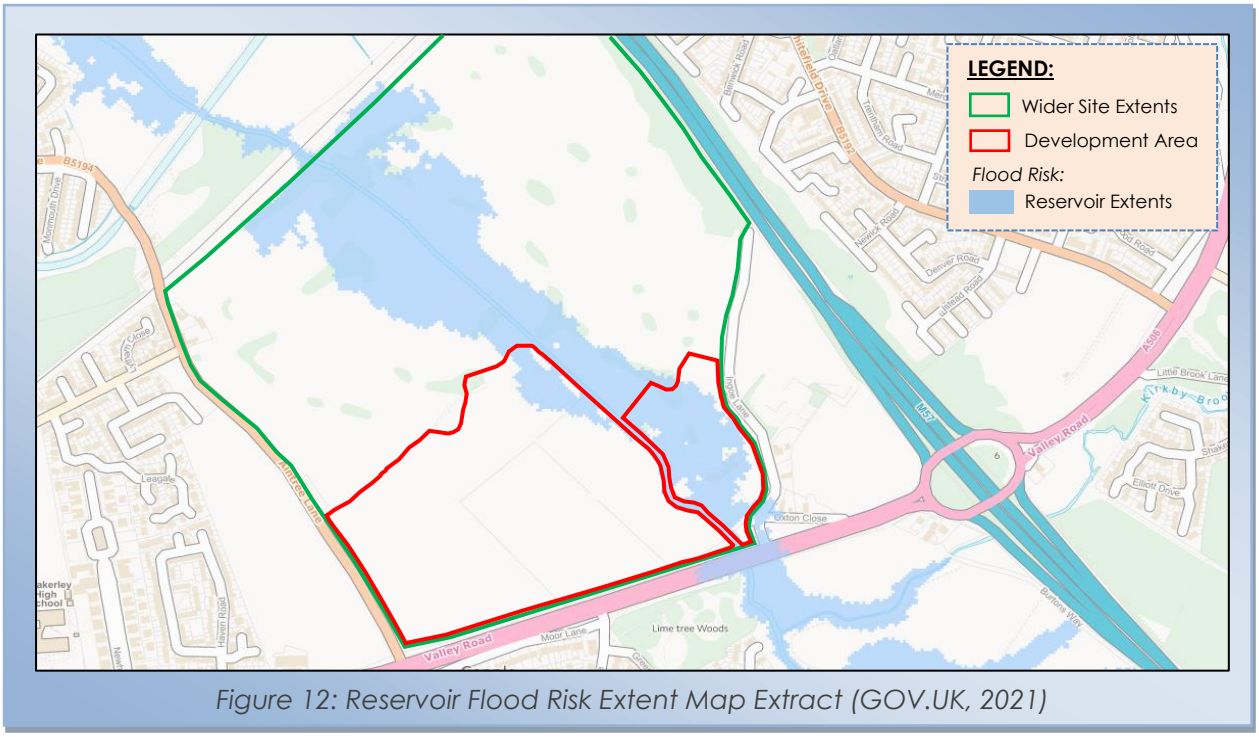


Figure 12: Reservoir Flood Risk Extent Map Extract (GOV.UK, 2021)

4.6.5 The potential flood extents associated with reservoir flooding follows the general route of the River Alt through the wider site, as this feature would act as a natural conduit. Those areas at greatest risk from reservoir flooding are located adjacent to the northern boundary of the wider site, adjacent to the adjacent raised railway line. In terms of the proposed development, those proposals to the west of the main River Alt route would remain mostly flood free during this worst-case exceedance scenario.

4.6.6 Most of the flood risks to the proposals from reservoir flooding would be to that proposed to the east of the River Alt. From review of the planning layout those proposals to the east are mostly green in nature or water compatible (lake). The existing clubhouse building will remain and will be internally altered to serve as a new golf academy including teaching classrooms and demo areas. The existing building currently has a residential area for the managers accommodation, this will be converted into overnight accommodation for visiting academy trainers. Although the existing building will remain post development and is located within the extents of flooding associated with reservoirs, the potential vulnerability remains like existing.

4.6.7 In the case of emergency (reservoir breach or failure), the Lead Local Flood Authority often prepare emergency plans in collaboration with the EA and other stakeholders to assist with improving community resilience. Additionally, it would be recommended that the business management create their own Flood Action Plan which provides information to staff and patrons on what to do in the event of a reservoir breach/failure.

Canals

4.6.8 The nearest canal to the site is the Leeds and Liverpool Canal, located approximately 500m to the north of the site. Due to the local topography, the associated flood risk is

'low', as any flow associated with a future breach would be directed with the natural catchment along the downstream River Alt (away from the sites upstream location).

4.7 Historical and Anecdotal Flooding Information

4.7.1 An internet-based search for flooding did not identify any historical flooding to the site area. Review of the Knowsley Metropolitan Borough Council's Strategic Flood Risk Assessment and Preliminary Flood Risk Assessment highlight there is a floodplain associated with the River Alt on the wider site. These Flood Zones are identified to be the same in the undefended scenario as the defended scenario (some mapping is included in **Appendix J**).

4.7.2 Consultation with various interested parties including the Environment Agency and KMBC also failed to highlight any historical flooding on the site, KMBC did however identify that the nearby Aintree Lane has been susceptible to surface water related flooding historically. Historical sewer flooding has not been identified at the site, following correspondence with UU (correspondence found in **Appendix A, B** and **C**).

4.8 Flood Risk Mitigation Measures & Residual Risks

4.8.1 The wider site is located within Flood Zones 1, 2 and 3; however, the proposed development areas will adopt an intra-sequential approach to development and locate as much of the development within the lesser flood risk areas where practical. To observe a conservative approach, mitigation measures have been proposed below to safeguard the development for its design life considering climate change in accordance with the revised NPPF and PPG.

Mitigation Measures

4.8.2 It is advised that Finished Floor Levels (FFL) of the proposed buildings are set above the external ground levels (where practical). By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks.

4.8.3 As the River Alt is designated as a main river by the EA, there will be a requirement to provide an 8m easement from the top of bank, into each development parcel to allow for any future maintenance requirements by the Environment Agency. The developer has confirmed that this 8m easement will be maintained, the nearest building proposed will be the new clubhouse which is located over 10m from the top of bank.

4.8.4 Formal design work has not been completed yet, but the bridge will be designed to have a soffit level set above the predicted in-channel top water level, at its location, in the design event. The design event will be the 1 in 100yr plus climate change event and a freeboard of 600mm is to be provided above the top water level during the design event. As the in-channel top water level is anticipated to be 12.611mAOD, based on the hydraulic modelling completed, a minimum soffit level of 13.211mAOD should be applied to the new bridge crossing design for the deck.

4.8.5 Any overland flows generated by the development must be carefully controlled. Safe avenues directing overland flow way from any existing and proposed buildings is

advised. Any natural conveyance routes through the site at present should be catered for through continued routing in an appropriate manner, this will ensure no increased run-off elsewhere as a result of the proposals.

4.8.6 To minimise the flood risk to the neighbouring properties it is recommended that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the pre-development greenfield situation. This assessment has considered a drainage strategy to manage surface water run-off this will be followed by a more detailed assessment at the next stage of design.

4.8.7 The proposed onsite surface water drainage system for the new development will need to be sized to contain storm events up to and including the 1 in 100yr return period storm event with up to a 30% allowance for climate change being contained onsite.

4.8.8 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either United Utilities or Knowsley Metropolitan Borough Council (depending on nature of asset involved) then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

Residual Risks

4.8.9 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the development site in the event that the capacity of the drainage system is exceeded.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 The total site covers over 79ha; however, the Development Area is focused on the proposed planning application area (red line boundary) which equates to 25.545ha. At present the development area is split into two separate parcels by the River Alt. The development parcel to the west of the River Alt is currently undeveloped, disused green space. This part of the site is thought to either drain to ground overtime or to the nearby River Alt via overland/pluvial run-off.

5.1.2 The development parcel to the east, currently has some impermeable areas associated with the existing clubhouse and shop. These existing buildings are thought to have their own formal means of manging run-off generated, although the exact method has not been confirmed at this time. The existing car park, which is also to the east of the river, is mostly made up of impermeable areas surrounded by granular base, so overland run-off would occur to those areas adjacent and drain naturally to ground.

5.1.3 The development areas can be further split within this section of the report, as the written drainage strategy will focus on those parts of the site where new buildings and hardstanding is proposed only. This section of the report will therefore focus on the new proposed buildings/hardstanding elements only which equate to 2.878ha.

5.1.4 This is because the remaining development is either existing impermeable to remain impermeable, proposed to be permeably surfaced, or is landscaping/golf green in nature and will be served by its own land drainage systems. A separate land/tee drainage regime has been prepared by a qualified golf course drainage engineer.

5.1.5 The peak rates and volumes of run-off generated by this area have been calculated for the peak events shown in **Table 2** (full details **Appendix K**). The surface water run-off rates have been calculated using the FEH Statistical Method, given the permeable (greenfield) nature of the drainage development area.

Area	*Run-Off Rates*				*Run-Off Volumes*	
	1 In 1 Year	*1 In 30 Year*	*1 In 100 Year*	*QBar*	*1 In 1 Year*	*1 In 100 Year*
2.878ha	9.4l/s	18.3l/s	22.4l/s	10.8l/s	274.5cu.m	856.1cu.m

Table 2: Pre-Development Surface Water Run-Off Rates (Betts Hydro, 2021)

5.2 Post Development Surface Water Run-Off

5.2.1 Based on the planning layout we have estimated that the drainage development area has the potential to decrease in permeability, should permeable surfacing not be considered for all external paved and surfaced areas which contrary to what is recommended as part of this assessment.

5.2.2 For this assessment we have considered the worst-case scenario where the drainage area increases from 0% impermeable at present to 100% impermeable. The unrestricted post-development brownfield run-off rates have been detailed in **Table 3**, based on an impermeable area of 2.878ha.

Area	Run-Off Rates			Run-Off Volumes	
	1 In 1 Year	1 In 30 Year	1 In 100 Year + CC	1 In 1 Year	1 In 100 Year
2.878ha	132.8l/s	246.6l/s	459.2l/s	60.5cu.m	180.7cu.m

Table 3: Post-Development Un-Restricted Run-Off Rates (Betts Hydro, 2021)

5.2.3 In accordance with national and local planning policies it is necessary to restrict surface water run-off rates where at all practical to mimic a pre-development greenfield situation. The proposals will therefore be to discharge surface water run-off from site mimicking the pre-development greenfield situation (**Table 1**). Further details of proposed drainage strategy can be found in Section 5.6.

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 In accordance with national and local planning policy, including the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) and the SuDS Manual (CIRIA 753), peak surface water discharge rates from new development should be appropriately managed and where possible reduced. To manage surface water run-off the preference should always be given to Sustainable Drainage Systems (SuDS) over the traditional methods of buried sewers wherever possible and practical.

5.3.2 SuDS can address the four key sustainability objectives embedded in this policy including providing space for water (water quantity), improving water quality and biodiversity, along with providing valuable amenity/recreational space within new development sites. It would be beneficial to implement wider green space/Public Open Space area(s) in one or more locations within site, where SuDS features could be implemented. Opportunities should also be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off.



Figure 13: SuDS Photographs (SusDrain, 2012)

5.3.3 Given the indicative layout, there will likely be the opportunity to incorporate SuDS methods such as swales, permeable surfacing and bio-retention to provide a degree of treatment before flows are carried offsite (**Figure 13**). The proposals will be to incorporate permeable surfacing for external hardstanding areas including the car

parking bays, outdoor seating areas, pedestrian areas and internal road links where at all practical. SuDS features can include permeable surfacing such as resin bound surfaces, permeable paving, grasscrete or granular substrate. Tree pits or bioretention can also be considered for external areas near to the proposed buildings to provide added water quality benefits prior to discharge to ground and possibly assist with managing some of the additional run-off.

5.3.4 Promoting SuDS to deal with surface water at source will limit the requirement for hard engineering-based attenuation and conveyance. Using SuDS onsite will reduce the volume of surface water entering the downstream watercourse and sewer network which is the preferred approach. The proposals will be to mimic the existing situation and drain to ground where practical utilising appropriate infiltration-based systems, subject to confirmation of onsite infiltration rates. Detailed design will confirm the technical details of the drainage infrastructure proposed following onsite testing.

5.4 Methods of Surface Water Management

5.4.1 At present the development area covers 25.545ha, a large portion of the development area is proposed for landscaping or golf course development and will therefore remain permeable and catered for by a land drainage regime. The focus of this assessment is to identify the appropriate means of managing surface water run-off generated by the newly proposed buildings and associated areas of hardstanding which cover 2.878ha as shown in purple below.



Figure 14: Surface Water Management Drainage Area (Betts Hydro, 2021)

5.4.2 When we consider the drainage focus area, this equates to most buildings and carparking areas proposed to the west of the River Alt, as shown above. This area at

present is 100% permeable and would increase to 100% impermeable should the development utilise no-permeable surfacing throughout. Although permeable surfacing is to be considered for those car parking areas, internal roads and footways where practical, for the purpose of this assessment we have considered that the entire area shown by the purple hatch in **Figure 14** will be impermeable post-development.

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

- Discharge via infiltration
- Discharge to watercourse/waterbody
- Discharge to public sewerage system

5.5 Discharge via Infiltration

5.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems. The published online datasets have initially been reviewed to consider how favourable the underlying strata is to support a potential infiltration-based solution at the site.

5.5.2 The Cranfield Soil and AgriFood Institute (CSAI), Soilscapes viewer identifies the soil within the site area to be naturally wet, very acid, sandy soils. The British Geology Survey (BGS) mapping data indicates that the bedrock geology composes of Chester Sandstone Formation (Sandstone), with superficial deposits consisting of the Shirdley Hill Sand Formation - Sand.

5.5.3 Based on the ground conditions noted online infiltration is considered to offer a possible means of dealing with surface water run-off, although the upper soil strata appears to be less favourable towards an infiltration based solution, the underlying geology is made up of sands and gravels which are highly permeable and would potentially support formal infiltration methods on the site.

5.5.4 Discussion with the landowner has confirmed the existing car parking, external paved areas within the eastern development parcel drain to ground via overland run-off and infiltration over time. There are no recorded issues with the existing infiltration-based drainage regime on the site and the proposals will be to mimic this approach for the new development via formal drainage mechanisms (such as soakaways) as illustrated in **Figure 15**.

5.5.5 Although the ground conditions appear favourable based on the online published ground conditions, at this time no onsite formal testing has been carried out to confirm the specific infiltration rates onsite. Onsite Soakaway Testing has therefore been commissioned by the client, to be undertaken on the site, in key locations where infiltration methods would likely be used (proposed car parking areas).

5.5.6 The proposals will therefore be to manage surface water run-off generated onsite by discharging to ground via appropriately designed infiltration-based Sustainable Drainage System. The proposals are to utilise permeable surface where at all feasible

for external hardstanding areas including parking bays, footways and patio areas. Where access roads are being proposed for adoption permeable surfacing is not typically accepted for adoption by the Lead Local Flood Authority and in these cases an alternative management regime would be required to be secured or an alternative surfacing material would need to be incorporated for these areas.



Figure 15: Preliminary Drainage Strategy Plan Extract (Betts Hydro, 2021)

5.5.7 There are 3no. new buildings proposed to be constructed as part of the development; these are the new clubhouse building which is nearest the western bank of the River Alt, further west is the newly proposed driving range building and nearest to Aintree Lane is the new proposed multi-functional sports facility. The proposals are to introduce new formal infiltration-based management solutions to cater for the additional surface water run-off generated by these new roof areas.

5.5.8 The specific infiltration-based infrastructure will be confirmed during the detailed design stage although it is likely that soakaways or infiltration trenches will best serve the buildings. There may be some scope to introduce rainwater harvesting into those buildings where shower facilities will be present to help re-use run-off on the site is a sustainable manner.

5.5.9 The proposed infiltration-based drainage solution will need to be sized holistically to ensure that flooding does not occur on any part of the site in the 1 in 30 year event and that events exceeding the 1 in 30 year event is contained within the site without flooding any building or land off site up to and including the 1 in 100 year event plus an allowance for climate change.

5.5.10 For infiltration features to be sized appropriately, onsite soakaway testing will be required to determine the onsite infiltration rates at the proposed infiltration locations. In terms of discharge rates, these will not exceed that of existing onsite infiltration rate (to be determined during onsite testing).

5.5.11 Detailed design will confirm the specific technical details of the drainage features and discussion with the LPA will ensure these are appropriately sized, to meet any local design requirements where adoptions are to be proposed. Where systems are proposed to remain private, the maintenance and funding of these features will be the responsibility of the private maintenance contractors at the golf club. Full details will be provided during detailed design.

5.6 Discharge to Watercourse

5.6.1 Should onsite soakaway tests show that rates onsite are not favourable to an infiltration-based surface water solution at the site, then the next approach in the hierarchical approach is to discharge to the nearest watercourse. As previously discussed, the River Alt flows through the wider golf course and would provide the alternative option for draining surface water run-off from the site.

5.6.2 Should infiltration no provide a full or part drainage solution then the proposals will be to form a new formal connection to the River Alt (see **Figure 15**), subject to formal consents and agreements from the Environment Agency's. Detailed design would be required to confirm whether a gravity system can be achieved, although given the levels difference between the ground levels onsite and the existing River Alt bed level (see Photographs in **Figure 16**), a gravity connection is anticipated to be feasible.



Figure 16: Photographs from the Site Walkover (Betts Hydro, 2019)

5.6.3 Consent and relevant agreements for works to the Main River will be required from the Environment Agency and the Lead Local Flood Authority. Consent will also be required from the LLFA (Knowsley Metropolitan Borough Council), who will also need to agree

to any proposed discharge rates. Early discussion is advised with all parties, to ensure there are no other constraints in terms of points of connection or rates of discharge.

5.6.4 In accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable.

5.6.5 The proposals would be to therefore restrict surface water run-off to mimic a pre-development greenfield situation. The pre-development greenfield rate (QBar) for those areas of site being considered as part of this drainage assessment (2.878ha) is 10.8l/s, using the FEH Statistical Method (see summary in **Appendix K**). *This equates to 3.752l/s/ha*. This discharge rate would need to be discussed and agreed with the Lead Local Flood Authority in due course, should infiltration not be viable at the site.

5.6.6 The restricted flow will generate a storage requirement during the extreme storm events. The stormwater storage figures quoted in **Table 4** are estimates only and the detailed drainage design will determine with accuracy the stormwater storage requirements. It would be beneficial to implement SuDS features such as a pond or swales, near to the proposed outfall locations. If designed appropriately the SuDS can aid in the attenuation and provide added benefits in terms of water quality.

IMPERMEABLE AREA (2.878HA)	1 In 1 Year	1 In 30 Year	1 In 100 Year + 20% CC
RESTRICTED RUN-OFF RATE	10.8l/s	10.8l/s	10.8l/s
ESTIMATED STORMWATER STORAGE VOLUME	392cm.m-657cu.m	911cu.m-1262cu.m	1632cu.m-2103cu.m

Table 4: Estimated Stormwater Storage Requirements (Betts Hydro, 2021)

5.7 Discharge to Public Sewer Network

5.7.1 Should infiltration and a connection to the nearby watercourse not be a feasible method for surface water management then the alternative method would be a connection to the neighbouring public sewer network. UU sewer records identify there to be public surface water sewers to the north, east, south and west of site and discussion would need to be had with UU for any new proposed connections. There are currently no proposals to connect surface water run-off generated by the new development into the public sewer network, this is because of the more primary options based on the initial assessment.

5.8 Climate Change

5.8.1 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall. It is believed that the impact of climate change means there is likely to be a long-term increase in the average sea levels, with an expectation that

sea levels will rise gradually. An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact.

5.8.2 In light of the future uncertainties Climate Change should be accounted for within the design of all new developments. The recently published Environment Agency document '*Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities*' supersedes Defra's policy statement on Flood Risk and Coastal Erosion Risk Management (2009) and should be used for future proposals. Climate change factors have been considered and any increase in the level of flood risk (to the site) from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.

5.8.3 In accordance with the updated Climate Change projections provides estimated changes to rainfall intensity (**Table 5**) and based on the design life of the development (50yrs) the "total potential change figures for the 2050's has been utilised.

PROJECTIONS	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE 2050'S
Upper End Estimate	20%
Central Change Factor	10%

Table 5: Change to Extreme Rainfall Intensity Compared to 1961-1990 Baseline (Environment Agency, 2016)

6.0 FOUL WATER MANAGEMENT

6.1 UU sewer records identify multiple sewer assets to be in proximity of the wider site, including surface and foul water sewers to the south and west. A public foul water sewer is located to the east within Ingoe Lane, this joins a public foul water sewer (1200mm dia.) located running parallel to Valley Road to the south of the site (sewer records within **Appendix C**).

6.2 The wider site currently has an existing clubhouse, including shop, food establishment and managers accommodation, which generate foul water flows, although the exact method of dealing with these is not confirmed at present. It is assumed from review of the UU sewer records that these connect into the neighbouring public sewer network.

6.3 In terms of the proposed drainage areas being considered as part of this assessment (development parcel to the west of the watercourse), at present this area is undeveloped and there are no onsite foul water flows are currently generated, thus no existing foul water connections present. There is however the potential for a new foul water connection to the existing public foul water sewer network to cater for the additional foul water flows generated by these proposals (refer to aerial drainage plan in **Figure 15** previously).

6.4 The primary option would be to form a new connection to cater for the foul water flows generated by the newly proposed buildings (clubhouse, driving range and multi-functional sports centre) to the public foul water sewer located to the south of the site. Detailed design will be required to confirm feasibility of the strategy and to confirm whether a full gravity connection can be achieved. The peak foul water flows generated by this development, will need to be calculated based on the guidance contained within Sewers for Adoption (4000 litres per dwelling per 24 hours).

6.5 Early dialogue with UU is advised to confirm where there preferred point of connection would be and any restrictions in terms of discharge rates. If a connection can be made within the wider land ownership boundary then there would be no need to obtain consent from nearby land/asset owners to route to the public sewer network. Where this is not the case and offsite works are required then relevant consents will need to be obtained.

7.0 SUMMARY AND CONCLUSIONS

7.1 This Flood Risk Assessment and Drainage Management Strategy has been prepared to support a planning application for mixed-use development at Kirkby Valley Golf Club in Kirkby. The total site covers over 79ha, however the main development area covers a much smaller 25.545ha.

Flood Risk

7.2 The site is located within Flood Zone 1 and 2 based on the Environment Agency Flood Zone Map for Planning. The proposals are mostly Less Vulnerable in nature and as such are confirmed to be appropriate for Flood Zones 1 and Flood Zone 2, providing there is no increase in flood risk elsewhere due to the proposals.

7.3 This report has reviewed all sources of flood risk both to and resulting from the proposed development site. Consultations with the Environment Agency, United Utilities and Knowsley Metropolitan Borough Council have been undertaken and have not identified any historical incidents of flooding directly to the development areas themselves. The main development area is at 'very low' to 'low' risk from most flood sources considered including fluvial, tidal, surface water and sewer flooding.

7.4 The nearest Main River is the River Alt, which flows through the wider site and splits the proposals into an eastern and western parcel. The Environment Agency provided in-channel top water levels in the key design events and in summary, the main development area remains flood free in both the undefended and defended modelled fluvial scenarios. The existing EA modelling data has subsequently been refined and a more detailed understanding of the potential flood risks to both the existing site and the proposed development has been gained through a detailed hydraulic modelling assessment undertaken in 2019 by Betts Hydro.

7.5 This modelling shows that the western development parcel remains flood free in all the key design return period events including during the proposed modelled scenarios. The eastern development parcel is shown to be more susceptible to inundation in the more extreme scenarios (0.1% AEP event), however the proposals in this part of the site will either be course reconfiguration or internal alterations to the existing building. When the proposals in the eastern parcel are compared to the predicted low flood depths the potential flood risks overall are thought to be manageable.

7.6 Surface water flood risks have also been considered and as the development proposals have the potential to increase the volumes of surface water run-off generated on the site, appropriate mitigation has been considered. The risk associated with surface water will be managed and reduced as part of the proposals through implementation of a sustainable surface water regime, appropriate levels design and permeable surfacing where at all feasible.

Drainage Strategy

7.7 Surface water management options have been assessed in accordance with the national and local policy to follow the sustainable drainage hierarchy. The primary measure to deal with surface water run-off from new sites is to drain to ground where at all practical. Based on the ground conditions noted online, infiltration is considered

to offer a possible means of dealing with surface water run-off, although the upper soil strata appear to be less favourable towards an infiltration-based solution, and deeper infrastructure may be required.

7.8 The proposals are to utilise permeable surfacing where at all feasible for external hardstanding areas including parking bays, footways and patio areas. Where access roads are being proposed for adoption permeable surfacing is not typically accepted for adoption by the Lead Local Flood Authority and in these cases an alternative management options would be required. Where testing onsite confirms that infiltration-based solutions would be feasible, the existing infiltration rates (determined during the onsite testing), will be the proposed discharge rates.

7.9 Should infiltration not provide a full or part drainage solution, then the proposals will be to form a new connection to the River Alt, subject to formal consents and agreements from the Environment Agency's. Detailed design would be required to confirm whether a gravity system can be achieved, although given the levels difference between the site and the existing River Alt a gravity connection is anticipated.

7.10 Consent and relevant agreements for works to the Main River will be required from the Environment Agency and the Lead Local Flood Authority. Consent will also be required from the LLFA (Knowsley Metropolitan Borough Council), who will also need to agree to any proposed discharge rates. Early discussion is advised with all parties, to ensure there are no other constraints in terms of points of connection or rates of discharge.

7.11 In accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. The proposals would be to therefore restrict surface water run-off to mimic a pre-development greenfield situation, with a greenfield rate (QBar) being calculated as 10.8l/s for those areas with proposed new buildings/carparking.

7.12 Restricting the rate of discharge will generate a stormwater storage requirement during the extreme storm events. It would be beneficial to implement SuDS features such as a pond or swales, near to the proposed outfall location. If designed appropriately the SuDS features can aid in the attenuation and provide added benefits in terms of water quality. In terms of design the sustainable drainage systems proposed onsite should be sized to ensure that exceedance up to and including the 1 in 100-year return period event with allowance for climate change is contained within site.

7.13 The Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

8.0 RECOMMENDATIONS

8.1 It is typical to set the Finished Floor Levels (FFL) of proposed buildings of 150mm above the existing ground levels although where existing foundations are being used this would not be practical. By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) this should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off exceedance risks.

8.2 As the River Alt is designated as a main river by the EA, there will be a requirement to provide an 8m easement from the top of bank, into each development parcel to allow for any future maintenance requirements by the Environment Agency. The developer has confirmed that this 8m easement will be maintained, the nearest building proposed will be the new clubhouse which is located over 10m from the top of bank.

8.3 The new proposed bridge crossing will need to be designed to accommodate the design standards of the Environment Agency. It is understood that open deck structure would be preferable with the foundations on either side of the riverbank being located outside of the predicted floodplain extents. Formal design work has not been completed yet, but the bridge will be designed to have a soffit level set 600m above the predicted in-channel top water level, at its location, in the design event. The design event will be the 1 in 100yr plus climate change event and the top water level in channel, during the design event is anticipated to be 12.611mAOD. Based on the hydraulic modelling completed and as a minimum the soffit level of the proposed bridge deck will need to be set at level of 13.211mAOD.

8.4 The pre-application process with the Environment Agency has begun, to discuss the development proposals that are in proximity of the Main River network including the new bridge crossing. However due to unforeseen circumstances, the Environment Agency are unable to assist with pre-application discussions currently. Further discussion with the EA will therefore need to be carried out as part of the planning application as they will be statutory consultees.

8.5 In the case of a flood emergency, the Lead Local Flood Authority often prepare emergency plans in collaboration with the EA and other stakeholders to assist with improving community resilience. Additionally, it would be recommended that the business create their own independent Flood Action Plan which provides information to staff and patrons on what to do in the event of a future flood event.

8.6 To minimise the flood risk to the neighbouring property and proposed but it is proposed that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted in accordance with the NPPF and Non-Technical Standards for SuDS.

8.7 In accordance with LPA's and UU requirements, Soakaway Testing to BRE365 will be required to be to evidence that discharge to ground will be a viable solution. Onsite Soakaway Testing has therefore been commissioned by the client, to be undertaken on the site, in key locations where infiltration methods would likely be used (proposed car parking areas). This will also provide the existing percolation infiltration rates onsite to steer the detailed drainage design.

8.8 Detailed design will need to be carried out for both the proposed surface water and separate foul water drainage proposals, this will confirm the technical drainage details and identify whether a full gravity solution will be feasible.

8.9 The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with exceedance from storm events up to and including the 1 in 100yr return period storm event with an allowance for climate change being contained onsite.

8.10 It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

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APPENDIX A: NPPF & PPG EXTRACTS

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14. Meeting the challenge of climate change, flooding and coastal change

148. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

Planning for climate change

149. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures[48]. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

150. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

151. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

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[48] In line with the objectives and provisions of the Climate Change Act 2008.

152. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

153. In determining planning applications, local planning authorities should expect new development to:

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

154. When determining planning applications for renewable and low carbon development, local planning authorities should:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

b) approve the application if its impacts are (or can be made) acceptable[49]. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Planning and flood risk

155. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

156. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

157. All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change

[49] Except for applications for the repowering of existing wind turbines, a proposed wind energy development involving one or more turbines should not be considered acceptable unless it is in an area identified as suitable for wind energy development in the development plan; and, following consultation, it can be demonstrated that the planning impacts identified by the affected local community have been fully addressed and the proposal has their backing.

– so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

158. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

159. If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance.

160. The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

161. Both elements of the exception test should be satisfied for development to be allocated or permitted.

162. Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

163. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[50]. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

164. Applications for some minor development and changes of use[51] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 50.

165. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits.

Coastal change

166. In coastal areas, planning policies and decisions should take account of the UK Marine Policy Statement and marine plans. Integrated Coastal Zone Management should be pursued across local authority and land/sea boundaries, to ensure effective alignment of the terrestrial and marine planning regimes.

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[50] A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

[51] This includes householder development, small non-residential extensions (with a footprint of less than 250m^2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

167. Plans should reduce risk from coastal change by avoiding inappropriate development in vulnerable areas and not exacerbating the impacts of physical changes to the coast. They should identify as a Coastal Change Management Area any area likely to be affected by physical changes to the coast, and:

a) be clear as to what development will be appropriate in such areas and in what circumstances; and

b) make provision for development and infrastructure that needs to be relocated away from Coastal Change Management Areas.

168. Development in a Coastal Change Management Area will be appropriate only where it is demonstrated that:

a) it will be safe over its planned lifetime and not have an unacceptable impact on coastal change;

b) the character of the coast including designations is not compromised;

c) the development provides wider sustainability benefits; and

d) the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast[52].

169. Local planning authorities should limit the planned lifetime of development in a Coastal Change Management Area through temporary permission and restoration conditions, where this is necessary to reduce a potentially unacceptable level of future risk to people and the development.

[52] As required by the Marine and Coastal Access Act 2009.

Revision date: 06 03 2014

What should be considered if bringing forward a Neighbourhood Development Order/Community Right to Build Order in an area at risk of flooding?

The general approach and requirements for site-specific flood risk assessments should be applied to developments in areas at risk of flooding to be permitted by Neighbourhood Development/ Community Right to Build Orders. This means that for any development proposals:

- in Flood Zone 2 or 3;
- or of at least 1 hectare;
- or in an area that has critical drainage problems (as notified to the local planning authority by the Environment Agency);
- or that may be subject to other sources of flood risk;

a site-specific flood risk assessment should support the draft Order. The flood risk assessment checklist may be helpful in this respect.

Where the neighbourhood planning area is in Flood Zone 2 or 3, or is in an area with critical drainage problems, advice on the scope of the flood risk assessment required should be sought from the Environment Agency. Where the area may be subject to other sources of flooding, it may be helpful to consult other bodies involved in flood risk management, as appropriate.

Where a Neighbourhood Development/Community Right to Build Order is under consideration for a site/area in Flood Zone 2 or 3, which has not been allocated in the development plan through the Sequential Test, and if necessary the Exception Test, it will be necessary for those proposing the development, in having regard to the National Planning Policy Framework's policies on flood risk, to demonstrate why the development cannot reasonably be located in areas of lower flood risk.

In all cases where new development is proposed, the sequential approach to locating development in areas of lower flood risk should still be applied within a neighbourhood planning area.

Neighbourhood Development/Community Right to Build Orders that propose new development that would be;

- contrary to the flood risk vulnerability and flood zone compatibility table (Table 3), or;
- within areas at risk of flooding where sequential testing shows there to be places at lower flood risk which are suitable and reasonably available for the development proposed,

should not be considered appropriate, having regard to the national policies on development and flood risk.

Paragraph: 064 Reference ID: 7-064-20140306

Revision date: 06 03 2014

Flood Zone and flood risk tables

- Table 1: Flood Zones
- Table 2: Flood risk vulnerability classification
- Table 3: Flood risk vulnerability and flood zone 'compatibility'

Table 1: Flood Zones

These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea (https://flood-map-for-planning.service.gov.uk/)), available on the Environment Agency's web site, as indicated in the table below.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.(Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Note: The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. Reference should therefore also be made to the Strategic Flood Risk Assessment when considering location and potential future flood risks to developments and land uses.

Paragraph: 065 Reference ID: 7-065-20140306

Revision date: 06 03 2014

Table 2: Flood risk vulnerability classification

Essential infrastructure

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood.
- Wind turbines.

Highly vulnerable

- Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding.
- Emergency dispersal points.
- Basement dwellings.
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').

More vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Less vulnerable

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

Water-compatible development

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

" * " Landfill is as defined in Schedule 10 of the Environmental Permitting (England and Wales) Regulations 2010 (http://www.legislation.gov.uk/uksi/2010/675/schedule/10/made).

Paragraph: 066 Reference ID: 7-066-20140306

Revision date: 06 03 2014

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Table 3: flood risk vulnerability and flood zone ‘compatibility'
(https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone__compatibility_.pdf) (PDF, 58.1KB, 1 page)

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Notes to table 3:

- This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
- Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

” * “ In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

Paragraph: 067 Reference ID: 7-067-20140306

Revision date: 06 03 2014

Site-specific flood risk assessment: Checklist

1 - Development site and location

You can use this section to describe the site you are proposing to develop. It would be helpful to include, or make reference to, a location map which clearly indicates the development site.

a. Where is the development site located? (eg postal address or national grid reference)

b. What is the current use of the site? (eg undeveloped land, housing, shops, offices)

c. Which Flood Zone (for river or sea flooding) is the site within? (ie Flood Zone 1, Flood Zone 2, Flood Zone 3). As a first step, you should check the Flood Map for Planning (http://apps.environment-agency.gov.uk/wiyby/37837.aspx) (Rivers and Sea). It is also a good idea to check the Strategic Flood Risk Assessment for the area available from the local planning authority.

2 - Development proposals

APPENDIX B: EA INFORMATION & CORRESPONDENCE

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Kirsty Williams

From: Sayce, Stephen <stephen.sayce@environment-agency.gov.uk>
Sent: 08 August 2019 15:51
To: Kirsty Williams
Subject: FW: HYD444 Kirkby Valley Golf Course, Liverpool
Attachments: LOCATION PLAN 2.pdf; 9627-09_A.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Kirsty

Thank you for your email regarding the above site.

Unfortunately due to numerous recent events, we are now in incident mode. This means staff have been pulled offline to help respond. As such at this time we are unable to undertake any chargeable work until September/October time.

Sorry for any inconvenience caused.

Thanks,

Kind Regards

Steve Sayce
Planning Specialist – Liverpool City Region

The Environment Agency
Sustainable Places
Richard Fairclough House
Knutsford Road
Latchford, Warrington
Cheshire
WA4 1HT

Mobile:07557758625
Office Tel: 02030 251 027
Email: stephen.sayce@environment-agency.gov.uk
Team email: SPPlanning.RFH@environment-agency.gov.uk



Does Your Proposal Have Environmental Issues or Opportunities? Speak To Us Early!

If you are planning a new project or development, we want to work with you to make the process as smooth as possible. Early engagement can improve subsequent planning applications to you and your clients' benefit and deliver environmental outcomes. For a cost recovery fee of £100 per hour + VAT we will provide you with a project manager who will coordinate all meetings and reviews in order to give you detailed specialist advice with guaranteed delivery dates. More information can be found on our website here.

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Creating a better place for people and wildlife

From: SPPlanning.RFH
Sent: 06 August 2019 11:00
To: Sayce, Stephen <stephen.sayce@environment-agency.gov.uk>; Hewitt, Dawn <dawn.hewitt@environment-agency.gov.uk>
Subject: FW: HYD444 Kirkby Valley Golf Course, Liverpool

From: PlanningSSD
Sent: 06 August 2019 10:58
To: SPPlanning.RFH <SPPlanning.RFH@environment-agency.gov.uk>
Subject: FW: HYD444 Kirkby Valley Golf Course, Liverpool

Hi SP

Apologies I this is not the correct mailbox to be sending this on to. Please let me know if not.

Charged advice request in email below.

Many thanks
Hannah

Hannah Brothwell | Planning Advisor | Sustainable Places | Solent and South Downs Area | Environment Planning and Engagement
Environment Agency | Romsey Depot | Canal Walk | Romsey | Hampshire | SO51 7LP
Tel: 02084 745865 Mobile: 07789747374
Hannah.brothwell@environment-agency.gov.uk

Working in partnership to enable sustainable growth and create better places for people and wildlife

We offer a cost recovery service for bespoke pre-application advice. For more information go to: gov.uk or email us

Have a look at 'Building a Better Environment' , our guide for developers

Our Flood Risk Standing Advice has been updated



From: Kirsty Williams [mailto:kirstywilliams@betts-associates.co.uk]
Sent: 06 August 2019 09:53
To: PlanningSSD <PlanningSSD@environment-agency.gov.uk>
Cc: GMMC Info Requests <InfoRequests.GMMC@environment-agency.gov.uk>
Subject: HYD444 Kirkby Valley Golf Course, Liverpool

To Whom it May Concern,

I have been asked to being dialogue with the EA on behalf of my client, who will be looking to formally submit a planning application over the coming months for the regeneration and new development of Kirkby Valley Golf Club in Liverpool. At this stage the proposals are still being developed and the various disciplines are being consulted to design and prepare their elements of work to support the application. I have attached a location plan illustrating the site area and those locations where development will be taking place. I'm not sure the best department to deal with this enquiry so I have sent to both the sustainable places team and the information requests team, please forward onto the correct department if one of these is not correct.

In terms of my dialogue with the EA, you will see from the attached that the River Alt (Main River) is shown to bisect the development area. My colleagues have already consulted with your data team to obtain the relevant river model and outputs for inclusion within our Flood Risk Assessment. While we wait for the data to land, I wanted to start initial discussions with the EA on some of the proposals. As noted, the layout is still being adapted however I have attached the current iteration for some context. The proposals do not include any residential type development. The hardstanding/building proposed will consist of new car parking, a new golf clubhouse/pavilion, new driving range building and multi-function sports centre. The other development being proposed involves alterations to two of the existing tees associated with the 18-hole golf course (nos. 1 and 18) and addition of a new Academy 9-hole golf course, with associated reprofiling work. You will see from the attached that the proposals also include a new detention lake (for irrigation) and adventure golf course.

Given the location of the River Alt to the proposals, we wanted to liaise with the EA at an early stage to understand whether there would be any constraints that need to be considered before we submit the application. We have advised the client that an 8m easement should be maintained from the top of bank on the Main River into the site (on both sides), they have confirmed that this has been allowed for and that the only proposed works within this 8m easement would be minor reprofiling associated with the moving of the golf tees no.1 and no.18 (see attached layout). They have confirmed that the new clubhouse will be located over 10m from the top of bank, and the driving range is outside of 16m from the top of bank. We would assume that this is acceptable, however please let me know if you require anything further in terms of these proposals. The key

proposals we are looking to identify and discuss with the EA at this early stage are pointed below. We are looking to identify if the EA will require anything specific to be provided or reviewed prior to the planning application being approved, we understand that in due course Environmental Permits might be required for some of the proposed works, but would think this can be conditioned as part of the application approval and would not hold up the consents process.

- Reprofiling works associated with the relocating of Tee no.18, the green area (to the north of the clubhouse) is located within the 8m easement area. Furthermore, the proposals are for Tee No. 1 and No.18 to be played across the Main River. We wanted to establish if you would have any constraints or requirements for this proposal.

- The furthest extent of the driving range area is shown (on the masterplan) to be within the 8m easement, I understand reprofiling works here would be kept to a minimum but would the EA requirement anything further on this aspect at this early stage.

- Resurfacing of the existing car park to the east of the River Alt is proposed as part of the wider works, some of the existing car parking bays are located within the 8m easement area from the Main River. We are assuming that given these existing here at present and resurfacing only is being proposed that this will be acceptable. Please let us know if this is not the case.

- A new Bridge Crossing is being proposed near to Tee No.1 & No.18 to allow the play over the watercourse. The initial designs are being drafted up although I understand that the EA will require a specific design to be adhered to. From experience its typically accepted for a new bridge crossing to be design in an open bridge deck formation, where the soffit of the deck is located above the predicted top water level in channel in the 1 in 100yr plus climate change event. Obviously at this stage we don't have the EA data to review and identify what this level should be, once we have received the data, we can provide these design requirements to the structural engineers who will be designing up the strategy. A further point would be that we would like to establish whether the EA will accept the foundations of the bridge to be located within the 8m easement on either side of the bank or does it need to be located fully outside of the easement and flood zones identified. Would the EA require anything further such as hydraulic modelling at this stage or can the more detailed assessment be carried out in due course by method of condition.

- There will be new outfalls into the Main River to serve the new 9-hole golf course tee drainage, currently there are 3no. outfalls proposed. I believe an Environmental permit will be required for these outfalls in due course, but at this stage would the EA require anything further. In terms of the new hardstanding areas onsite, we will be carrying out soakaway testing in September to confirm whether we can formally deal with the new drainage onsite, if this is not productive then we will be looking to form a new separate connection to the Main River to serve the hardstanding areas onsite. The rate of discharge will be required to mimic the pre-development situation and formal consents will be obtained in due course. If this is going to be a problem, then please let us know as soon as possible so that the EAs requirements can be considered.

I apologise for the extended email, but we need to identify the full proposals to the EA at this stage so that any constraints can be dealt with early doors. I trust that this is understandable, and I appreciate your assistance with this matter. My client is aware that this advice may be classed as pre-application advice and therefore may be subject to the EA's charged advice service. I would be grateful if you can confirm any required costs so that I can pass these onto the client and obtain approval from them.

Kind Regards

Kirsty Williams BSc(Hons) GradCIWEM

Flood Risk Analyst

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Consulting Engineers

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Chester +44 (0)1244 289041

kirstywilliams@betts-associates.co.uk
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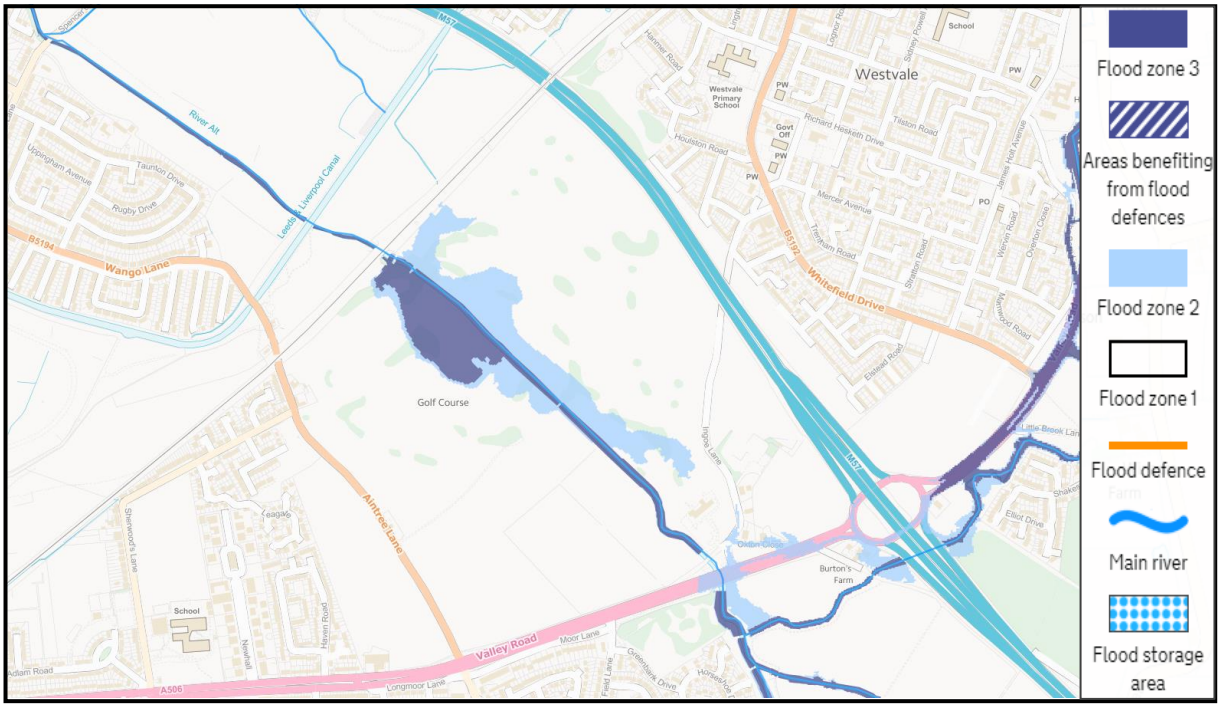
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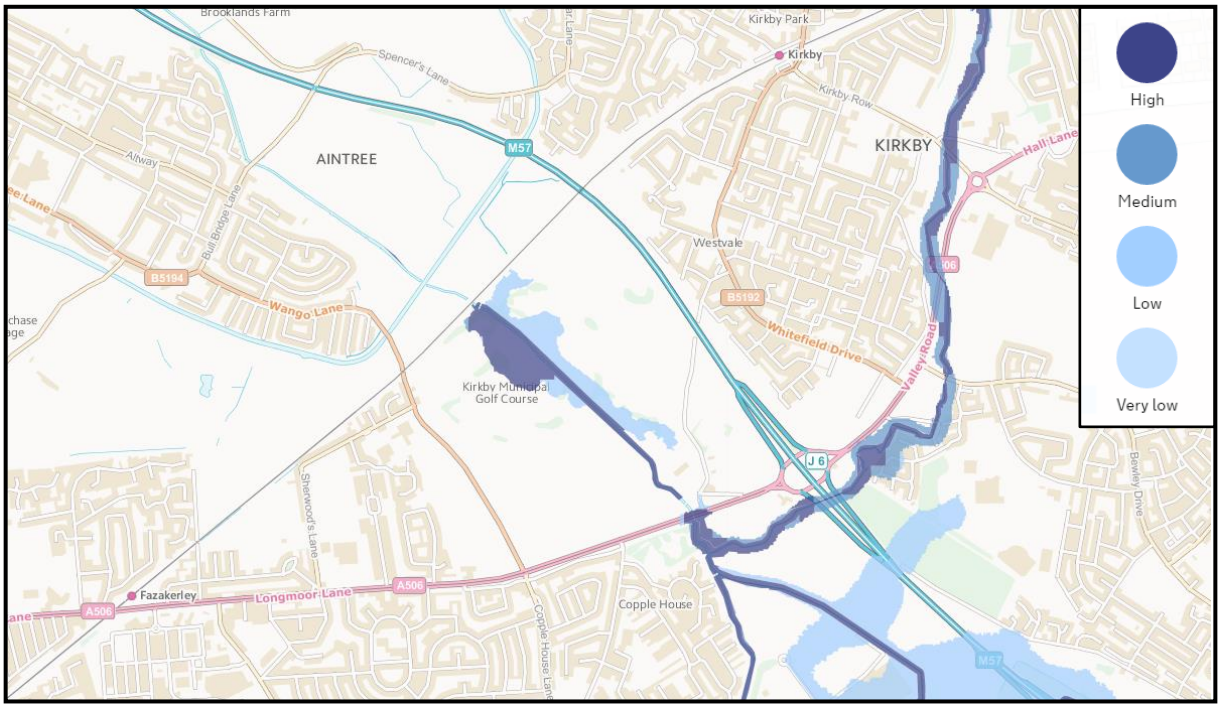
NATIONAL FLOOD MAPPING

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Flood Map for Planning



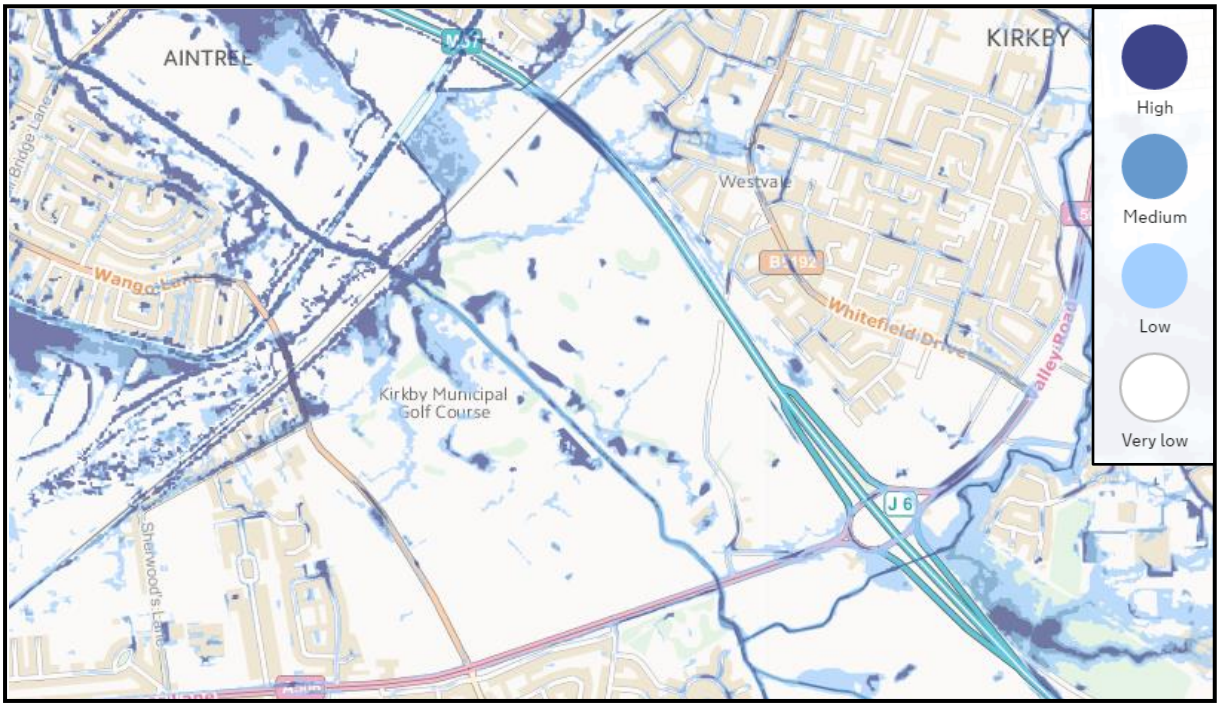
Long Term Flood Risk – Rivers or Sea



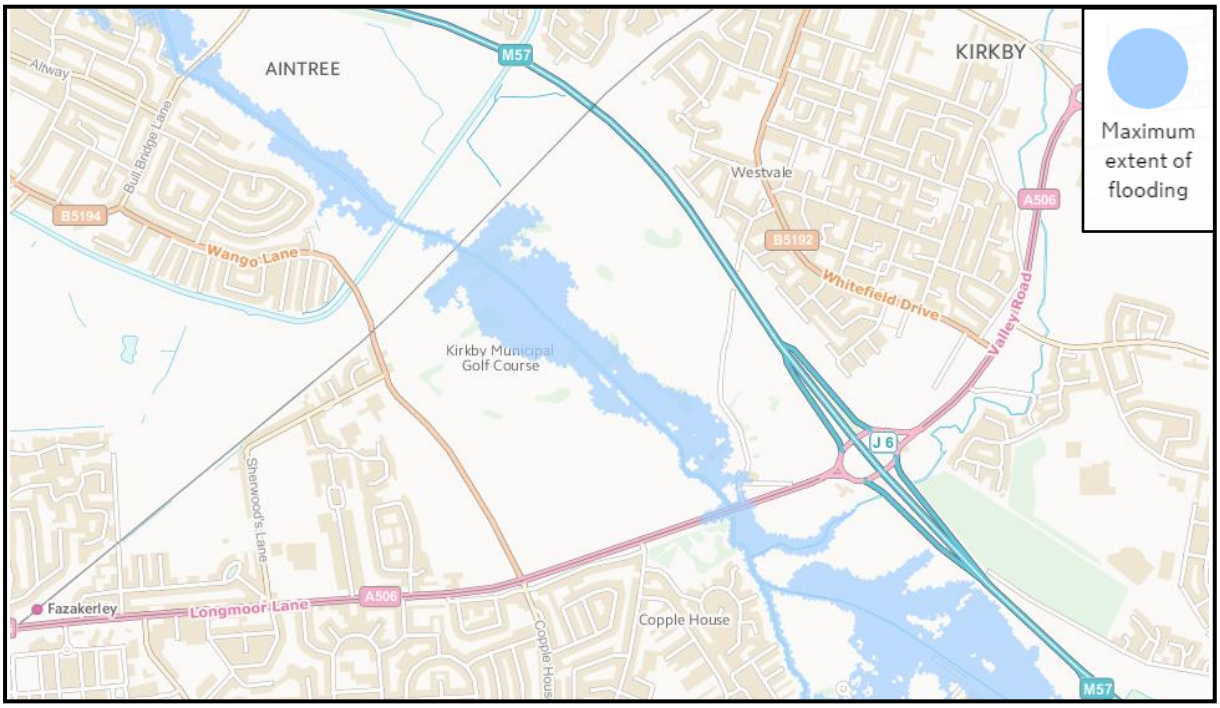
NATIONAL FLOOD MAPPING

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Long Term Flood Risk – Surface Water



Long Term Flood Risk - Reservoirs



Flood Zone Map: Kirkby Valley Golf Club, Valley Road, Liverpool L10 8LQ

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NGR: SJ3950498026

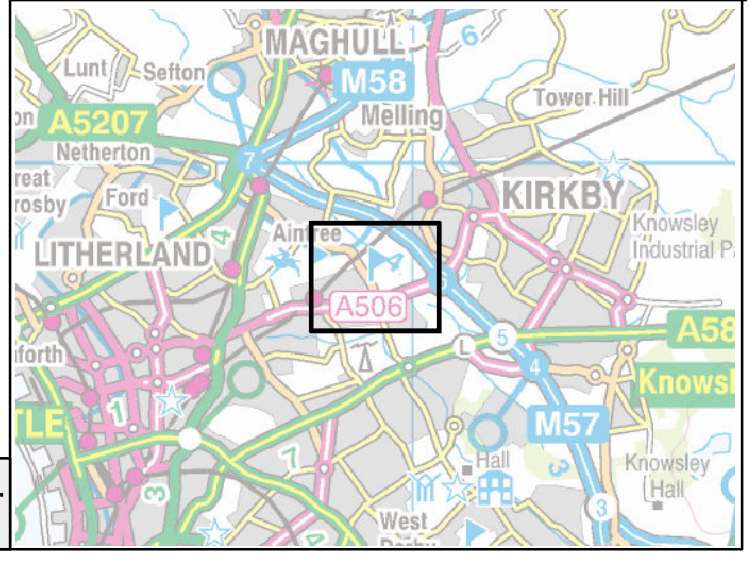
Key

- Main River
- Areas Benefitting from Defences
- Flood Zone 3
- Flood Zone 2

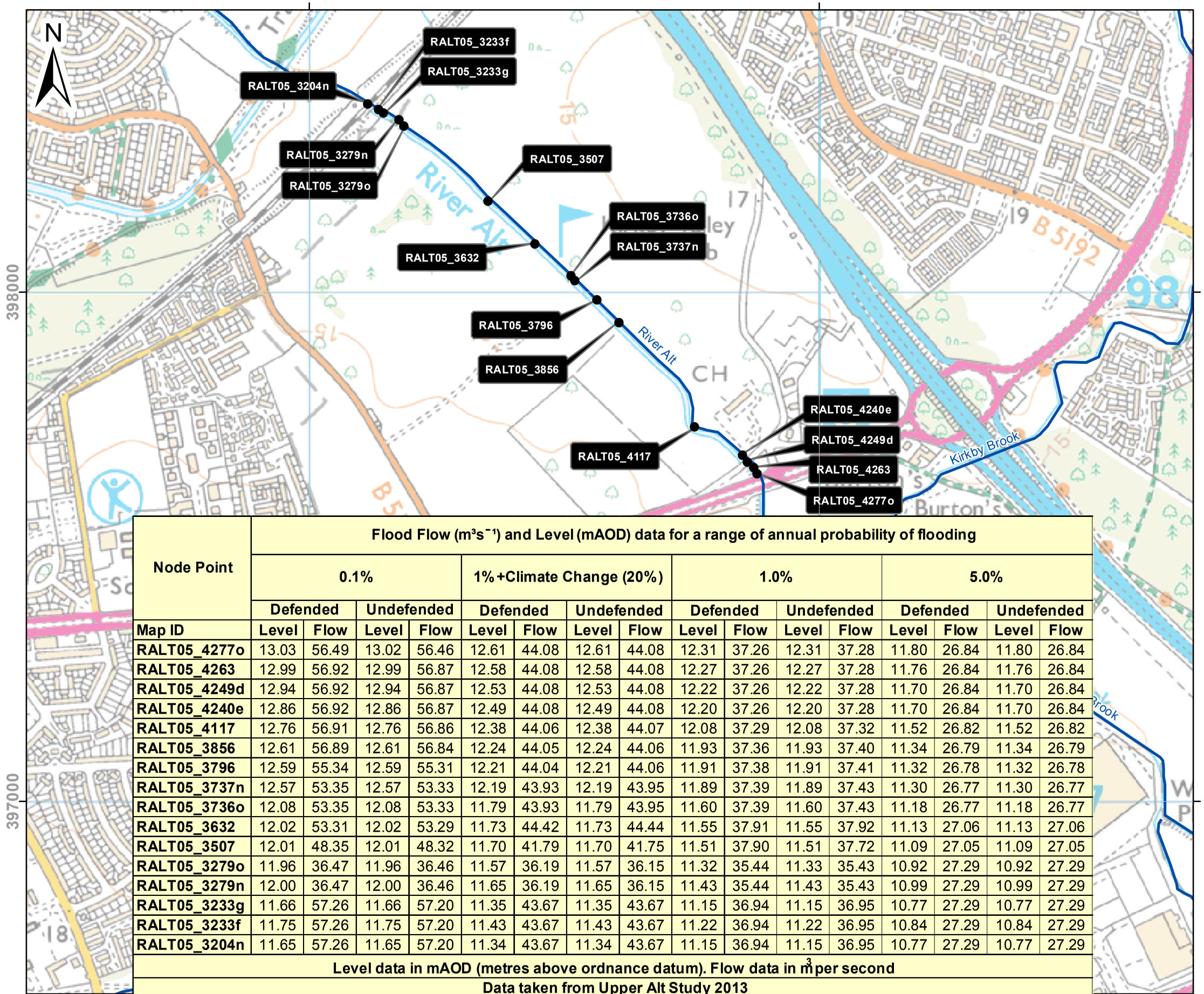
Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.



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Node Point	Flood Flow (m^3s^{-1}) and Level (mAOD) data for a range of annual probability of flooding															
	0.1%				1%+Climate Change (20%)				1.0%				5.0%			
	Defended		Undefended		Defended		Undefended		Defended		Undefended		Defended		Undefended	
Map ID	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
RALT05_4277o	13.03	56.49	13.02	56.46	12.61	44.08	12.61	44.08	12.31	37.26	12.31	37.28	11.80	26.84	11.80	26.84
RALT05_4263	12.99	56.92	12.99	56.87	12.58	44.08	12.58	44.08	12.27	37.26	12.27	37.28	11.76	26.84	11.76	26.84
RALT05_4249d	12.94	56.92	12.94	56.87	12.53	44.08	12.53	44.08	12.22	37.26	12.22	37.28	11.70	26.84	11.70	26.84
RALT05_4240e	12.86	56.92	12.86	56.87	12.49	44.08	12.49	44.08	12.20	37.26	12.20	37.28	11.70	26.84	11.70	26.84
RALT05_4117	12.76	56.91	12.76	56.86	12.38	44.06	12.38	44.07	12.08	37.29	12.08	37.32	11.52	26.82	11.52	26.82
RALT05_3856	12.61	56.89	12.61	56.84	12.24	44.05	12.24	44.06	11.93	37.36	11.93	37.40	11.34	26.79	11.34	26.79
RALT05_3796	12.59	55.34	12.59	55.31	12.21	44.04	12.21	44.06	11.91	37.38	11.91	37.41	11.32	26.78	11.32	26.78
RALT05_3737n	12.57	53.35	12.57	53.33	12.19	43.93	12.19	43.95	11.89	37.39	11.89	37.43	11.30	26.77	11.30	26.77
RALT05_3736o	12.08	53.35	12.08	53.33	11.79	43.93	11.79	43.95	11.60	37.39	11.60	37.43	11.18	26.77	11.18	26.77
RALT05_3632	12.02	53.31	12.02	53.29	11.73	44.42	11.73	44.44	11.55	37.91	11.55	37.92	11.13	27.06	11.13	27.06
RALT05_3507	12.01	48.35	12.01	48.32	11.70	41.79	11.70	41.75	11.51	37.90	11.51	37.72	11.09	27.05	11.09	27.05
RALT05_3279o	11.96	36.47	11.96	36.46	11.57	36.19	11.57	36.15	11.32	35.44	11.33	35.43	10.92	27.29	10.92	27.29
RALT05_3279n	12.00	36.47	12.00	36.46	11.65	36.19	11.65	36.15	11.43	35.44	11.43	35.43	10.99	27.29	10.99	27.29
RALT05_3233g	11.66	57.26	11.66	57.20	11.35	43.67	11.35	43.67	11.15	36.94	11.15	36.95	10.77	27.29	10.77	27.29
RALT05_3233f	11.75	57.26	11.75	57.20	11.43	43.67	11.43	43.67	11.22	36.94	11.22	36.95	10.84	27.29	10.84	27.29
RALT05_3204n	11.65	57.26	11.65	57.20	11.34	43.67	11.34	43.67	11.15	36.94	11.15	36.95	10.77	27.29	10.77	27.29

Level data in mAOD (metres above ordnance datum). Flow data in m^3 per second

Data taken from Upper Alt Study 2013

Environment Agency

Fluvial Flood Levels Map: Kirkby Valley Golf Club, Valley Road, Liverpool L10 8LQ

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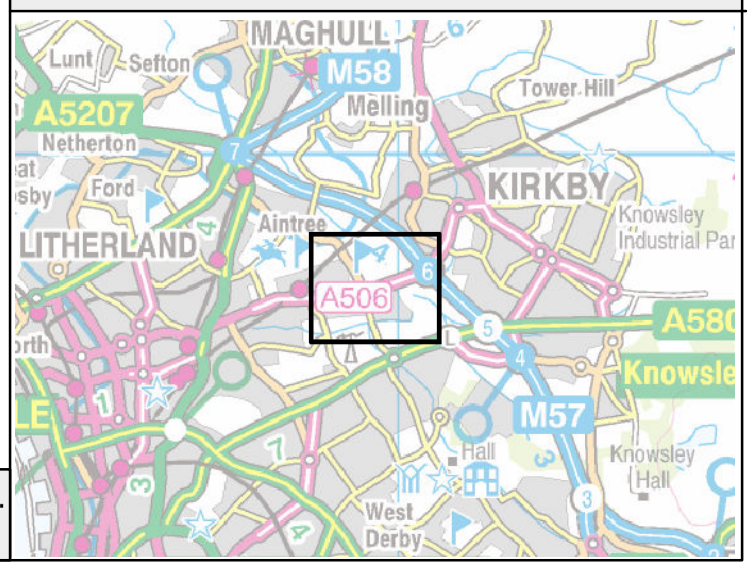
Key

Main River

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.



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Fluvial Flood Levels Map: Kirkby Valley Golf Club, Valley Road, Liverpool L10 8LQ

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NGR: SJ3950498026

Key

Main River

Fluvial 5% annual probability of flooding Defended Scenario

mAOD

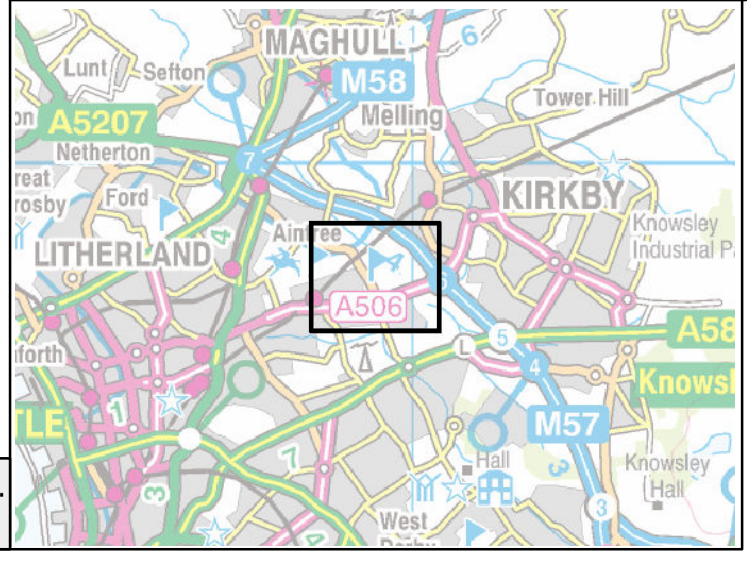
High : 12.75

Low : 10.75

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
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Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.



Defended Level data given in mAOD. (Metres above ordnance datum)

AEP - Annual Exceedance Probability

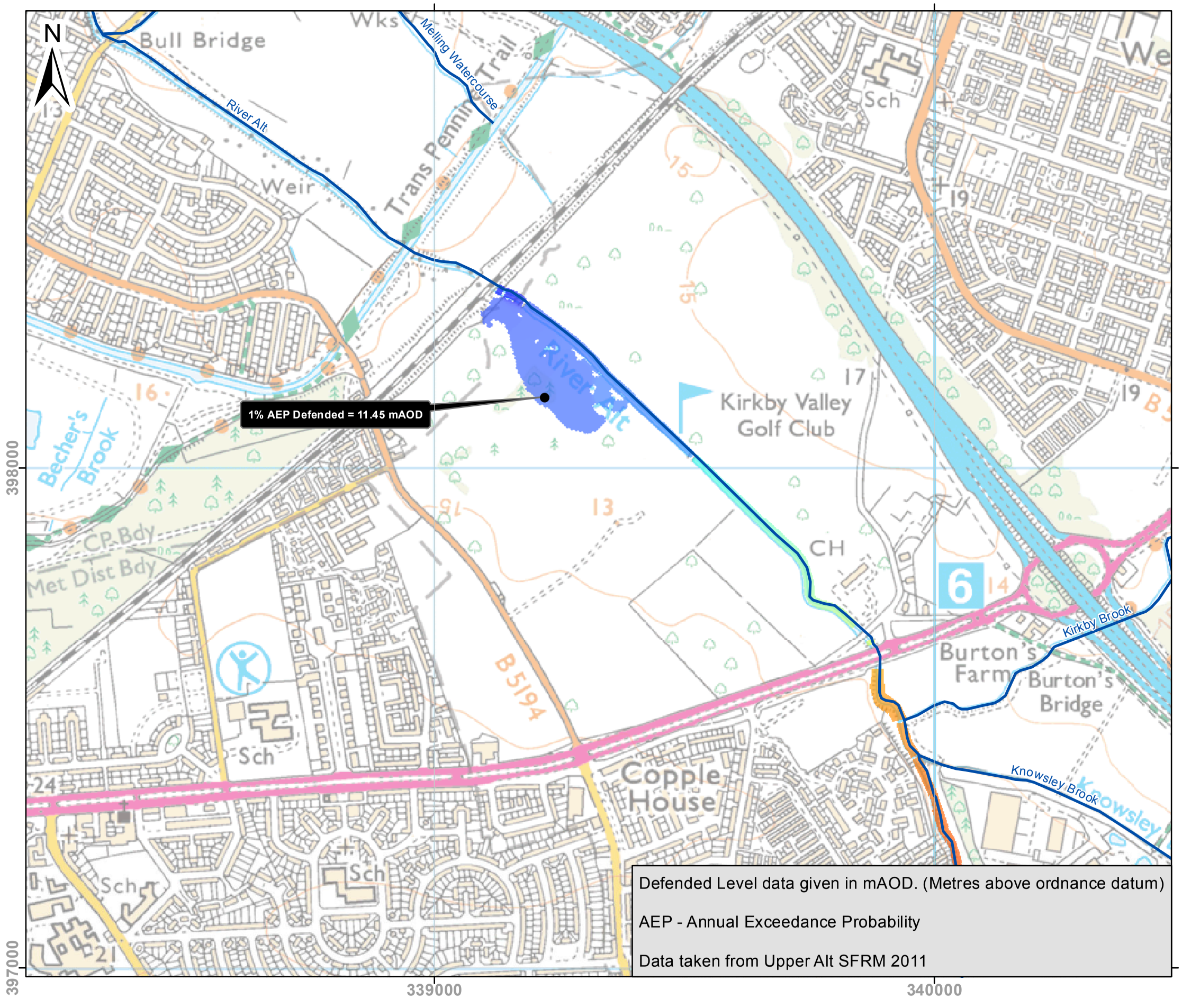
Data taken from Upper Alt SFRM 2011

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Fluvial Flood Levels Map: Kirkby Valley Golf Club, Valley Road, Liverpool L10 8LQ

Produced: 16 August 2019
Our Ref: CL136142
NGR: SJ3950498026



Defended Level data given in mAOD. (Metres above ordnance datum)

AEP - Annual Exceedance Probability

Data taken from Upper Alt SFRM 2011

Key

Main River

Fluvial 1% annual probability of flooding Defended Scenario

mAOD

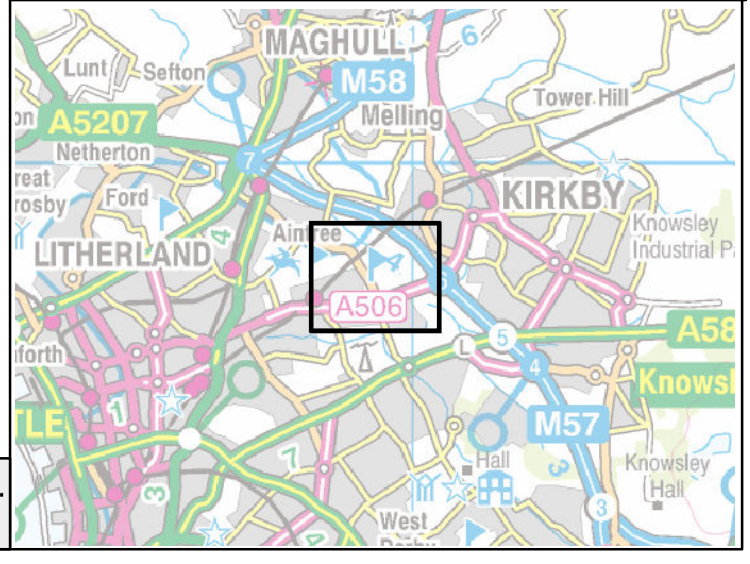
High : 13

Low : 11.25

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

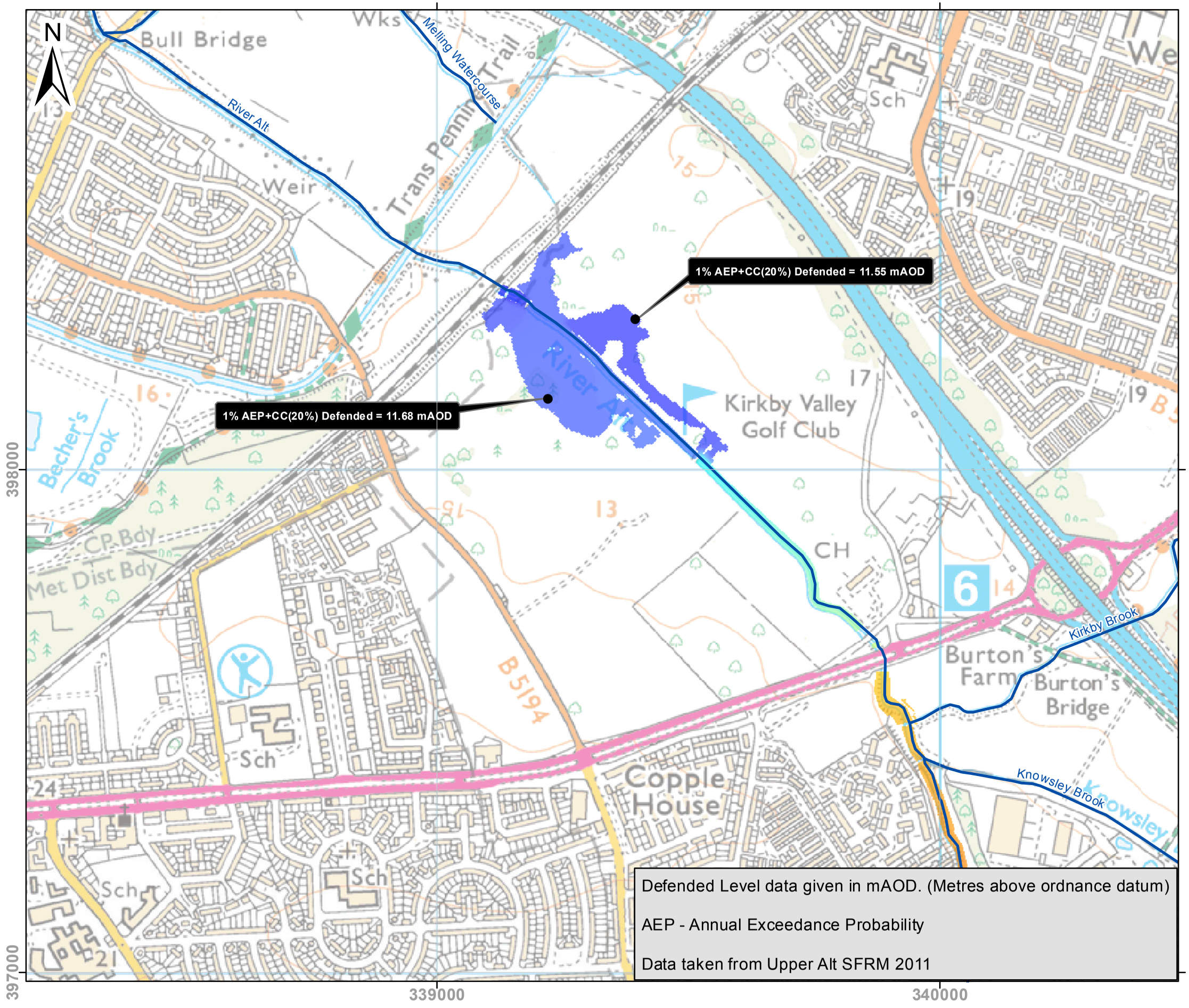
ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.



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Produced: 16 August 2019
Our Ref: CL136142
NGR: SJ3950498026



Defended Level data given in mAOD. (Metres above ordnance datum)

AEP - Annual Exceedance Probability

Data taken from Upper Alt SFRM 2011

Key

Main River

Fluvial Climate Change 1%(+20%) annual probability of flooding Defended Scenario

mAOD

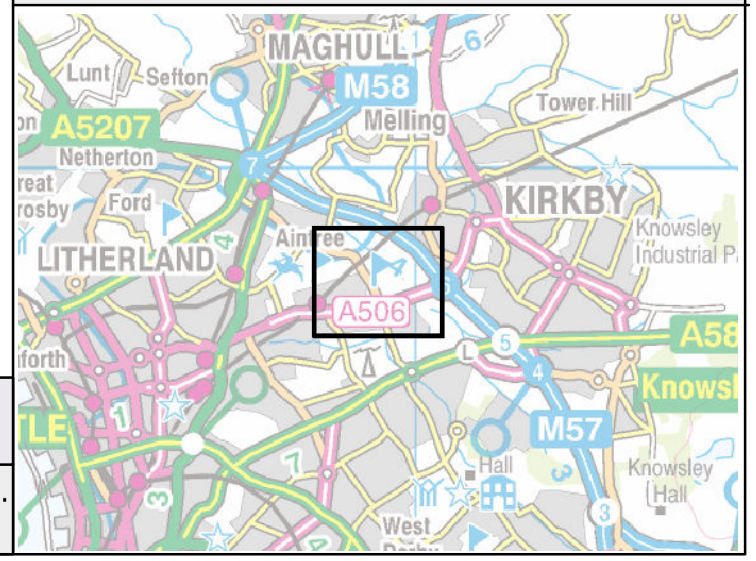
High : 13.5

Low : 11.5

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

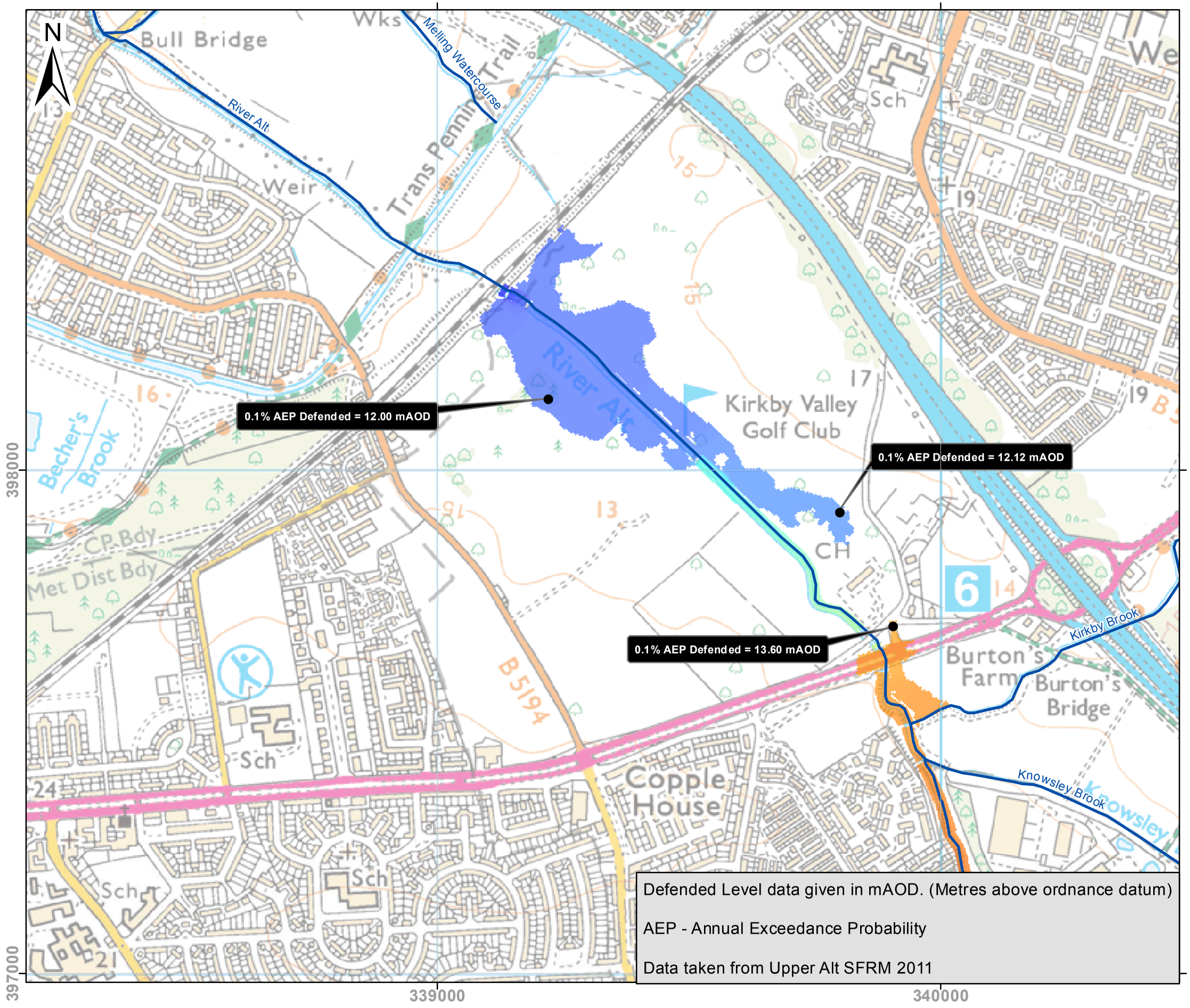
ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.



Modelled water levels with climate change using +20% flow allowances are not suitable for the majority of planning purposes. New climate change allowances can be checked on the following website; www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

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Defended Level data given in mAOD. (Metres above ordnance datum)

AEP - Annual Exceedance Probability

Data taken from Upper Alt SFRM 2011

Fluvial Flood Levels Map: Kirkby Valley Golf Club, Valley Road, Liverpool L10 8LQ

Produced: 16 August 2019
Our Ref: CL136142
NGR: SJ3950498026

Key

Main River

Fluvial 0.1% annual probability of flooding Defended Scenario

mAOD

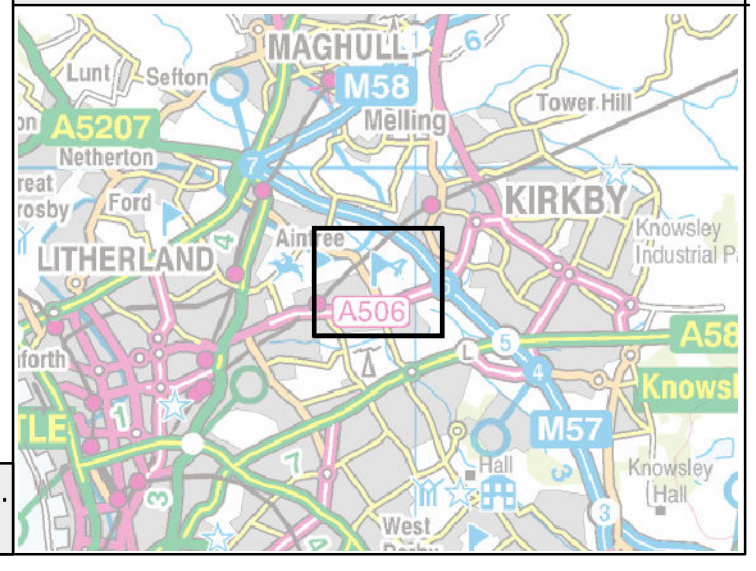
High : 14

Low : 11.75

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.



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Fluvial Flood Levels Map: Kirkby Valley Golf Club, Valley Road, Liverpool L10 8LQ

Produced: 16 August 2019
Our Ref: CL136142
NGR: SJ3950498026

Key

Main River

Fluvial 5% annual probability of flooding Undefended Scenario

mAOD

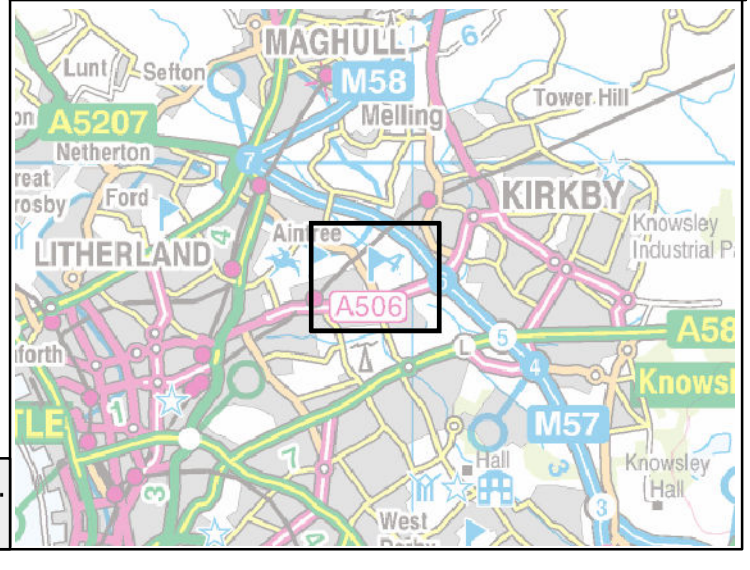
High : 12.5

Low : 10.75

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.

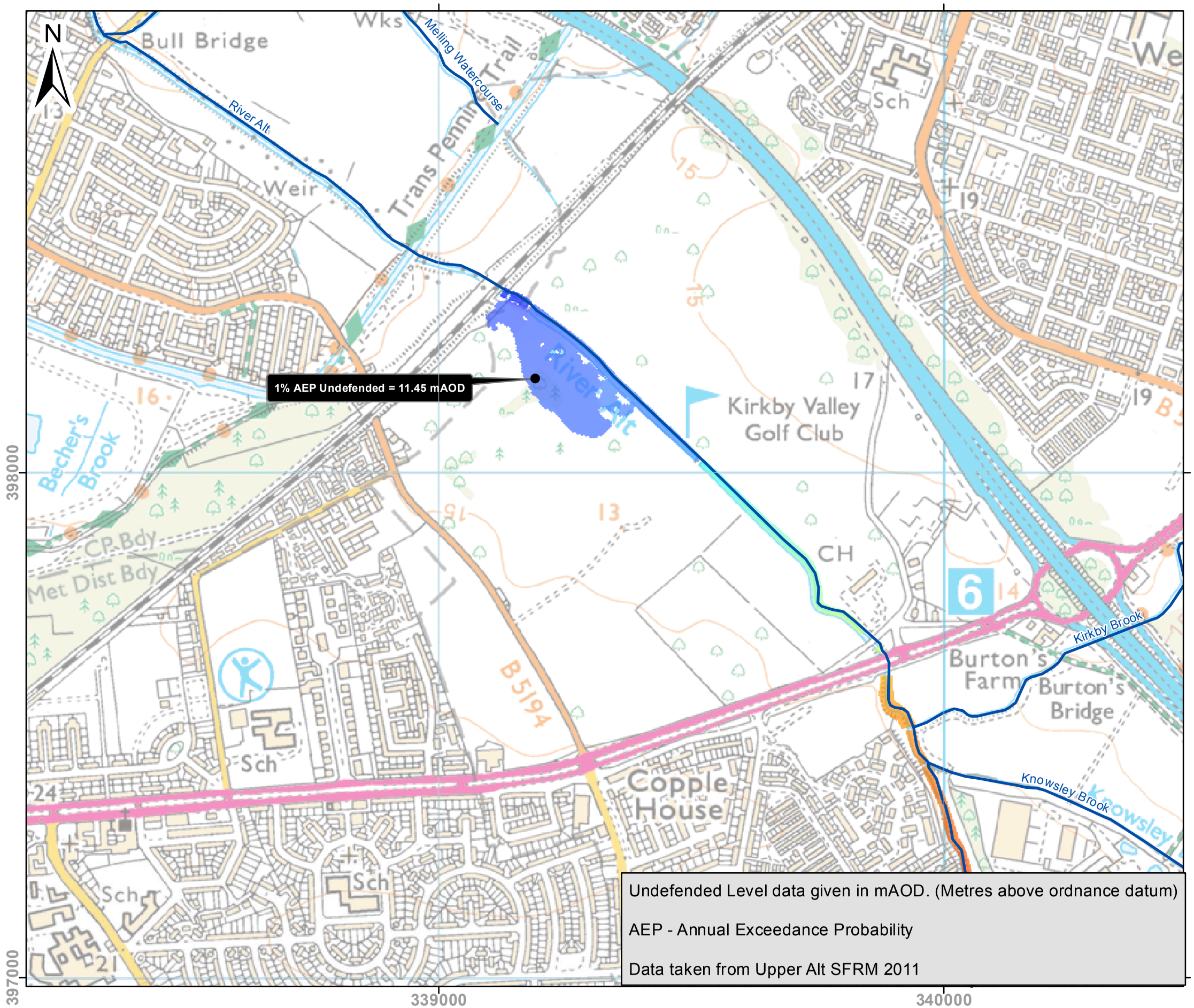


Undefended Level data given in mAOD. (Metres above ordnance datum)

AEP - Annual Exceedance Probability

Data taken from Upper Alt SFRM 2011

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Data taken from Upper Alt SFRM 2011

Fluvial Flood Levels Map: Kirkby Valley Golf Club, Valley Road, Liverpool L10 8LQ

Produced: 16 August 2019
Our Ref: CL136142
NGR: SJ3950498026

Key

Main River

Fluvial 1% annual probability of flooding Undefended Scenario

mAOD

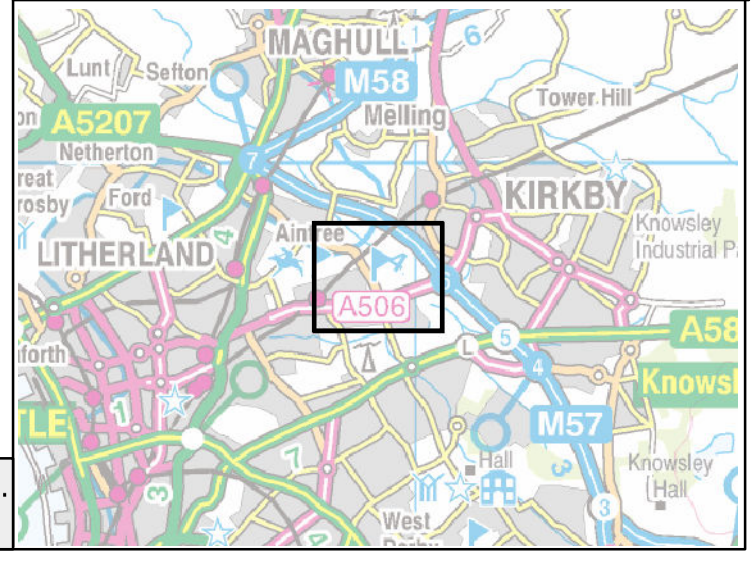
High : 13

Low : 11.25

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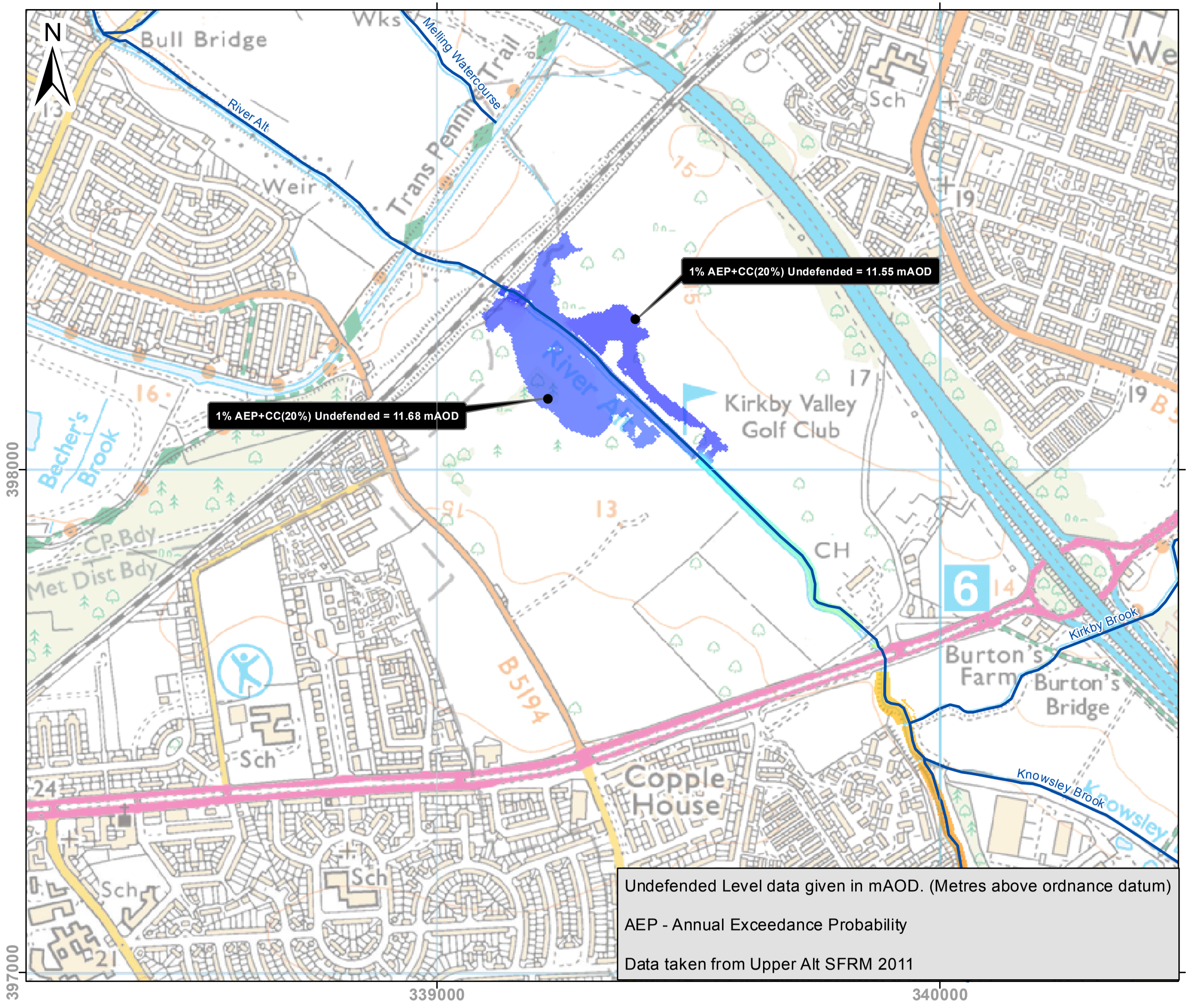
ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1% fluvial flood event.



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Key

Main River

Fluvial Climate Change 1%(+20%) annual probability of flooding Undefended Scenario

mAOD

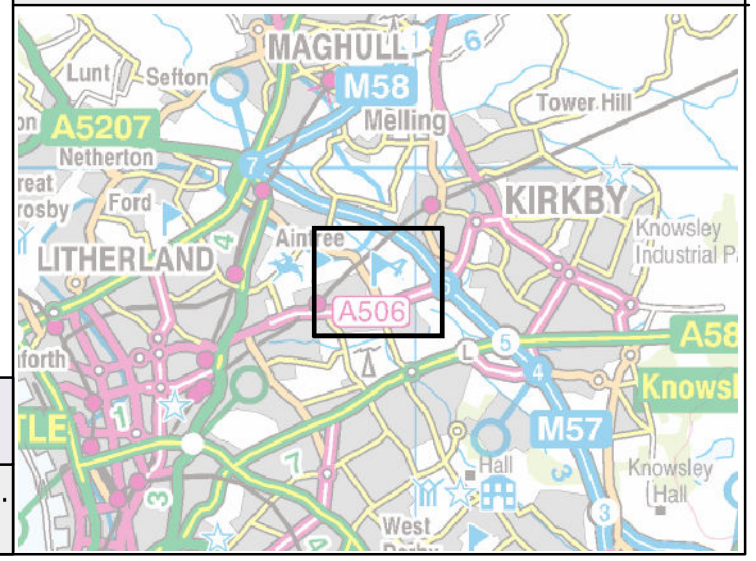
High : 13.5

Low : 11.5

Flood Zone 3 shows the area that could be affected by flooding:
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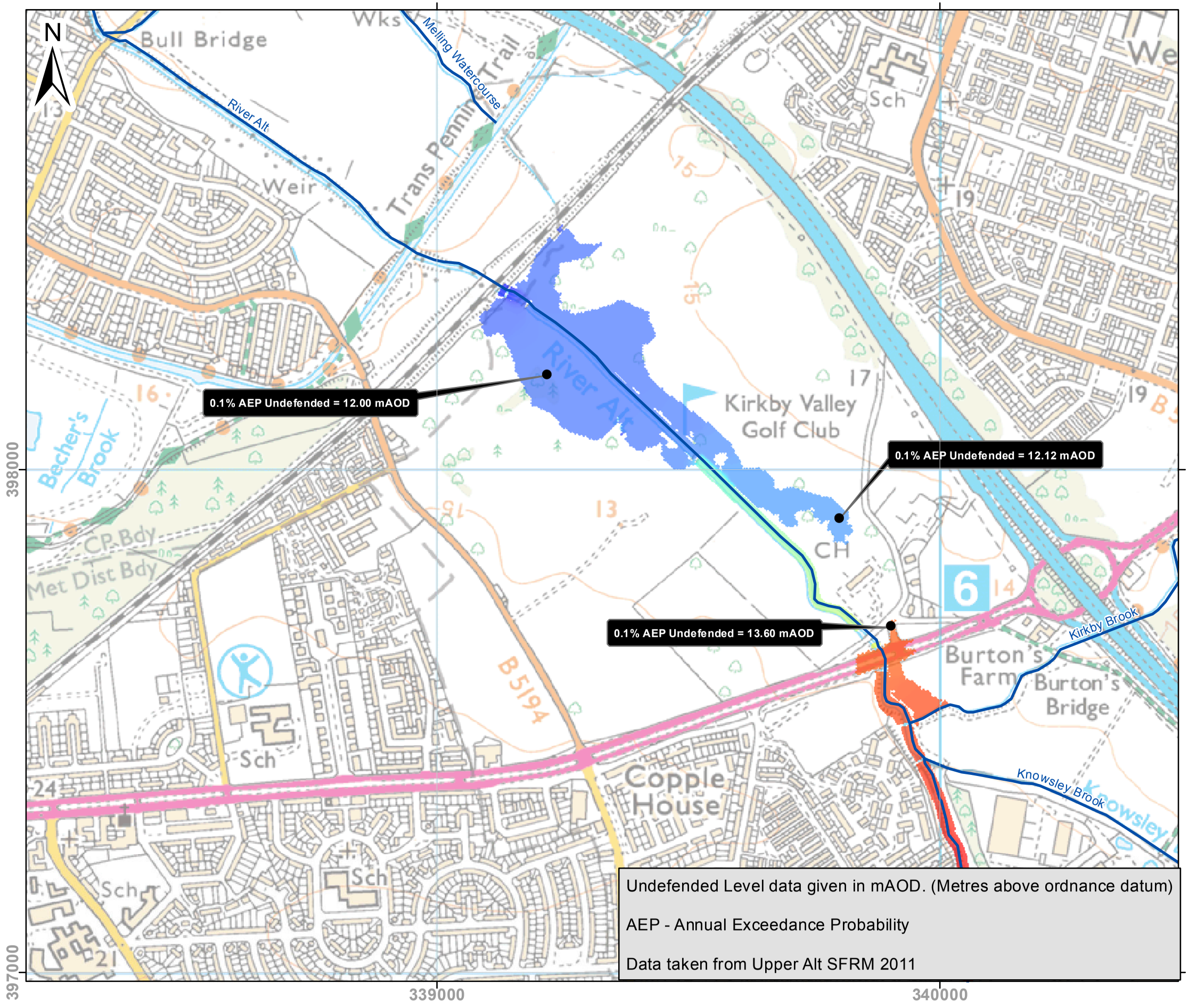
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Key

Main River

Fluvial 0.1% annual probability of flooding Undefended Scenario

mAOD

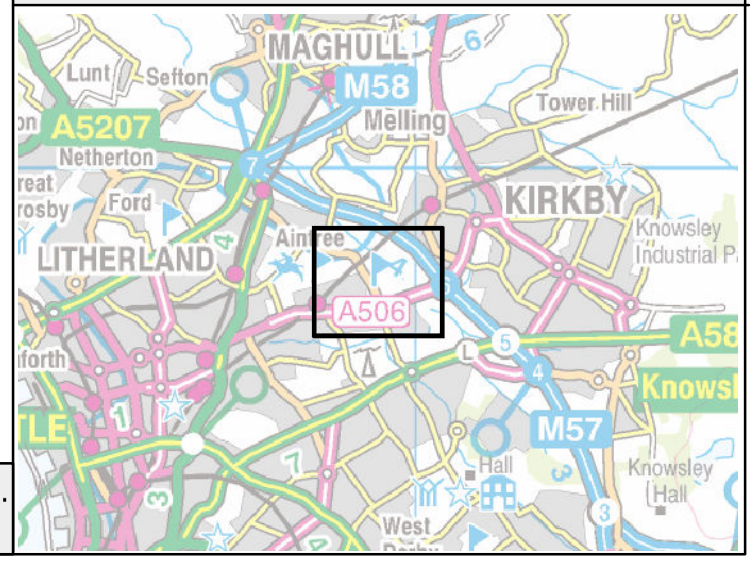
High : 13.75

Low : 11.75

Flood Zone 3 shows the area that could be affected by flooding:
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DO NOT SCALE

LEGEND:

WIDER SITE OWNERSHIP

DEVELOPMENT SITE AREA

EXISTING FEATURES

CONTOURS

17.5m LEVELS

TOP OF BANK
(ESTIMATED BASED ON AERIAL IMAGERY & SITE OBSERVATIONS)

8m EASEMENT FROM TOP OF BANK

FLOOD ZONES
(BASED ON THE ENVIRONMENT AGENCY SHAPEFILE DATA OBTAINED FROM GOV.UK, PUBLISHED APRIL 2019)

FLOOD ZONE 3

FLOOD ZONE 2

REV	DATE	BY	DESCRIPTION	CHK
C	10.02.20	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
B	07.08.19	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
A	05.08.19	KW	PRELIMINARY FOR REVIEW	RDN

DRAWING STATUS:

PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Manse Farm Barns, Manse Road, Scotland, Flintshire, CH5 2LY
Tel: 07764 785041 enquiries@betts-consulting.co.uk

CLIENT:

L32 TRADING LTD

PROJECT:

KIRKBY VALLEY GOLF CLUB
LIVERPOOL

TITLE:

FLOOD ZONE PLAN
(Based on EA 2019 Release Shapfiles)

DATE:	SCALE @ A0:	DRAWN:	CHECKED:
FEB 2020	1:1000 @ A0	KW	RDN

PROJECT:	DRAWING No:	REV:
HYD444	100	C

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APPENDIX C: UU CORRESPONDENCE

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Megan Berry

From: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Sent: 25 July 2019 08:11
To: Megan Berry
Subject: RE: Sewer Flood Risk

Hi

'I can confirm we do have current records of sewer flooding on our DG5 register within the vicinity of the proposed development. The DG5 register is a register of properties that have flooded as a result of hydraulic inadequacy of the public sewer network.

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

Our response does not include:

- *any sewer flooding events caused by blockages or collapses which are the result of third party actions, natural events or other actions over which UUW has no control and not a facet of sewer capacity; or*

- *any historical sewer flooding events that have been removed from the register as a result of investment in our infrastructure.*

As with all development sites, we recommend you liaise with our water and wastewater engineers by contacting our Developer Services team so the details of your development proposal can be considered further. Details can be found at the following link.

https://www.unitedutilities.com/services/builders-developers/

Should you require any further information please do not hesitate to contact me.'

Regards,

The WOW! Awards
for outstanding customer service...
If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow
Sue King
Developer Services Assistant
Developer Services
Network Delivery
T: 01925 679413 (internal 79413)
unitedutilities.com

Please note that as from the 1 April 2019 the fee for the administration of a Building Over Agreement will be £139.00 (this fee is none vatable) http://www.unitedutilities.com/build-over-sewer.aspx).

Please send postal applications to the following address:

Wastewater Developer Services and Planning, 2nd floor Grasmere House, Lingley Mere Business Park, Lingley Green Ave, Great Sankey, Warrington WA5 3LP

Any applications sent to Gatewarth Industrial Estate will result in delays in your application.

From: Megan Berry [mailto:meganberry@betts-associates.co.uk]
Sent: 24 July 2019 16:30
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: Sewer Flood Risk

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/ office

To whom it may concern,

Kirkby Valley Golf Club, Valley Road, Liverpool

Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry BSc(Hons) GradCIWEM
Graduate Flood Risk Analyst

BETTS HYDRO
Consulting Engineers

Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
Chester +44 (0)1244 289041

meganberry@betts-associates.co.uk
www.betts-associates.co.uk

CIVIL | STRUCTURAL | GEO-ENVIRONMENTAL | HYDROLOGY | FLOOD RISK MANAGEMENT
SUDS | STRUCTURAL SURVEYS | PARTY WALL DUTIES | INFILTRATION | GEOTECHNICAL

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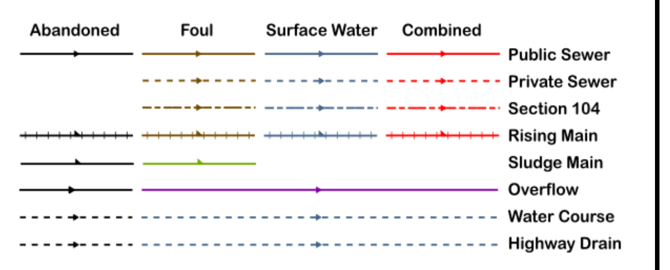
The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
7204	18.83	SW	17.05	375			CO	30.80584	
0110	18.1	SW	15.74	375			CO	2	1 in 200
0110	18.1	SW	15.74	375			CO	2	1 in 200
8304	17.86	FO	15.29	150			VC	41.12574	1 in 158
8916		FO		150			VC	11.91937	
8412	17.64	SW	13.91	525			CO	12.70254	1 in 12
8412	17.64	SW	13.91	525			CO	12.70254	1 in 12
7018		FO		150			VC	9.232847	
0103	18.53	SW	16.37	225			VC	41.61731	1 in 134
0103	18.53	SW	16.37	225			VC	41.61731	1 in 134
5115		FO	0	100			VC	12.75338	
5115		FO	0	100			VC	12.75338	
6009		CO		150			VC	15.05192	
7019		FO		150			VC	16.0308	
8415	17.77	SW	12.71	525			CO	15.7563	1 in 315
8415	17.77	SW	12.71	525			CO	15.7563	1 in 315
9115		SW		150			VC	8.318845	
8103	18.58	SW	16.7	375			CO	64.88139	1 in 171
0007		SW	0	375			CO	26.61977	
0007		SW	0	375			CO	26.61977	
8205	17.93	SW	16.21	225			VC	27.34712	1 in 85
9208	17.58	SW	15.63	300			VC	27.18023	1 in 85
6102	18.85	FO	16.46	225			VC	24.55267	1 in 153
3301		FO	0	900			ST	336.5427	
9904		SW	0	939			CO	23.94731	
9002		FO		150			VC	2.260747	
6407	18.46	SW	16.05	225			CO	59.89844	1 in 107
6407	18.46	SW	16.05	225			CO	59.89844	1 in 107
8906	17.31	SW	15.47	150			VC	2.828427	
5411	21.18	SW	19.8	225			VC	13	1 in 130
8302		FO		100			VC	9.383154	
5203	19.61	SW	0	225			VC	58.5235	
6903	16.43	FO	13.09	300			VC	75.16648	
8410	17.57	SW	14.19	525			CO	17.32754	1 in 62
7017		FO		150			VC	1.057597	
9304	17.65	FO	14.99	150			VC	13.4562	1 in 336
5205	20.5	SW	18.9	300			CO	31.38471	1 in 63
5205	20.5	SW	18.9	300			CO	31.38471	1 in 63
8315		FO		0			VC	10.96112	
9101	17.74	SW	15.94	450			CO	103.1746	1 in 295
6406	18.18	FO	12.22	150			VC	25.69859	1 in 15
6406	18.18	FO	12.22	150			VC	25.69859	1 in 15
4109	18.28	FO	17.05	225			VC	47.38143	1 in 364
4109	18.28	FO	17.05	225			VC	47.38143	1 in 364
0004	17.96	SW	15.68	375			CO	1	
0004	17.96	SW	15.68	375			CO	1	
9316	17.8	FO	15.16	150			VC	16.79016	1 in 99
5114		FO	0	100			VC	4.003606	
5114		FO	0	100			VC	4.003606	
5406	19.66	FO		150			VC	8.091113	
5406	19.66	FO		150			VC	8.091113	
5213		FO		100			VC	4.735409	
8907	17.24	SW	15.59	150			VC	17.20465	1 in 191
7014		FO		100			VC	5.212698	
7009		SW		100			VC	13.60096	
7501	16.37	FO	9.6	1220			BR	86.18609	1 in 1724
7501	16.37	FO	9.6	1220			BR	86.18609	1 in 1724
5304	20.42	FO	17.83	225			VC	60.87693	1 in 80
0001	17.78	FO	15.24	225			VC	44.10215	
0001	17.78	FO	15.24	225			VC	44.10215	
7311	17.97	FO	13.53	150			VC	52.74548	1 in 182
9105	18.2	SW	15.88	300			CO	21.9545	1 in 366
9105	18.2	SW	15.88	300			CO	21.9545	1 in 366
5207	20.32	FO	18.36	150			VC	33.24154	1 in 87
5207	20.32	FO	18.36	150			VC	33.24154	1 in 87
8202	19.11	FO	16.35	225			VC	65.19202	1 in 6519.20240
6404	18.16	FO	9.55	1220			BR	140.4339	1 in 1170
6404	18.16	FO	9.55	1220			BR	140.4339	1 in 1170
6003	17.97	SW	16.71	225			VC	30.5873	1 in 78
6201		FO		100			VC	3.299389	
6307		FO		150			VC	13.62371	
4312	20.8	SW	19.69	300			CO	12.08305	1 in 110
6408	18.54	FO	12.57	150			VC	24.15855	1 in 69
6408	18.54	FO	12.57	150			VC	24.15855	1 in 69
9909		FO		150			VC	14.32865	
5305	19.81	SW	19.23	300			VC	23.25941	1 in 258
8003		SW	0	150			VC	43.56604	
0102	18.44	SW	16.57	225			VC	41.34005	1 in 80
7306	18.73	SW	15.49	300			CO	17.13647	1 in 343
7007		SW		100			VC	35.55892	
6017		FO		100			VC	6.262609	
8311	18.07	FO	15.64	150			VC	29.2906	1 in 84
8109		FO		150			VC	13.05393	
7101		SW	0	150			VC	39.66106	
9917		FO		150			VC	7.374465	
9917		FO		150			VC	7.374465	
6110		FO		100			VC	7.09701	
4307	20.88	SW	19.2	300			CO	45.88028	1 in 153
4307	20.88	SW	19.2	300			CO	45.88028	1 in 153
0901		FO	0	225			VC	45.17606	
0901		FO	0	225			VC	45.17606	
5402		FO	0	225			VC	74.43118	
5402		FO	0	225			VC	74.43118	
8413	17.73	FO	15.94	150			VC	15.01837	1 in 65
8413	17.73	FO	15.94	150			VC	15.01837	1 in 65
4004	17.71	SW	15.63	600			CO	67.92132	1 in 295
4004	17.71	SW	15.63	600			CO	67.92132	1 in 295
6403	17.98	SW	16.37	225			VC	15.9296	1 in 145
6403	17.98	SW	16.37	225			VC	15.9296	1 in 145
5408	21.34	SW	19.86	225			VC	13.92839	1 in 348
6105		FO		100			VC	24.79706	
7105		CO		100			VC	4.068139	
8305	17.94	SW	14.91	450			CO	24.42432	1 in 349
8601	13.42	FO	9.7	1220			BR	168.2788	1 in 1683
5406	19.66	FO	18.14	150			VC	18.21965	
5406	19.66	FO	18.14	150			VC	18.21965	
6916		CO		150			VC	4.822834	
8001	18.15	SW	16.6	225			VC	57.14018	1 in 190
4201	20.31	SW	18.37	450			CO	31.95309	1 in 399
4201	20.31	SW	18.37	450			CO	31.95309	1 in 399
5403		SW		100			PVC	7.147776	
5403		SW		100			PVC	7.147776	
8310	18	FO	15.75	150			VC	11.59532	1 in 105
8407	17.61	FO	14.22	150			VC	10.23668	1 in 205
9305	17.52	SW	15.31	375			CO	31.17039	1 in 164
5206	20.5	FO	18.74	150			VC	26.40076	1 in 69
5206	20.5	FO	18.74	150			VC	26.40076	1 in 69
9102	17.73	FO	15.27	225			VC	50.77401	1 in 1015
8216		FO		100			VC	10.028	
9916		FO		150			VC	30.26082	
6007		CO		150			VC	21.10933	
5003	17.49	SW	15.8	600			CO	8.83092	1 in 126
5003	17.49	SW	15.8	600			CO	8.83092	1 in 126
7209		CO		100			VC	14.6761	
0002	17.75	SW	15.52	375			CO	48.25971	
0002	17.75	SW	15.52	375			CO	48.25971	
5317		FO		100			VC	7.036206	
5317		FO		100			VC	7.036206	
7303	18.94	SW	17.45	300			VC	26.62705	1 in 296
8105	18.3	SW	16.66	225			VC	59.07622	1 in 269
7906	17.27	FO	15.63	225			VC	82.37718	1 in 44
4110		SW	0	225			VC	48.25971	
4110		SW	0	225			VC	48.25971	
7308	18.3	SW	15.44	300			CO	54.08308	1 in 135
7913		FO		100			VC	4.598158	
9111	18.28	SW	0	225			VC	39.11522	
9111	18.28	SW	0	225			VC	39.11522	
8912		FO	0	225			VC	4.512362	
8401	17.94	FO	13.84	150			VC	26.1412	1 in 187
4314	20.73	SW	19.58	300			CO	29.73214	1 in 165
4314	20.73	SW	19.58	300			CO	29.73214	1 in 165
7205		SW	0	375			CO	32.75668	
8206	17.97	FO	15.92	150			VC	27.19662	1 in 74
6301	19.49	SW	17.9	225			VC	29.01724	1 in 104
7207	18.59	FO	16.88	225			VC	96.51942	1 in 193
5201		FO	0	1220			BR	4.123106	
0902		SW	0	375			CO	30.06081	
0902		SW	0	375			CO	30.06081	
9317	17.78	SW	15.42	300			VC	16.66022	1 in 278
7304	18.92	FO	17.29	225			VC	82.37718	1 in 206
9309	17.86	SW	16.25	225			VC	14.59231	1 in 69
8302	18.15	FO	15.03	150			VC	28.6397	1 in 19
9001	17.8	SW	16.3	225			VC	41.59538	1 in 33
9307	17.52	SW	15.12	450			CO	26.63845	1 in 148
9103	18.01	SW	16.22	450			CO	26.07452	1 in 109
9114		SW		150			VC	9.40096	
5110		SW	0	100			VC	4.273706	
5110		SW	0	100			VC	4.273706	
7211		CO		150			VC	17.95068	
8316		FO		0			VC	13.63618	
6415		FO		150			VC	7.894062	
8102	18.67	FO	15.82	225			VC	49.1078	1 in 214
6917		CO		150			VC	13.4262	
5410		FO	0	150			VC	24.62195	
5307	21.41	SW	19.97	225			VC	33.65954	1 in 421
5307	21.41	SW	19.97	225			VC	33.65954	1 in 421
7912		FO		100			VC	6.303711	
8307	18.01	SW	16.04	225			VC	12.02686	1 in 93
9006		FO		150			VC	1.113355	
8312	17.55	SW	14.74	450			CO	30.54022	1 in 139
5319		FO		100			VC	14.07807	
5319		FO		100			VC	14.07807	
0005	18.36	SW	16.19	225			VC	30.80584	1 in 134
8212		FO		150			VC	14.93786	
8203	18.01	SW	16.18	225			CO	34.60461	1 in 55
7910		FO		100			VC	6.736717	
9314	17.5	FO	14.72	150			VC	29.24323	1 in 172
8208	18.07	FO	15.55	150			VC	20.33594	1 in 136
4204		SW	0	225			VC	51.26402	
4204		SW	0	225			VC	51.26402	
8306	17.82	SW	16.32	225			VC	16.60133	1 in 59
5405		FO		100			PVC	15.25413	
4106	19.29	FO	17.8	225			VC	53.85165	1 in 128
4106	19.29	FO	17.8	225			VC	53.85165	1 in 128
3301		FO	0	450			ST	335.0761	
8211		FO		150			VC	7.687081	
7301	19.07	SW	17.43	150			VC	8.602325	
9315	17.5	FO	14.55	150			VC	12.93906	1 in 162
0101	18.08	SW	15.72	375			CO	28.30194	1 in 708
0101	18.08	SW	15.72	375			CO	28.30194	1 in 708
9119		FO		150			VC	14.11697	
9119		FO		150			VC	14.11697	
7002	17.58	SW	15.63	225			VC	9.055386	
5104	18.3	FO	16.57	225			VC	57.93962	1 in 92
9107	18.19	SW	16	300			CO	33.28663	1 in 303
9107	18.19	SW	16	300			CO	33.28663	1 in 303
5401	19.51	FO	17.65	225			VC	5.385165	
5401	19.51	FO	17.65	225			VC	5.385165	
9206	17.46	SW	15.93	225			VC	33.26924	1 in 79
5407		FO	0	150			VC	16.49242	
5407		FO	0	150			VC	16.49242	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
9202	18.04	SW	16.44	225			VC	31.90611	1 in 128
6405	18.14	SW	16.26	225			VC	23.91133	1 in 114
6405	18.14	SW	16.26	225			VC	23.91133	1 in 114
5101		FO	0	150			VC	7.203097	
6103	18.46	SW	16.54	300			CO	51.24451	1 in 165
6412		FO		100			VC	4.26433	
7004	17.53	SW	16.24	225			VC	27.85678	1 in 47
8303	17.89	SW	15.55	300			CO	37.67304	1 in 188
9303	17.65	SW	15.36	300			VC	13.96138	1 in 279
0905		SW	0	939			CO	62.61435	
0905		SW	0	939			CO	62.61435	
8416		FO		100			PVC	29.44277	
9312	18.01	FO	15.83	150			VC	14.34195	1 in 25
8406	17.6	SW	14.67	450			CO	11.43476	1 in 76
6001	17.35	SW	15.6	450			CO	69.64194	1 in 188
9308	17.46	SW	14.94	450			CO	13.13664	1 in 66
6112		FO		150			VC	6.659176	
6111		FO		150			VC	14.77341	
5107		FO	0	150			VC	32.17324	
6013		FO		150			VC	8.336884	
8903	17.07	FO	14.08	225			VC	23.19921	1 in 136
8408	17.62	SW	14.52	525			CO	20.33991	1 in 62
8101	18.71	SW	16.31	375			CO	49.90943	1 in 555
6913		SW		150			VC	3.242147	
6024		CO		100			VC	5.415915	
8207	18.08	SW	15.89	300			VC	19.72623	1 in 197
5310		FO	0	150			VC	28.28427	
8108		FO		150			VC	5.383275	
9306	17.53	FO	14.95	150			VC	28.87439	1 in 126
9104	17.96	FO	15.59	225			VC	29.31256	1 in 109
9302	17.88	FO	15.22	150			CO	8.658527	1 in 144
8402	17.94	SW	14.84	450			CO	21.34356	1 in 178
5309		SW	0	150			VC	14	
5904	17.24	FO	15.3	150			VC	10.71871	1 in 2
5904	17.24	FO	15.3	150			VC	10.71871	1 in 2
7915		FO		100			VC	3.953738	
0104	18.36	SW	16.41	225			VC	37.73592	1 in 122
0104	18.36	SW	16.41	225			VC	37.73592	1 in 122
8409	17.56	FO	15.61	150			VC	16.15495	1 in 12
6304	20	FO	9.43	1220			BR	156.5248	
4313	20.93	SW	19.81	300			CO	29.96665	1 in 130
4313	20.93	SW	19.81	300			CO	29.96665	1 in 130
5301	20.45	SW	19.17	225			CO	24.20744	
8905	17.35	SW	14.91	225			VC	74.0761	
9310	18.04	SW	16.04	225			VC	17.60689	1 in 45
7203	18.97	SW	17.64	375			CO	28.01785	1 in 33
5102	18.31	FO	17.29	225			VC	40.84647	
8414	17.71	SW	12.84	525			CO	12.036	1 in 93
8414	17.71	SW	12.84	525			CO	12.036	1 in 93
7914		FO		100			VC	4.310979	
5311	20.68	SW	19.41	225			VC	24.04163	1 in 401
7905		SW	0	300			VC	9.219544	
9005	17.51	FO	15.2	225			VC	52.43091	1 in 655
5103	18.37	SW	16.91	225			VC	18.37816	
8411	17.63	FO	15.71	150			VC	16.37448	1 in 164
8411	17.63	FO	15.71	150			VC	16.37448	1 in 164
8002	18.62	SW	17.45	225			VC	58.60034	1 in 49
6104	18.51	FO	16.29	225			VC	54.07518	1 in 135
8201	19.09	SW	16.75	375			CO	65.19221	1 in 2173
5209	19.81	SW	19.14	300			VC	32.89377	1 in 274
5417		FO		300			VC	18.37557	
5417		FO		300			VC	18.37557	
5001		FO		100			VC	9.045515	
9401	17.61	SW	12.66	525			CO	36.79497	1 in 26
9401	17.61	SW	12.66	525			CO	36.79497	1 in 26
9207	17.51	FO	15.68	150			VC	32.60294	1 in 71
8904	17.11	SW	15.25	225			VC	28.20287	1 in 188
8301	18.16	SW	15.35	375			CO	30.50685	1 in 98
8405	17.55	FO	14.17	150			VC	28.51688	1 in 238
6308		FO		100			VC	3.128721	
8915		FO		150			VC	24.1281	
6010		CO		150			VC	15.02944	
9004	17.58	FO	15.11	225			VC	12.08305	
9004	17.58	FO	15.11	225			VC	12.08305	
5208	20.32	SW	19.02	300			CO	27.313	1 in 228
5208	20.32	SW	19.02	300			CO	27.313	1 in 228
0904		FO	0	225			VC	52.81141	
0904		FO	0	225			VC	52.81141	
9204	17.89	FO	15.4	150			VC	23.22146	1 in 137
6018		FO		150			VC	7.895736	
9110	18.19	FO	16.55	225			VC	32.44996	1 in 216
6005	17.72	SW	16.16	375			CO	73.53911	1 in 150
7312		FO		100			VC	5.953602	
9311	17.71	SW	15.65	225			CO	17.4925	1 in 25
7907		SW	0	300			VC	68.50548	
5106		FO	0	150			VC	3.491815	
9210		FO		100			VC	13.39685	
8317		FO		100			VC	7.156271	
9908		FO	0	225			VC	32.88065	
9301	17.86	SW	15.51	300			CO	8.408864	1 in 93
5318		FO		100			VC	14.90664	
5318		FO		100			VC	14.90664	
5004	17.45	FO	15.81	150			VC	9.839408	1 in 30
5004	17.45	FO	15.81	150			VC	9.839408	1 in 30
4309	20.94	SW	19.4	300			CO	33.61547	1 in 168
4309	20.94	SW	19.4	300			CO	33.61547	1 in 168
6305		FO		100			VC	9.475478	
5308		FO	0	150			VC	11.74955	
5105	18.97	FO	10.97	1220			BR	205.0604	1 in 325
7202	19.55	SW	18.16	225			VC	80.21222	1 in 90
5202		FO	0	1220			BR	31.257	
8404	17.61	SW	14.72	450			CO	28.82108	1 in 576
6904	16.86	FO	0	300			VC	37.73592	
7309	18.3	FO	13.24	150			VC	16.63385	1 in 42
5302	20.73	SW	19.35	225			VC	30.41381	1 in 169
0003	18.01	FO	15.41	225			VC	28.86174	1 in 192
0003	18.01	FO	15.41	225			VC	28.86174	1 in 192
5306	19.96	FO	17.07	225			VC	8	
5303	19.81	FO	17.98	225			VC	15.23155	1 in 102
9003	17.55	SW	15.6	450			CO	16.12452	
9003	17.55	SW	15.6	450			CO	16.12452	
9205	17.56	FO	15.23	150			VC	28.382	1 in 101
4401	20.39	FO	19.19	150			VC	62.99297	1 in 95
4401	20.39	FO	19.19	150			VC	62.99297	1 in 95
7201		SW	0	150			VC	66.0303	
5412		FO	0	150			VC	20.61553	
7302	18.69	SW	17.32	375			CO	60.75369	
7307	18.72	FO	12.84	150			VC	60.16059	1 in 223
5006		CO		150			VC	38.26354	
8213		FO		100			VC	6.791588	
7005	17.86	SW	17.12	150			VC	35.8469	1 in 42
5902	17.11	FO	10.34	1220			BR	128.6178	
5902	17.11	FO	10.34	1220			BR	128.6178	
7310	17.92	SW	15.04	450			CO	11.29758	1 in 87
5313		FO	0	150			VC	10.77033	
4308	20.88	FO	19.2	150			VC	44.94441	1 in 98
4308	20.88	FO	19.2	150			VC	44.94441	1 in 98
5314		FO	0	1220			BR	14.03567	
9203	17.91	SW	15.79	300			VC	22.68462	1 in 142
4003	17.6	SW	15.72	600			CO	11.5215	1 in 128
4003	17.6	SW	15.72	600			CO	11.5215	1 in 128
7206	19.56	SW	17.81	150			VC	35.51056	1 in 122
8214		FO		150			VC	13.10921	
8204	17.99	FO	15.95	150			VC	32.77291	1 in 50
6907		FO		100			VC	7.762928	
9109	17.94	SW	16.18	225			VC	31.06445	1 in 259
0006		FO	0	225			VC	26.29327	
0006		FO	0	225			VC	26.29327	
9313	17.73	FO	15.25	150			VC	16.74701	1 in 24
6202		FO		100			VC	26.55892	
9915		FO		150			VC	4.469121	
9108	18.2	FO	15.85	225			VC	34.1321	
9108	18.2	FO	15.85	225			VC	34.1321	
9905		SW	0	939			CO	35.09107	
6012		FO		100			VC	6.090837	
8403	17.55	FO	14.05	150			VC	21.43733	1 in 102
8314	17.92	FO	13.7	150			VC	14.88213	1 in 88
7001	17.59	FO	15.09	150			VC	48.82622	1 in 100
9106		FO	0	225			VC	53	
9106		FO	0	225			VC	53	
7010	17.57	SW	15.47	225			VC	88.3636	1 in 421
9201	18.04	FO	16.4	225			VC	61.29437	1 in 116
6905	16.88	SW	15.2	375			CO	40.49691	1 in 92
5409		FO	0	150			VC	16.15549	
8309	17.86	FO	15.92	150			VC	12.95798	1 in 76
6302	19.17	SW	17.6	225			VC	31.76476	1 in 212
6101	18.84	SW	16.7	300			CO	24.16609	1 in 173
6004	17.74	FO	15.89	225			VC	70.26697	1 in 281
8104	18.61	FO	16.33	225			VC	63.38296	1 in 132
0201	18.3	SW	16.8	225			VC	73.78347	1 in 264
0201	18.3	SW	16.8	225			VC	73.78347	1 in 264
6022		CO		100			VC	12.58668	
6306	20.12	FO	19.53	1220			BR	13.3	
5005	17.4	FO	15.48	150			VC	25.10326	1 in 139
5005	17.4	FO	15.48	150			VC	25.10326	1 in 139
4315	20.98	FO	19.83	150			VC	51.47815	1 in 80
8313	17.57	FO	14.47	150			VC	32.53416	1 in 130
6002	17.36	FO	15.59	225			VC	72.49098	
5312	21.04	SW	19.68	225			VC	32.24903	1 in 124
6902	16.4	SW	14.74	375			CO	76.00658	
8911		FO	0	225			VC	41.61229	
6906		FO		100			VC	4.097453	
8106	19.14	SW	17.82	150			VC	2.236068	
8308	18.09	SW	15.91	225			CO	26.33827	1 in 73
5109		SW	0	100			VC	21.02526	
0008	17.98	SW	15.68	375			CO	31.04835	1 in 194
0008	17.98	SW	15.68	375			CO	31.04835	1 in 194
6414		FO		150			VC	4.101258	
5204	19.54	FO	18.28	225			VC	52.20153	1 in 109
7920		FO		100			CI	6.2542	
5216		FO		100			VC	17.5984	
5216		FO		100			VC	17.5984	
7919		FO		100			CI	8.085994	

LEGEND



All point assets follow the standard colour convention:
red - combined   blue - surface water
brown - foul   purple - overflow

- ● Manhole
- ● Head of System
- ● Extent of Survey
- ● Rodding Eye
- ● Inlet
- ● Discharge Point
- ● Vortex
- ● Penstock
- ● Washout Chamber
- ● Valve
- ● Air Valve
- ● Non Return Valve
- ● Soakaway
- ● Gully
- ● Cascade
- ● Flow Meter
- ● Hatch Box
- ● Oil Interceptor
- ● Summit
- ● Drop Shaft
- ● Orifice Plate
- ● Side Entry Manhole
- Outfall
- ▦ Screen Chamber
- ■ Inspection Chamber
- ◎ Bifurcation Chamber
- ■ Lamp Hole
- ■ T Junction / Saddle
- ◎ Catchpit
- ◎ Valve Chamber
- ■ Vent Column
- ◎ Vortex Chamber
- ◎ Penstock Chamber
- ☐ Network Storage Tank
- ☐ Sewer Overflow
- ▦ Ww Treatment Works
- ▲ Ww Pumping Station
- ▨ Septic Tank
- ▨ Control Kiosk
- ▽ Change of Characteristic

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular   TR Trapezoidal
EG Egg   AR Arch
OV Oval   BA Barrel
FT Flat Top   HO HorseShoe
RE Rectangular   UN Unspecified
SQ Square

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

Address or Site Reference:

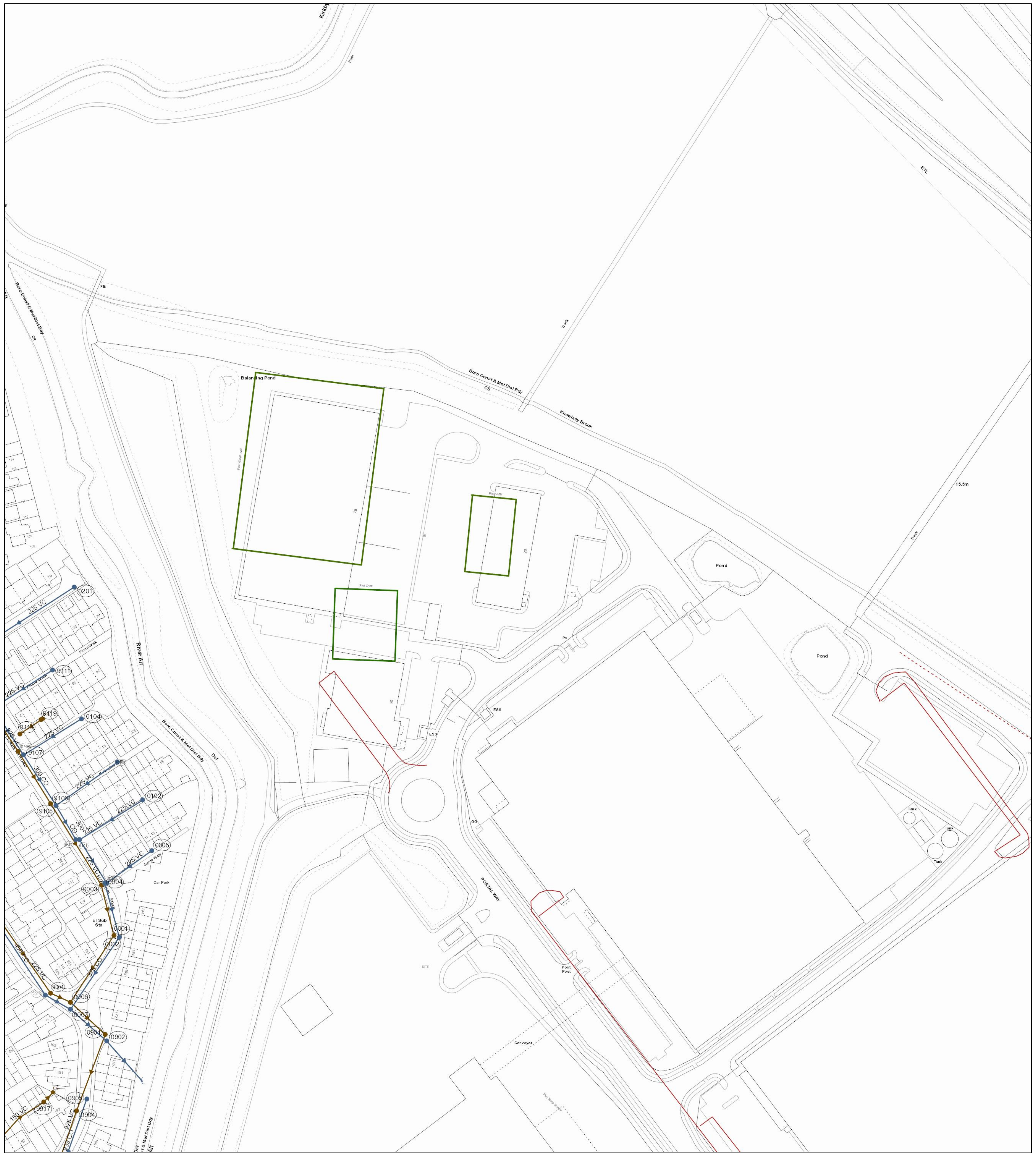
HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ3997SE
Scale: 1:1250   **Date:** 31/07/2019
Nodes: 384
Sheet: 1 of 9

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SEWER RECORDS

United Utilities
helping life flow smoothly



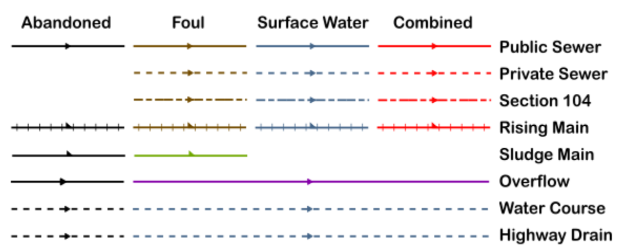
The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
0110	18.1	SW	15.74	375			CO	2	1 in 200
0110	18.1	SW	15.74	375			CO	2	1 in 200
9109	17.94	SW	16.18	225			VC	31.06445	1 in 259
0006		FO	0	225			VC	26.29327	
0006		FO	0	225			VC	26.29327	
9916		FO		150			VC	30.26082	
0905		SW	0	939			CO	62.61435	
0905		SW	0	939			CO	62.61435	
0001	17.78	FO	15.24	225			VC	44.10215	
0001	17.78	FO	15.24	225			VC	44.10215	
0103	18.53	SW	16.37	225			VC	41.61731	1 in 134
0103	18.53	SW	16.37	225			VC	41.61731	1 in 134
9005	17.51	FO	15.2	225			VC	52.43091	1 in 655
0002	17.75	SW	15.52	375			CO	48.25971	
0002	17.75	SW	15.52	375			CO	48.25971	
9105	18.2	SW	15.88	300			CO	21.9545	1 in 366
9105	18.2	SW	15.88	300			CO	21.9545	1 in 366
9108	18.2	FO	15.85	225			VC	34.1321	
9108	18.2	FO	15.85	225			VC	34.1321	
0003	18.01	FO	15.41	225			VC	28.86174	1 in 192
0003	18.01	FO	15.41	225			VC	28.86174	1 in 192
0102	18.44	SW	16.57	225			VC	41.34005	1 in 80
0005	18.36	SW	16.19	225			VC	30.80584	1 in 134
0007		SW	0	375			CO	26.61977	
0007		SW	0	375			CO	26.61977	
9106		FO	0	225			VC	53	
9106		FO	0	225			VC	53	
9003	17.55	SW	15.6	450			CO	16.12452	
9003	17.55	SW	15.6	450			CO	16.12452	
9201	18.04	FO	16.4	225			VC	61.29437	1 in 116
9917		FO		150			VC	7.374465	
9917		FO		150			VC	7.374465	
9111	18.28	SW	0	225			VC	39.11522	
9111	18.28	SW	0	225			VC	39.11522	
0901		FO	0	225			VC	45.17606	
0901		FO	0	225			VC	45.17606	
0101	18.08	SW	15.72	375			CO	28.30194	1 in 708
0101	18.08	SW	15.72	375			CO	28.30194	1 in 708
9119		FO		150			VC	14.11697	
9119		FO		150			VC	14.11697	
0201	18.3	SW	16.8	225			VC	73.78347	1 in 264
0201	18.3	SW	16.8	225			VC	73.78347	1 in 264
9004	17.58	FO	15.11	225			VC	12.08305	
9004	17.58	FO	15.11	225			VC	12.08305	
9107	18.19	SW	16	300			CO	33.28663	1 in 303
9107	18.19	SW	16	300			CO	33.28663	1 in 303
0904		FO	0	225			VC	52.81141	
0904		FO	0	225			VC	52.81141	
0902		SW	0	375			CO	30.06081	
0902		SW	0	375			CO	30.06081	
9101	17.74	SW	15.94	450			CO	103.1746	1 in 295
0104	18.36	SW	16.41	225			VC	37.73592	1 in 122
0104	18.36	SW	16.41	225			VC	37.73592	1 in 122
0004	17.96	SW	15.68	375			CO	1	
0004	17.96	SW	15.68	375			CO	1	
0008	17.98	SW	15.68	375			CO	31.04835	1 in 194
0008	17.98	SW	15.68	375			CO	31.04835	1 in 194

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND



All point assets follow the standard colour convention:
red - combined blue - surface water
brown - foul purple - overflow

- ● Manhole
- ● Head of System
- ● Extent of Survey
- ● Rodding Eye
- ● Inlet
- ● Discharge Point
- ● Vortex
- ● Penstock
- ● Washout Chamber
- ● Valve
- ● Air Valve
- ● Non Return Valve
- ● Soakaway
- ● Gully
- ● Cascade
- ● Flow Meter
- ● Hatch Box
- ● Oil Interceptor
- ● Summit
- ● Drop Shaft
- ● Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- ▲ Ww Pumping Station
- Septic Tank
- Control Kiosk
- ▽ Change of Characteristic

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular TR Trapezoidal
EG Egg AR Arch
OV Oval BA Barrel
FT Flat Top HO HorseShoe
RE Rectangular UN Unspecified
SQ Square

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

Address or Site Reference:

HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ4097SW
Scale: 1:1250 **Date:** 31/07/2019
Nodes: 57
Sheet: 2 of 9

Printed by: Property Searches

SEWER RECORDS

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The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
3003		FO	16.16	225			VC	1.414214	1 in 71
0306		CO		150			VC	29.51811	
9307		CO	0	225			VC	60.00833	
2003		CO	0	225			VC	68.09615	
2302		CO		225			VC	36.85826	
0205		SW	0	225			VC	54.971	
4103	19.11	SW	16.96	225			VC	68.0294	1 in 227
1002		SW	0	225			VC	78.10249	
5115		FO	0	100			VC	12.75338	
5115		FO	0	100			VC	12.75338	
2109		FO	0	225			VC	77.34176	
2203		FO	0	225			VC	73.58008	
1009		FO		100			VC	18.29491	
3203	20.29	FO	0	225			VC	36.92831	
4002		SW	0	225			VC	68.593	
3301		FO	0	900			ST	336.5427	
2227		CO		100			VC	12.22331	
3907		SW	0	150			VC	7.615773	
5203	19.61	SW	0	225			VC	58.5235	
9424		CO		150			VC	28.51561	
9424		CO		150			VC	28.51561	
9424		CO		150			VC	28.51561	
0007		CO		150			VC	18.25468	
5205	20.5	SW	18.9	300			CO	31.38471	1 in 63
5205	20.5	SW	18.9	300			CO	31.38471	1 in 63
9117		CO		100			VC	7.615819	
4305	20.66	FO	18.97	225			VC	48.10405	1 in 253
9114		CO		100			VC	7.162227	
0908		FO	0	150			VC	8.246211	
9404		SW	0	300			VC	39	
9404		SW	0	300			VC	39	
9404		SW	0	300			VC	39	
0918		CO		150			VC	10.16833	
3008	17.47	SW	15.36	300			CO	9.086233	1 in 61
2303		SW		300			CO	8.245352	
1102		FO		225			VC	61.25428	
4108	18.28	FO	17.05	225			VC	47.38143	1 in 364
4109	18.28	FO	17.05	225			VC	47.38143	1 in 364
3903		SW	0	225			VC	45.04442	
2218		CO		150			VC	5.397775	
1919		CO		100			VC	5.05739	
5114		FO	0	100			VC	4.003606	
5114		FO	0	100			VC	4.003606	
3016		FO		150			VC	5.19706	
1915		SW	0	225			VC	21	
1909		SW	0	225			VC	39.88909	
3102		FO		150			VC	12.31395	
5207	20.32	FO	18.36	150			VC	33.24154	1 in 87
5207	20.32	FO	18.36	150			VC	33.24154	1 in 87
4312	20.8	SW	19.69	300			CO	12.08305	1 in 110
0401		SW	0	225			VC	6.653003	
0401		SW	0	225			VC	6.653003	
0401		SW	0	225			VC	6.653003	
0203	20.49	SW	17.44	225			VC	25.31798	1 in 133
0907		FO	0	150			VC	10.04888	
2007		CO		150			VC	6.378764	
1202		SW	0	225			VC	43.04649	
3009	17.56	SW	16.14	225			VC	2.194403	1 in 219
2108		SW	0	225			VC	45.60702	
4307	20.88	SW	19.2	300			CO	45.88028	1 in 153
4307	20.88	SW	19.2	300			CO	45.88028	1 in 153
4005	17.77	SW	15.4	600			CO	67.92132	1 in 505
4004	17.71	SW	15.63	600			CO	67.92132	1 in 295
4004	17.71	SW	15.63	600			CO	67.92132	1 in 295
1308		CO		150			CI	8.707046	
2016		FO		150			VC	20.19808	
0014		FO		100			VC	4.0568	
0906	17.65	SW	15.54	225			VC	28.16026	1 in 176
9124		CO		150			VC	17.55441	
0117		CO		150			VC	3.432302	
2208		CO	0	150			VC	10.42157	
0123		FO		150			VC	9.196805	
9103		SW	0	225			VC	83.43403	
0101		CO	0	225			VC	53.08484	
0003	17.73	SW	16.05	225			VC	15.81139	
4201	20.31	SW	18.37	450			CO	31.95309	1 in 399
4201	20.31	SW	18.37	450			CO	31.95309	1 in 399
5403		SW		100			PVC	7.147776	
5403		SW		100			PVC	7.147776	
0201	20.85	CO	17.01	225			VC	85.09406	1 in 75.9768442
3904		SW	0	150			VC	19.23538	
2102		CO	0	150			VC	47.31541	
0118		CO		150			VC	12.48347	
5206	20.5	FO	18.74	150			VC	26.40076	1 in 69
5206	20.5	FO	18.74	150			VC	26.40076	1 in 69
4311	20.89	FO	19.18	225			VC	21.73154	1 in 114
5003	17.49	SW	15.8	600			CO	8.83092	1 in 126
5003	17.49	SW	15.8	600			CO	8.83092	1 in 126
4202	20.4	FO	18.74	225			VC	61.7414	1 in 71
9302	21.03	CO	18.85	1200			BR	69.18092	
3105		SW	0	300			VC	48.24612	
5317		FO		100			VC	7.036206	
5317		FO		100			VC	7.036206	
1101		FO		100			VC	17.8719	
0001	17.44	CO	13.93	225			VC	51.12915	
4107	18.2	FO	16.88	225			VC	37.01351	1 in 195
2105		FO	0	225			VC	37.33631	
0303		SW	0	225			VC	29.06888	
3010		FO	0	225			VC	15.13275	
3303		SW	0	150			VC	33.52611	
2001		CO	0	225			VC	67.06713	
0224		CO		150			VC	10.8472	
2205		FO	0	150			VC	13.88454	
0108		FO		150			VC	10.47305	
0302		CO		225			VC	33.01515	
4110		SW	0	225			VC	48.25971	
4110		SW	0	225			VC	48.25971	
1101		FO	0	225			VC	52.03845	
4314	20.73	SW	19.58	300			CO	29.73214	1 in 165
4314	20.73	SW	19.58	300			CO	29.73214	1 in 165
1107		SW	0	225			VC	70.57007	
1001	17.64	CO	14.5	225			VC	70.20607	1 in 123
3200		SW	0	300			VC	97.4948	
2304		CO		100			VC	17.6933	
2020		CO		150			VC	2.901735	
0008		CO		150			VC	14.37753	
1102		FO	0	225			VC	38.61909	
2102		FO		150			VC	63.23998	
3009		FO	16.13	225			VC	2.192441	1 in 110
1922		CO		150			VC	29.60442	
3902		FO	0	150			VC	96.25497	
0223		CO		150			VC	4.280543	
9906		SW	0	600			VC	208.799	
5110		SW	0	100			VC	4.273706	
5110		SW	0	100			VC	4.273706	
3204	20.29	SW	18.14	450			CO	18.24829	1 in 140
2106		FO	0	225			VC	23.5372	
5307	21.41	SW	19.97	225			VC	33.65954	1 in 421
5307	21.41	SW	19.97	225			VC	33.65954	1 in 421
2004		SW	0	225			VC	70.17834	
4301	21.08	SW	19.57	225			VC	24.16609	1 in 101
5319		FO		100			VC	14.07807	
5319		FO		100			VC	14.07807	
3019		FO		150			VC	13.95905	
3918		FO		100			VC	7.459846	
4204		SW	0	225			VC	51.26402	
4204		SW	0	225			VC	51.26402	
3310	21.22	SW	19.23	225			VC	57.87054	1 in 141
9202	19.8	SW	15.89	225			VC	81.84131	1 in 248
2101		SW	0	225			VC	66.07714	
9408	20.62	FO	15.85	150			VC	59.22202	
9408	20.62	FO	15.85	150			VC	59.22202	
4106	19.29	FO	17.8	225			VC	53.85165	1 in 128
4106	19.29	FO	17.8	225			VC	53.85165	1 in 128
3012	17.46	SW	0				UN	0.3545707	
3301		FO	0	450			ST	335.0761	
4303	20.84	SW	19.32	225			VC	34.17601	1 in 228
1903		FO	0	150			VC	36.34556	
4302	20.88	FO	19.71	225			VC	21.0238	
0909		FO	0	150			VC	31.01612	
2301		CO		150			VC	12.00877	
4907	17.29	SW	16.1	225			VC	11.16741	1 in 37
5407		FO	0	150			VC	16.49242	
5407		FO	0	150			VC	16.49242	
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
4102	19.19	FO	17.77	225			VC	30.67572	1 in 114
0207		CO	0	225			VC	7.071068	
3210	20.79	SW	18.79	225			VC	5.385165	1 in 269
3103		FO		150			VC	24.51732	
1016		FO		150			VC	15.96794	
0901		CO	0	225			VC	44.40721	
0919		CO		150			VC	5.452144	
0021		CO		100			VC	5.380207	
0213		FO		150			VC	9.974166	
2926	17.39	SW	14.37	750			PVC	22.62118	1 in 73
9501	19.38	FO	16.57	225			VC	48.50773	1 in 180
9501	19.38	FO	16.57	225			VC	48.50773	1 in 180
2002		SW	0	225			VC	65.06919	
9130		CO		100			VC	4.132107	
9115		CO		100			VC	14.21476	
0009		CO		150			VC	10.94359	
2107		SW	0	225			VC	38.47077	
9409	20.54	SW	18.63	225			VC	10.62063	
9409	20.54	SW	18.63	225			VC	10.62063	
9409	20.54	SW	18.63	225			VC	10.62063	
3011		SW	0	225			VC	16.12452	
1109		FO		150			VC	13.1614	
0206		CO	0	225			VC	90.48047	
9403		SW	0	225			VC	37.21559	
9403		SW	0	225			VC	37.21559	
9403		SW	0	225			VC	37.21559	
2114		CO		150			VC	16.449	
2910		SW	0	150			VC	33.06555	
3909		FO		100			VC	9.831995	
1127		FO		150			VC	33.76673	
9410	20.62	SW	18.29	225			VC	14.87864	
9410	20.62	SW	18.29	225			VC	14.87864	
9410	20.62	SW	18.29	225			VC	14.87864	
1012		CO		150			VC	6.388664	
0422		CO		100			VC	6.272639	
0422		CO		100			VC	6.272639	
9406		SW	0	225			VC	4.149458	
9406		SW	0	225			VC	4.149458	
9406		SW	0	225			VC	4.149458	
1904		SW	0	150			VC	15.23155	
9405		SW	0	225			VC	75.00667	
9009		CO		150			VC	16.22367	
1307		CO		150			CI	3.855924	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
0104		FO	0	225			VC	53.03772	
4203	20.39	SW	18.28	450			CO	59.09315	1 in 591
9010		CO		150			VC	8.814127	
3912		FO		150			VC	12.03112	
5904	17.24	FO	15.3	150			VC	10.71871	1 in 2
5904	17.24	FO	15.3	150			VC	10.71871	1 in 2
3023		FO		100			VC	8.631138	
0120		FO		150			VC	5.886763	
2201		SW	0	225			VC	28.86174	
0102		FO	0	225			VC	51.15662	
0204	20.37	SW	17.25	225			VC	17.08801	
4313	20.93	SW	19.81	300			CO	29.96665	1 in 130
4313	20.93	SW	19.81	300			CO	29.96665	1 in 130
2935		CO		150			VC	15.36178	
9907		SW	0	600			VC	37.48333	
5301	20.45	SW	19.17	225			CO	24.20744	
0420		CO		100			VC	24.91066	
0420		CO		100			VC	24.91066	
0420		CO		100			VC	24.91066	
5102	18.31	FO	17.29	225			VC	40.84647	
1122		FO		100			VC	5.590019	
2005		SW	0	225			VC	34.9285	
9401	20.5	FO	16.8	225			VC	77.02597	1 in 62
4906	17.4	SW	15.8	450			VC	58.17262	1 in 145
0208		SW	0	225			VC	56.0357	1 in 26.0631164
5103	18.37	SW	16.91	225			VC	16.37816	
0912	17.28	SW	15.19	300			CO	23.02173	1 in 110
5209	19.81	SW	19.14	300			CO	32.89377	1 in 274
9106		CO	0	225			VC	62.96825	
1021		CO		100			VC	6.891249	
1905		SW	0	150			VC	28.07134	
3201	20.34	SW	18.61	225			VC	19.23538	1 in 77
9425		CO		150			VC	19.3184	
9425		CO		150			VC	19.3184	
9425		CO		150			VC	19.3184	
0212		FO		150			VC	37.86659	
9303	21.04	CO	15.71	300			VC	71.17584	1 in 117
1108		FO		150			VC	2.951878	
0110		FO		150			VC	11.35379	
1104		FO	0	225			VC	51.04046	
4304	20.85	FO	19.31	225			CO	31.77508	1 in 244
5208	20.32	SW	19.02	300			CO	27.313	1 in 228
5208	20.32	SW	19.02	300			CO	27.313	1 in 228
0216		FO		100			PVC	17.93446	
9207		CO		150			VC	11.00325	
2008		CO		150			VC	6.082704	
3013	17.46	SW	15.21	300			CO	65.08363	1 in 97
2207		CO	0	150			VC	9.876294	
2112		FO		150			VC	11.66524	
0421		CO		100			VC	6.969846	
0421		CO		100			VC	6.969846	
0421		CO		100			VC	6.969846	
4310	20.87	SW	19.13	325			VC	9.174094	1 in 54
5318		FO		100			VC	14.90664	
5318		FO		100			VC	14.90664	
2103		SW	0	225			VC	86.30135	
5004	17.45	FO	15.81	150			VC	9.839408	1 in 30
5004	17.45	FO	15.81	150			VC	9.839408	1 in 30
4309	20.94	SW	19.4	300			CO	33.61547	1 in 168
4309	20.94	SW	19.4	300			CO	33.61547	1 in 168
0902		SW	0	225			VC	22.82542	
3007		SW	17.48	300			CO	69.32677	1 in 33
5105	18.97	FO	10.97	1220			BR	205.0004	1 in 325
2908		CO		150			VC	5.13049	
3925	16.9	SW	14.54	300			CO	23.01836	
2924		SW		150			VC	10.31057	
2907		SW	0	150			VC	22.26506	
2919		SW		150			VC	19.703	
3001	17.3	FO	16.22	225			VC	97.9901	
5304	19.54	FO	18.28	225			VC	52.20153	1 in 109
2909		SW	0	150			CO	23.92475	
3002	17.6	FO	16.35	225			VC	20.95479	1 in 161
5216		FO		100			VC	9.274999	
5216		FO		100			VC	17.5984	
5216		FO		100			VC	17.5984	
3018		FO		225			VC	12.87249	
4203	20.93	SW	19.81	300			CO	29.96665	1 in 130
9902		CO	0	375			CO	82.18047	
0402	20.94	SW	17.99	225			VC	70.17834	1 in 128
0006		SW	0	225			VC	51.08816	
3004		FO	0	225			VC	26.07681	
1105		FO		150			VC	19.7895	
4104	19.06	FO	17.38	225			VC	60	1 in 120
3302	20.85	SW	19.36	150			CO	28.4605	1 in 77
4308	20.88	FO	19.2	150			VC	44.94441	1 in 98
4308	20.88	FO	19.2	150			VC	44.94441	1 in 98
9008		SW	0	225			VC	32.38827	
3104		CO		150			VC	5.897793	
2111		CO		150			VC	9.589	
4003	17.6	SW	15.72	600			CO	11.5215	1 in 128
4003	17.6	SW	15.72	600			CO	11.5215	1 in 128
1112		FO		150			VC	31.53576	
2116		FO		150			VC	9.025078	
9902		CO	0	375			CO	82.18047	
1018		FO		150			VC	11.44651	
2904		SW	0	150			CI	13.48367	
1907	17.58	FO	15.82	150			BR	128.6178	
9402	20.51	FO	15.56	300			VC	13.77808	1 in 123
9402	20.51	FO	15.56	300			VC	13.77808	
9402	20.51	FO	15.56	300			VC	13.77808	
2401		FO	0	1200			CO	51.97115	
2104		SW	0	225			VC	73.68175	
0301		FO	0	1200			CO	187.4166	
1201		FO	0	225			VC	46.95743	
0005		SW	0	225			VC	47.16991	
2202		SW	0	225			VC	44.01136	
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
1126		SW		150			VC	34.0507	
3006		FO		225			VC	58.93209	
9310		CO		225			VC	14.60509	
1003		SW	0	225			VC	65.06919	
2209		CO	0	150			VC	9.815034	
0423		CO		100			VC	10.71548	
0423		CO		100			VC	10.71548	
0423		CO		100			VC	10.71548	
3914		FO		100			VC	15.31061	
4001	18.41	FO	16.68	225			VC	60.959	
0004		CO	0	225			VC	39.08202	
2225		CO		150			VC	12.24907	
5005	17.4	FO	15.48	150			VC	25.10326	1 in 139
5005	17.4	FO	15.48	150			VC	25.10326	1 in 139
2221		FO		225			VC	2.568128	
0502		CO		150			VC	22.08449	
0502		CO		150			VC	22.08449	
0502		CO		150			VC	22.08449	
1120		FO		150			VC	1.150356	
9212		CO		150			VC	14.39401	
4315	20.98	FO	19.83	150			VC	51.47815	1 in 80
0103		SW	0	225			VC	60.07495	1 in 35.7589018
2012		FO	0	225			VC	54.14795	
9007		SW	0	225			VC	36.05551	
5109		SW	0	100			VC	21.02526	
2905		FO		150			VC	18.59704	
2908		SW		150			VC	19.05912	
3925	16.9	SW	14.54	300			CO	23.01836	
2924		SW		150			VC	10.31057	
2907		SW	0	150			VC	22.26506	
2919		SW		150			VC	19.703	
3001	17.3	FO	16.22	225			VC	97.9901	
5304	19.54	FO	18.28	225			VC	52.20153	1 in 109
2909		SW	0	150			CO	23.92475	
3002	17.6	FO	16.35	225			VC	20.95479	1 in 161
5216		FO		100			VC	9.274999	
5216		FO		100			VC	17.5984	
5216		FO		100			VC	17.5984	
3018		FO		225			VC	12.87249	

LEGEND

Abandoned · Foul · Surface Water · Combined

- Public Sewer
- Private Sewer
- Section 104
- Rising Main
- Sludge Main
- Overflow
- Water Course
- Highway Drain

All point assets follow the standard colour convention:
red - combined · blue - surface water
brown - foul · purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
GRC	Glass Reinforced Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

Address or Site Reference:

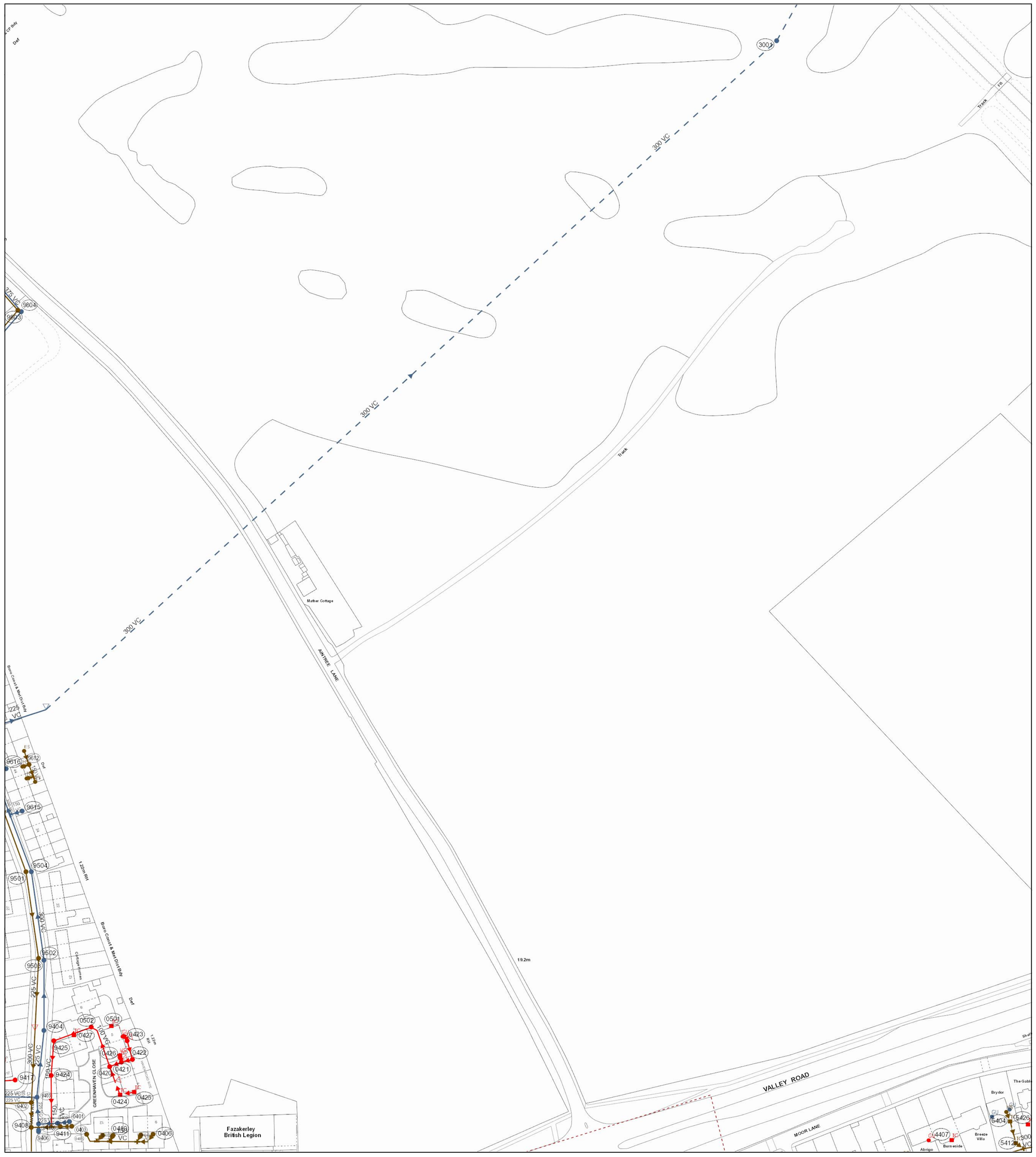
HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ3997SW
Scale: 1:1250 **Date:** 31/07/2019
Nodes: 361
Sheet: 3 of 9

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SEWER RECORDS

United Utilities — helping life flow smoothly



Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
9501	19.38	FO	16.57	225			VC	48.50773	1 in 180
9501	19.38	FO	16.57	225			VC	48.50773	1 in 180
9803	17.4	FO	14.65	225			CO	48.35311	1 in 134
9803	17.4	FO	14.65	225			CO	48.35311	1 in 134
0420		CO		100			VC	24.91066	
0420		CO		100			VC	24.91066	
0420		CO		100			VC	24.91066	
9401	20.5	FO	16.8	225			VC	77.02597	1 in 62
9409	20.54	SW	18.63	225			VC	10.62063	
9409	20.54	SW	18.63	225			VC	10.62063	
9409	20.54	SW	18.63	225			VC	10.62063	
9402	20.51	FO	15.56	300			VC	13.77808	
9402	20.51	FO	15.56	300			VC	13.77808	
9402	20.51	FO	15.56	300			VC	13.77808	
9411	20.5	FO	17.44	150			VC	16.08351	1 in 22
9411	20.5	FO	17.44	150			VC	16.08351	1 in 22
9411	20.5	FO	17.44	150			VC	16.08351	1 in 22
9403		SW	0	225			VC	37.21559	
9403		SW	0	225			VC	37.21559	
9403		SW	0	225			VC	37.21559	
9504	19.39	SW	16.59	300			VC	73.73602	
9504	19.39	SW	16.59	300			VC	73.73602	
0403		FO	0	150			VC	6.371142	
0403		FO	0	150			VC	6.371142	
0403		FO	0	150			VC	6.371142	
0401		SW	0	225			VC	6.653003	
0401		SW	0	225			VC	6.653003	
0401		SW	0	225			VC	6.653003	
9419		CO		150			VC	19.39855	
9410	20.62	SW	18.29	225			VC	14.87864	
9410	20.62	SW	18.29	225			VC	14.87864	
9410	20.62	SW	18.29	225			VC	14.87864	
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
3001		SW		300			VC	67.37228	
9801	17.89	SW	15.83	375			CO	86.71454	1 in 117
0422		CO		100			VC	6.272639	
0422		CO		100			VC	6.272639	
9408	20.62	FO	15.85	150			VC	59.22202	
9408	20.62	FO	15.85	150			VC	59.22202	
9408	20.62	FO	15.85	150			VC	59.22202	
4401	20.39	FO	19.19	150			VC	62.99297	1 in 95
4401	20.39	FO	19.19	150			VC	62.99297	1 in 95
9406		SW	0	225			VC	4.149458	
9406		SW	0	225			VC	4.149458	
9406		SW	0	225			VC	4.149458	
9425		CO		150			VC	19.3184	
9425		CO		150			VC	19.3184	
9425		CO		150			VC	19.3184	
0423		CO		100			VC	10.71548	
0423		CO		100			VC	10.71548	
0423		CO		100			VC	10.71548	
9804	16.98	SW	15.09	375			VC	88.25493	1 in 130
9804	16.98	SW	15.09	375			VC	88.25493	1 in 130
9405		SW	0	225			VC	75.00667	
9424		CO		150			VC	28.51561	
9424		CO		150			VC	28.51561	
9424		CO		150			VC	28.51561	
9616		SW		150			VC	7.160587	
9616		SW		150			VC	7.160587	
9606		SW	0	225			VC	38.8973	
9604		FO	0	225			VC	69.28925	
9612		FO		150			VC	10.22571	
9612		FO		150			VC	10.22571	
0502		CO		150			VC	22.08449	
0502		CO		150			VC	22.08449	
0502		CO		150			VC	22.08449	
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
9404		SW	0	300			VC	39	
9404		SW	0	300			VC	39	
9404		SW	0	300			VC	39	
9802	18.04	FO	15.28	939			CO	85.15882	1 in 135
9615		SW		150			VC	7.160758	
9615		SW		150			VC	7.160758	
0421		CO		100			VC	6.969846	
0421		CO		100			VC	6.969846	
0421		CO		100			VC	6.969846	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

Abandoned — Foul — Surface Water — Combined

- Public Sewer
- Private Sewer
- Section 104
- Rising Main
- Sludge Main
- Overflow
- Water Course
- Highway Drain

All point assets follow the standard colour convention:

red - combined blue - surface water

brown - foul purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
GRC	Glass Reinforecd Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

Address or Site Reference:

HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ3997NW

Scale: 1:1250 **Date:** 31/07/2019

Nodes: 80

Sheet: 4 of 9

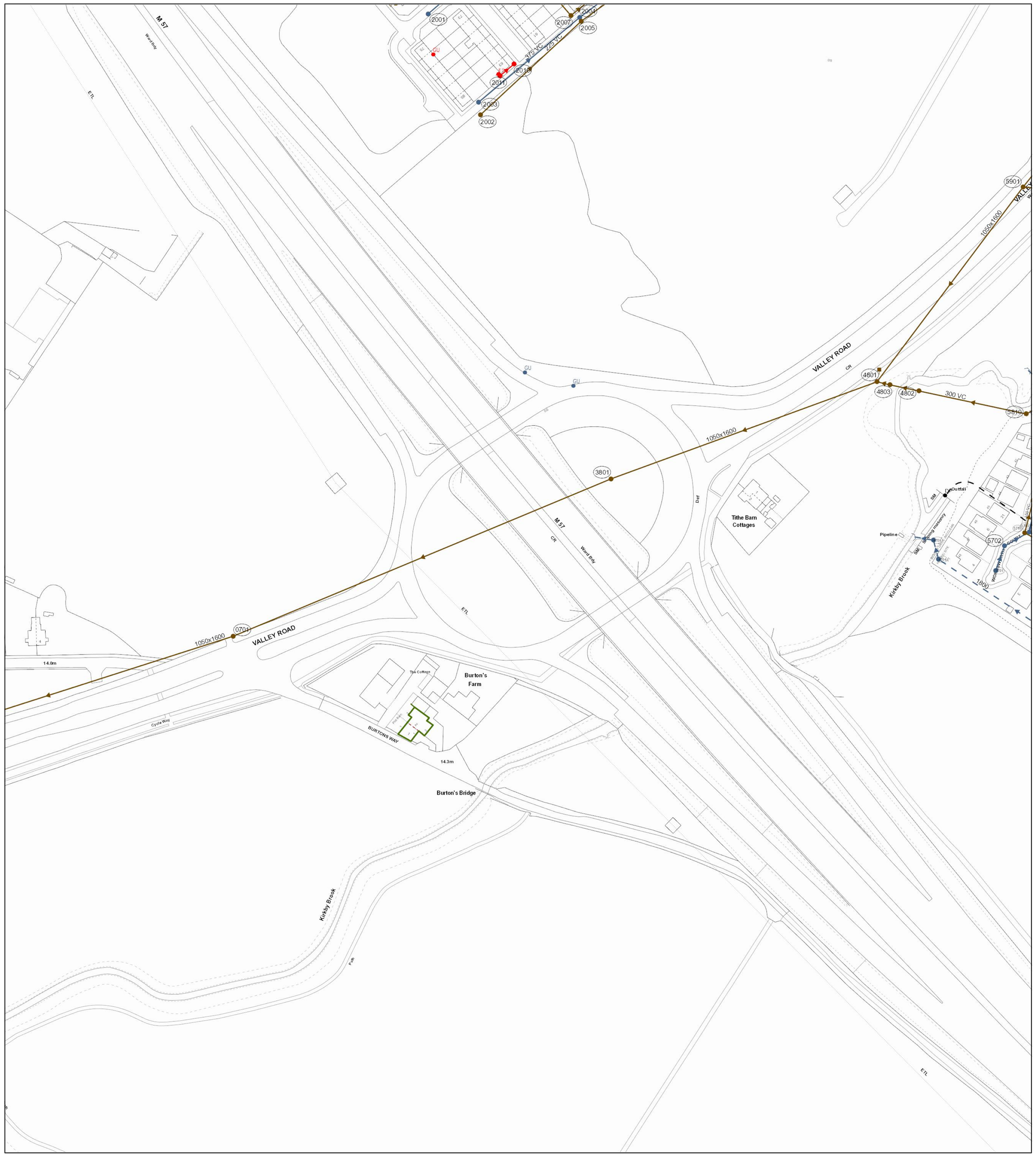
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SEWER RECORDS

United Utilities — helping life flow smoothly

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
4803		FO	0	300			VC	7.307272	
3801	14.59	FO	10.85	1050			BR	226.9277	1 in 1194
0701	14.2	FO	10.66	1050			BR	216.2997	1 in 865
2007		FO		150			VC	11.72824	
2007		FO		150			VC	11.72824	
4801	15.28	FO	11.07	1050			BR	157.0062	1 in 714
5710		FO	0	150			VC	18.61196	
2006		FO		150			VC	34.92025	
2005	18.26	FO	15.94	225			VC	75.21303	
2005	18.26	FO	15.94	225			VC	75.21303	
5702		SW	0	150			VC	15.66708	
2004	18.26	SW	0	375			CO	73.60027	
2004	18.26	SW	0	375			CO	73.60027	
2011		CO		150			VC	10.08586	
2011		CO		150			VC	10.08586	
4701		SW		1800				11.01291	
5701		SW	0	150			VC	14.53521	
2001	18.87	SW	17.49	225			VC	102.8251	1 in 219
2001	18.87	SW	17.49	225			VC	102.8251	1 in 219
4704		SW		1800				10.99513	
4802		FO	0	300			VC	16.4877	
5901	16.05	FO	11.22	1050			BR	134.9978	1 in 900
5901	16.05	FO	11.22	1050			BR	134.9978	1 in 900
5703		SW	0	1200			CO	17.63349	
2003	18.18	SW	0	375			VC	73.1095	
2003	18.18	SW	0	375			VC	73.1095	
2002		FO	0	225			VC	76.41989	
2002		FO	0	225			VC	76.41989	
5810		FO	0	300			VC	60.7816	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

Abandoned / Foul / Surface Water / Combined

- Public Sewer
- Private Sewer
- Section 104
- Rising Main
- Sludge Main
- Overflow
- Water Course
- Highway Drain

All point assets follow the standard colour convention:

red - combined blue - surface water

brown - foul purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
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DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

Address or Site Reference:

HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ4097NW

Scale: 1:1250 **Date:** 31/07/2019

Nodes: 29

Sheet: 5 of 9

Printed by: Property Searches

SEWER RECORDS

United Utilities — helping life flow smoothly



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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
6801	18.05	FO	16.42	225			VC	43.1707	
8904	16.26	SW	14.92	225			VC	30.76326	1 in 192
8807	18.29	SW	16.86	225			PVC	27.51457	1 in 275
9703	18.5	SW	16.52	939			CO	10.41758	1 in 80
7808	18.85	SW	16.96	939			CO	18.62595	1 in 373
7812		SW	0	375			CO	23.49944	
8704	18.57	SW	16.39	939			CO	37.36299	1 in 121
6804		FO		100			VC	6.106473	
8503	19.6	SW	17.97	225			VC	52.7731	
7811	18.29	SW	16.42	375			VC	35.90588	1 in 106
9424		CO		150			VC	28.51561	
9424		CO		150			VC	28.51561	
9424		CO		150			VC	28.51561	
7904	17.26	FO	15.16	225			VC	58.55059	1 in 115
7908	17.18	SW	15.54	225			VC	46.10608	1 in 171
8024		FO		100			VC	11.86249	
8001	16.22	SW	14.71	225			VC	34.48188	1 in 115
9404		SW	0	300			VC	39	
9404		SW	0	300			VC	39	
9404		SW	0	300			VC	39	
7807	18.77	SW	17.26	939			CO	29.11229	1 in 97
9418		CO		150			VC	6.188895	
9001	15	SW		375			VC	15.48666	
8003	15.67	FO	14.39	225			VC	17.26268	1 in 58
9803	17.4	FO	14.65	225			CO	48.35311	1 in 134
9803	17.4	FO	14.65	225			CO	48.35311	1 in 134
8710	19.34	FO	16.94	939			CO	14.15631	1 in 129
9412		CO		0			VC	5.971643	
9415		CO		0			VC	11.31898	
0401		SW	0	225			VC	6.653003	
0401		SW	0	225			VC	6.653003	
0401		SW	0	225			VC	6.653003	
8802	18.47	FO	15.52	939			CO	31.06574	1 in 129
8901	15.62	FO	13.16	225			VC	11.65921	
5703		CO		100			VC	12.32709	
5803	18.82	FO	16.95	225			VC	83.65002	1 in 167
7815		FO		150			VC	12.51272	
8705	19.34	SW	17.58	939			CO	11.98666	1 in 71
7802	18.84	FO	16.63	225			CO	18.49163	1 in 185
8902	15.97	FO	13.24	225			VC	18.59076	1 in 232
8025		FO		100			VC	11.63136	
8715		CO		150			VC	8.810678	
9606		SW	0	225			VC	38.8973	
8908	15.37	SW	14.11	375			VC	38.26529	1 in 96
9603		SW	0	225			VC	20.61553	
7806	18.2	FO	16.81	225			VC	22.99007	1 in 34
6803	17.65	SW	16.08	375			VC	41.43839	
8912	17.62	FO	15.6	150			PVC	30.21436	1 in 45
9601		SW	0	225			VC	25.31798	
7825	18.55	FO	15.75	150			PVC	43.88879	1 in 54
9706	18.49	FO	16.04	939			CO	11.58609	1 in 61
7903	17.23	SW		375			VC	58.5573	
9901	18.26	FO	14.26	150			PVC	22.73641	1 in 142
9903	17.5	FO	14.1	150			PVC	25.19754	1 in 157
9904	16.6	FO	13.94	225			VC	33.98718	1 in 131
9801	17.89	SW	15.83	375			CO	86.71454	1 in 117
5402	21.94	CO	19.91	300			VC	91.5478	
6805		FO		100			VC	15.47634	
8917	17.69	SW	14.48	525			CO	22.34949	1 in 172
8709	18.57	FO	15.85	939			CO	40.20974	1 in 122
8501		SW	0	225			VC	97.86214	
5801		SW		375				195.0932	
7909		SW		0				4.702716	1 in
9804	16.98	SW	15.09	375			VC	88.25493	1 in 130
9804	16.98	SW	15.09	375			VC	88.25493	1 in 130
8914	17.5	SW	15.38	450			CO	34.73658	1 in 217
7902	17.74	SW	16.06	225			VC	36.66946	
5805	20.2	SW	16.68	825			CO	91.01151	1 in 433
4802	20.77	SW	16.93	825			CO	99.80339	1 in 399
7805	18.3	FO	16.13	225			VC	34.88217	1 in 145
9001	15	SW	14	375			VC	28.83352	
7907	17.2	FO	15.33	225			VC	51.61615	1 in 89
8009	15.09	FO	13.64	150			VC	7.475636	1 in 107
8708	19.04	FO	0	939			CO	44.33566	
9422		CO		150			VC	27.84713	
5802	19.87	FO	17.73	225			VC	30.60596	1 in 1530
9905	15.41	FO	13.78	225			VC	15.94657	1 in 133
4418		CO		150			VC	7.77204	
9504	19.39	SW	16.59	300			VC	73.73602	
9504	19.39	SW	16.59	300			VC	73.73602	
8711	19.24	FO	16.83	939			CO	24.63223	1 in 107
8809	18.66	SW	16.21	300			PVC	27.31929	1 in 91
9414		CO		0			VC	18.1037	
8603	19.45	SW	17.7	939			CO	19.38774	1 in 162
9408	20.62	FO	15.85	150			VC	59.22202	
9408	20.62	FO	15.85	150			VC	59.22202	
9408	20.62	FO	15.85	150			VC	59.22202	
9616		SW		150			VC	7.160587	
9616		SW		150			VC	7.160587	
9701	18.8	SW	17.05	939			CO	39.45269	1 in 96
8701	19.06	SW	17.34	939			CO	22.55968	1 in 113
9612		FO		150			VC	10.22571	
9612		FO		150			VC	10.22571	
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
9503	19.74	SW	16.78	300			VC	49.49747	1 in 291
7901	17.71	FO	15.98	225			VC	42.04496	1 in 67
8913	18.3	SW	14.94	525			CO	12.46567	1 in 27
9420		CO		150			VC	8.499342	
9501	19.38	FO	16.57	225			VC	48.50773	1 in 180
9501	19.38	FO	16.57	225			VC	48.50773	1 in 180
8916	18.07	SW	14.98	525			CO	14.00206	1 in 350
9505		SW	0	225			VC	39.62323	
7816		FO		100			PVC	2.308113	
7910		SW		0				12.66228	1 in
7801	18.82	FO	16.86	939			CO	26.33231	1 in 114
9409	20.54	SW	18.63	225			VC	10.62063	
9409	20.54	SW	18.63	225			VC	10.62063	
9409	20.54	SW	18.63	225			VC	10.62063	
8604	19.49	FO	17.05	939			CO	19.68637	1 in 179
8606		SW		100			VC	16.53145	
6901	20.27	SW	16.47	825			CO	91.13161	1 in 396
7803	18.77	FO	16.53	225			VC	28.27796	1 in 166
8801	18.44	SW	16.08	939			CO	30.37682	1 in 122
9403		SW	0	225			VC	37.21559	
9403		SW	0	225			VC	37.21559	
9403		SW	0	225			VC	37.21559	
8805	18.92	FO	16.15	150			PVC	59.24426	1 in 148
9410	20.62	SW	18.29	225			VC	14.87864	
9410	20.62	SW	18.29	225			VC	14.87864	
9410	20.62	SW	18.29	225			VC	14.87864	
8502		FO	0	225			VC	112.45	
9602		FO	0	225			VC	23.4094	
0422		CO		100			VC	6.272639	
0422		CO		100			VC	6.272639	
9406		SW	0	225			VC	4.149458	
9406		SW	0	225			VC	4.149458	
9406		SW	0	225			VC	4.149458	
8911	18.13	FO	14.35	150			PVC	13.45148	1 in 149
8903	16.01	SW	14.64	375			VC	43.20702	1 in 82
9607	18.77	FO	17.02	225			VC	19.31321	
9405		SW	0	225			VC	75.00667	
8401		FO		150			VC	9.395504	
8002	16.23	FO	13.63	225			VC	23.5372	1 in 147
0420		CO		100			VC	24.91066	
0420		CO		100			VC	24.91066	
0420		CO		100			VC	24.91066	
8713		CO		150			VC	5.048918	
9401	20.5	FO	16.8	225			VC	77.02597	1 in 62
8915	18.29	SW	15.05	525			CO	28.10625	1 in 402
8810	18.9	SW	16.51	300			PVC	61.96256	1 in 188
9907	16.84	FO	14.29	225			VC	36.97453	1 in 106
7001	20.26	SW	16.03	825			CO	89.38535	1 in 470
5401		CO	0	225			VC	44.55334	
9425		CO		150			VC	19.3184	
9425		CO		150			VC	19.3184	
9425		CO		150			VC	19.3184	
8601		SW	0	225			VC	35.51056	
9605		SW	0	225			VC	9.486833	
5702		FO	0	150			VC	43.95583	
5701		FO	0	150			VC	16.74414	
9604		FO	0	225			VC	69.28925	
7809	18.79	SW	16.91	375			CO	30.78991	1 in 114
8905	16.27	FO	13.49	225			VC	35.10986	1 in 207
8712	18.91	SW	17.56	0				24.3665	1 in 111
9704	18.78	FO	16.6	939			CO	36.50525	1 in 96
0421		CO		100			VC	6.969846	
0421		CO		100			VC	6.969846	
0421		CO		100			VC	6.969846	
4703		CO		100			VC	9.825393	
8602		FO	0	225			VC	47.85394	
8907	15.13	FO	13.66	225			VC	46.09162	1 in 92
7813		SW		300			VC	94.69231	1 in
7810	18.51	SW	16.64	375			VC	23.36146	1 in 106
7906	16.63	SW	15.13	375			VC	60.40531	1 in 129
8803	18.29	FO	16.65	150			PVC	23.7241	1 in 77
6902	20.27	SW	16.24	825			CO	90.89562	1 in 433
9411	20.5	FO	17.44	150			VC	16.08351	1 in 22
9411	20.5	FO	17.44	150			VC	16.08351	1 in 22
9411	20.5	FO	17.44	150			VC	16.08351	1 in 22
8006	15.61	FO	14.14	225			VC	5.385165	1 in 108
4701		CO		100			VC	6.456467	
8806	18.28	FO	14.93	150			PVC	34.83096	1 in 151
0403		FO	0	150			VC	6.371142	
0403		FO	0	150			VC	6.371142	
0403		FO	0	150			VC	6.371142	
9419		CO		150			VC	19.39855	
8703	19.22	SW	17.57	939			CO	20.38157	1 in 47
8702	19.06	SW	17.14	939			CO	47.10944	1 in 63
8612		FO		100			PVC	29.37902	
7826	18.55	SW	16.18	300			PVC	47.66317	1 in 59
8012	15.47	SW	13.94	225			VC	24.63564	1 in 224
9702	18.41	SW	16.64	939			CO	14.21687	1 in 118
9902	16.66	SW	14	375			VC	31.20672	1 in 120
6802	17.69	FO	15.89	225			VC	41.51911	1 in 58
5704		CO		100			VC	28.40424	
8706	19.22	SW	17.41	939			CO	26.52426	1 in 74
8804	18.61	FO	16.34	150			PVC	28.89978	1 in 152
7905	16.67	FO	14.64	225			VC	59.39046	1 in 205
9413		CO		0			VC	10.96608	
9705	18.44	FO	16.22	939			CO	13.91154	1 in 77
9402	20.51	FO	15.56	300			VC	13.77808	
9402	20.51	FO	15.56	300			VC	13.77808	
9402	20.51	FO	15.56	300			VC	13.77808	
8605		FO		100			VC	16.07862	
8714		CO		100			PP	7.292731	
9906	15.3	SW	13.74	375			VC	15.02917	1 in 58
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
9502	19.73	FO	16.28	225			VC	40.04997	1 in 267
8007	15.71	SW	14.19	225			VC	26.91447	1 in 112

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
7804	18.51	FO	16.36	225			VC	23.59751	1 in 103
7814		SW		300			VC	15.74499	1 in
0423		CO		100			VC	10.71548	
0423		CO		100			VC	10.71548	
0423		CO		100			VC	10.71548	
9805	18.08	SW	16.65	225			PVC	48.22357	1 in 172
8707	19.25	FO	0	939			CO	20.40091	
8005	15.75	FO	13.93	225			VC	37.21658	1 in 128
7702		SW		300			VC	48.61322	1 in
4403		CO		150			VC	17.66487	
0502		CO		150			VC	22.08449	
0502		CO		150			VC	22.08449	
0502		CO		150			VC	22.08449	
8808	18.29	SW	15.14	525			CO	29.75791	1 in 331
9802	18.04	FO	15.28	939			CO	85.15882	1 in 135
8004	15.78	SW	14.4	225			VC	27.0363	1 in 135
9615		SW		150			VC	7.160758	
9615		SW		150			VC	7.160758	
8910	18.24	FO	14.7	150			PVC	33.13602	1 in 95
7701		SW		300			VC	3.613108	1 in

LEGEND

	Abandoned	Foul	Surface Water	Combined
Public Sewer				
Private Sewer				
Section 104				
Rising Main				
Sludge Main				
Overflow				
Water Course				
Highway Drain				

All point assets follow the standard colour convention:
red - combined   blue - surface water
brown - foul   purple - overflow

- ● Manhole
- HS Head of System
- ES Extent of Survey
- RE Rodding Eye
- IN Inlet
- DP Discharge Point
- HY Vortex
- PE Penstock
- WO Washout Chamber
- VA Valve
- AV Air Valve
- NRV Non Return Valve
- SO Soakaway
- GU Gully
- CA Cascade
- FM Flow Meter
- HA Hatch Box
- OI Oil Interceptor
- SM Summit
- DS Drop Shaft
- OP Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- IC Inspection Chamber
- Bifurcation Chamber
- LH Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- ▲ Ww Pumping Station
- Septic Tank
- Control Kiosk
- ▽ Change of Characteristic

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular   TR Trapezoidal
EG Egg   AR Arch
OV Oval   BA Barrel
FT Flat Top   HO HorseShoe
RE Rectangular   UN Unspecified
SQ Square

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

Address or Site Reference:

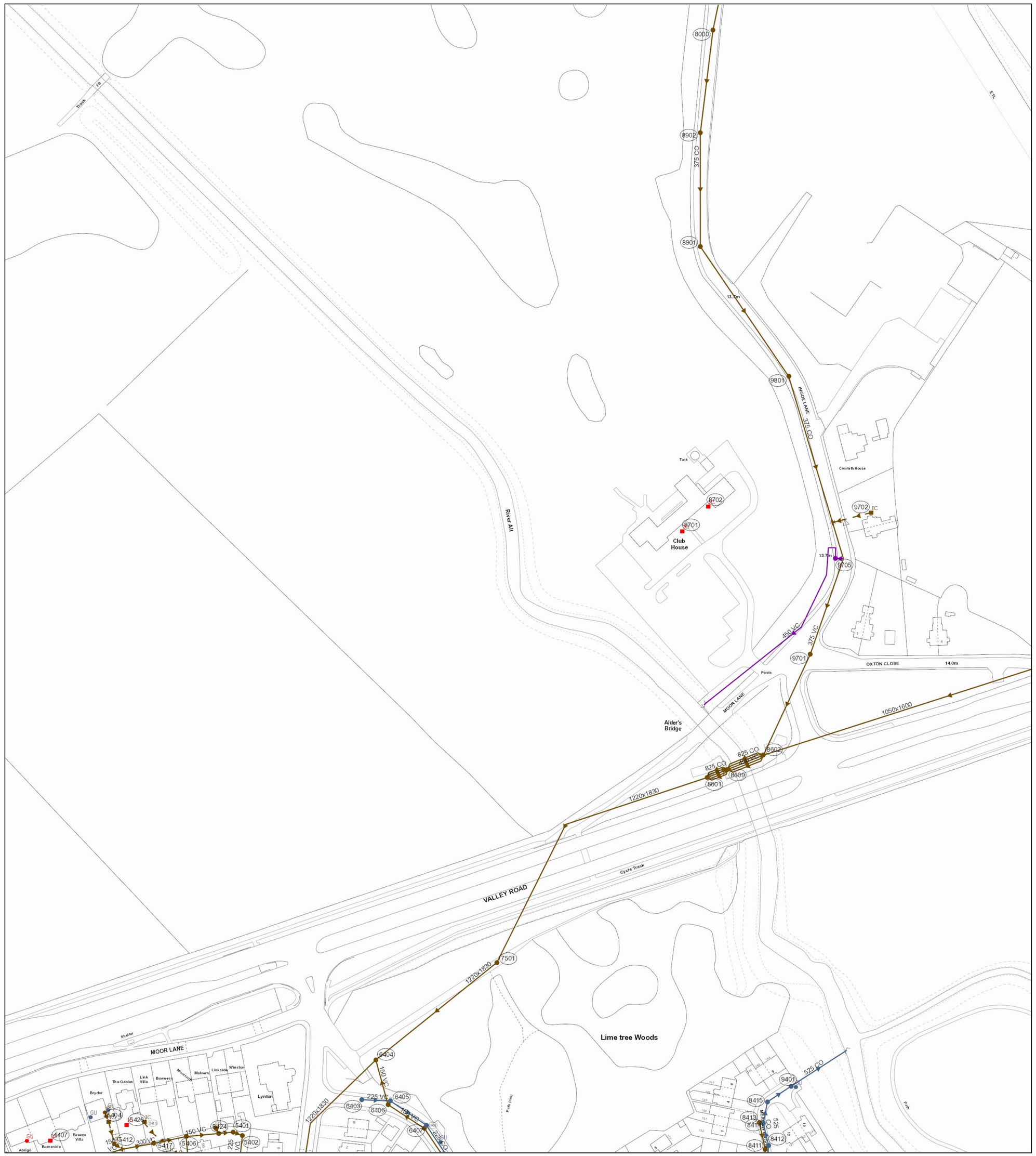
HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ3897NE
Scale: 1:1250 **Date:** 31/07/2019
Nodes: 221
Sheet: 6 of 9

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SEWER RECORDS

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helping life flow smoothly



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
5406	19.66	FO		150			VC	8.091113	
5406	19.66	FO		150			VC	8.091113	
8609		FO		825			CO	14.28059	
8609		FO		825			CO	14.10025	
8414	17.71	SW	12.84	525			CO	12.036	1 in 93
8414	17.71	SW	12.84	525			CO	12.036	1 in 93
9705		OV	0	450			VC	126.2648	
8901	14.08	FO	11.91	375			CO	87.0919	1 in 335
8901	14.08	FO	11.91	375			CO	87.0919	1 in 335
7501	16.37	FO	9.6	1220			BR	86.18609	1 in 1724
7501	16.37	FO	9.6	1220			BR	86.18609	1 in 1724
8602	13.65	FO		825			CO	23.61954	
8602	13.65	FO		450			VC	22.08659	
8412	17.64	SW	13.91	525			CO	12.70254	1 in 12
8412	17.64	SW	13.91	525			CO	12.70254	1 in 12
5410		FO	0	150			VC	24.62195	
8000	16.02	FO	12.37	375			CO	57.42822	1 in 185
8000	16.02	FO	12.37	375			CO	57.42822	1 in 185
6404	18.16	FO	9.55	1220			BR	140.4339	1 in 1170
6404	18.16	FO	9.55	1220			BR	140.4339	1 in 1170
6408	18.54	FO	12.57	150			VC	24.15855	1 in 69
6408	18.54	FO	12.57	150			VC	24.15855	1 in 69
8415	17.77	SW	12.71	525			CO	15.7563	1 in 315
8415	17.77	SW	12.71	525			CO	15.7563	1 in 315
8602	13.65	FO		825			CO	23.48585	
8411	17.63	FO	15.71	150			VC	16.37448	1 in 164
8411	17.63	FO	15.71	150			VC	16.37448	1 in 164
8609		FO		450			VC	12.62752	
0701	14.2	FO	10.66	1050			BR	216.2997	1 in 865
5417		FO		300			VC	18.37557	
5417		FO		300			VC	18.37557	
9401	17.61	SW	12.66	525			CO	36.79497	1 in 26
9401	17.61	SW	12.66	525			CO	36.79497	1 in 26
6407	18.46	SW	16.05	225			CO	59.89844	1 in 107
6407	18.46	SW	16.05	225			CO	59.89844	1 in 107
4401	20.39	FO	19.19	150			VC	62.99297	1 in 95
4401	20.39	FO	19.19	150			VC	62.99297	1 in 95
7307	18.72	FO	12.84	150			VC	60.16059	1 in 223
8609		FO		450			VC	12.52655	
9701		FO	0	375			VC	61.7414	
5402		FO	0	225			VC	74.43118	
5402		FO	0	225			VC	74.43118	
8413	17.73	FO	15.94	150			VC	15.01837	1 in 65
8413	17.73	FO	15.94	150			VC	15.01837	1 in 65
9801	13.8	FO	11.65	375			CO	105.518	1 in 310
8410	17.57	SW	14.19	525			CO	17.32754	1 in 62
8602	13.65	FO		450			VC	22.10023	
6403	17.98	SW	16.37	225			VC	15.9296	1 in 145
6403	17.98	SW	16.37	225			VC	15.9296	1 in 145
8101	16.81	FO	12.67	375			CO	68.44706	1 in 228
5401	19.51	FO	17.65	225			VC	5.385165	
5401	19.51	FO	17.65	225			VC	5.385165	
8601	13.42	FO	9.7	1220			BR	168.2788	1 in 1683
5406	19.66	FO	18.14	150			VC	18.21965	
5406	19.66	FO	18.14	150			VC	18.21965	
6405	18.14	SW	16.26	225			VC	23.91133	1 in 114
6405	18.14	SW	16.26	225			VC	23.91133	1 in 114
8609		FO		375			VC	11.96892	
6406	18.18	FO	12.22	150			VC	25.69859	1 in 15
6406	18.18	FO	12.22	150			VC	25.69859	1 in 15
8602	13.65	FO		375			VC	21.54066	
8902	14.29	FO	12.06	375			CO	63	1 in 420
8902	14.29	FO	12.06	375			CO	63	1 in 420

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

Abandoned
Foul
Surface Water
Combined

- Public Sewer
- Private Sewer
- Section 104
- Rising Main
- Sludge Main
- Overflow
- Water Course
- Highway Drain

All point assets follow the standard colour convention:

red - combined blue - surface water
brown - foul purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
GRC	Glass Reinforced Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

Address or Site Reference:

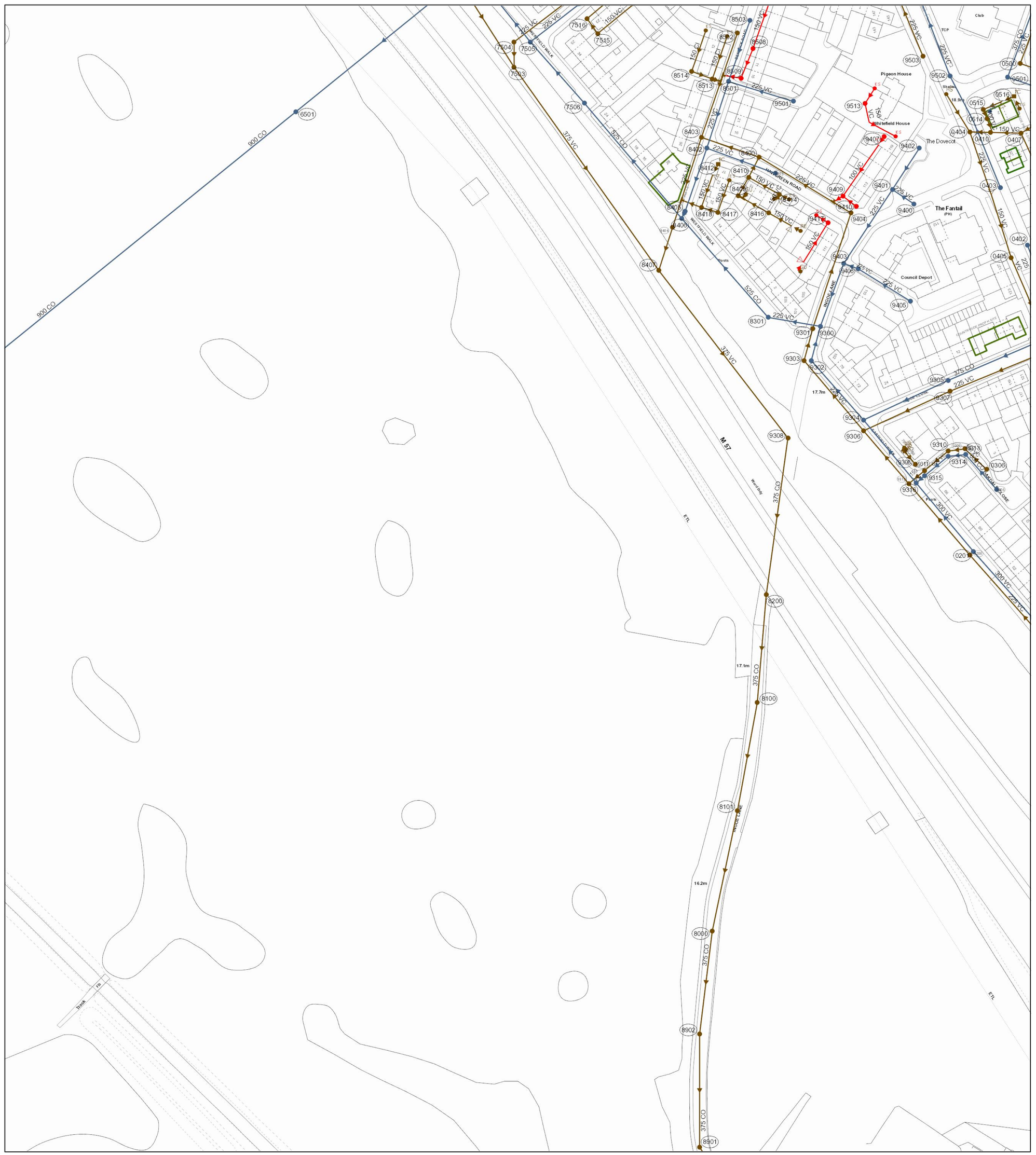
HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ3997NE
Scale: 1:1250 **Date:** 31/07/2019
Nodes: 63
Sheet: 7 of 9

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SEWER RECORDS

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helping life flow smoothly



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
0101	18.69	FO	0	225			VC	92.09777	
6501		SW	0	900			CO	426.2905	
8509		CO		150			VC	10.22339	
0514		FO		100			VC	8.113119	
0514		FO		100			VC	8.113119	
0507		SW	17.62	375			CO	56.86266	
9305	18.14	SW	16.4	375			CO	51.89412	
9305	18.14	SW	16.4	375			CO	51.89412	
9503	18.83	FO	0	225			VC	52	
9503	18.83	FO	0	225			VC	52	
7506	16.84	SW	13.79	525			CO	45.34314	1 in 206
0206		SW	0	600			CO	25.98385	
0206		SW	0	600			CO	25.98385	
9400	18.5	SW	16.58	225			VC	14.4222	
9400	18.5	SW	16.58	225			VC	14.4222	
8418		FO		150			VC	11.83688	
8410		FO		150			VC	12.58507	
8100	17.44	FO	12.9	375			CO	61	1 in 265
9404	18.23	FO	16.2	225			VC	59.68365	1 in 298
0402	19.26	SW	0	375			VC	51.62364	
0402	19.26	SW	0	375			VC	51.62364	
9315		SW	0	150			VC	6.043146	
9315		SW	0	150			VC	6.043146	
0500	18.94	FO	0	225			VC	40.49691	
0500	18.94	FO	0	225			VC	40.49691	
0306		FO	0	150			VC	16.59257	
0306		FO	0	150			VC	16.59257	
8101	16.81	FO	12.67	375			CO	68.44706	1 in 228
8502	17.81	FO	15.83	225			VC	61.35145	1 in 6135
8402	17.48	SW	15.9	225			VC	37	1 in 103
8417		FO		150			VC	9.492887	
8508		CO		150			VC	17.64671	
8409		FO		150			VC	11.76333	
8200		FO	0	375			CO	60.20797	
7505	16.82	SW	13.54	525			CO	25.6125	1 in 171
9405	18.4	SW	16.96	225			VC	34.1321	1 in 88
9405	18.4	SW	16.96	225			VC	34.1321	1 in 88
9501		SW	0	225			VC	37.64306	
9401	18.42	SW	0	225			VC	49.09175	
0201	18.82	SW	15.6	300			VC	49.52304	
0201	18.82	SW	15.6	300			VC	49.52304	
9309		FO	0	150			VC	9.378772	
9309		FO	0	150			VC	9.378772	
9301		FO	0	225			VC	67.77612	
9310		FO	0	150			VC	17.04485	
9310		FO	0	150			VC	17.04485	
9308		FO	0	375			CO	87.82368	
8406	17.34	SW	0	525			CO	83.73769	
0200	18.81	FO	15.08	225			VC	52.11584	
0200	18.81	FO	15.08	225			VC	52.11584	
8514		FO		150			CI	12.18866	
9502	19.03	SW	16.92	225			VC	61.09828	1 in 255
9502	19.03	SW	16.92	225			VC	61.09828	1 in 255
9302		SW	0	375			CO	19.64688	
0407		FO		150			VC	16.96986	
0407		FO		150			VC	16.96986	
9304		SW	0	375			CO	43.93177	
9316		SW	0	300			VC	45.60844	
9316		SW	0	300			VC	45.60844	
9303	17.66	SW	0	225			VC	18.26938	
0100	18.59	SW	16.16	300			VC	96.33276	1 in 175
8901	14.08	FO	11.91	375			CO	87.0919	1 in 335
8901	14.08	FO	11.91	375			CO	87.0919	1 in 335
8407	17	FO	13.66	375			VC	117.4637	
8000	16.02	FO	12.37	375			CO	57.42822	1 in 185
8000	16.02	FO	12.37	375			CO	57.42822	1 in 185
7515		FO		150			VC	10.15826	
0404	19	FO	16.85	225			VC	37	
0404	19	FO	16.85	225			VC	37	
9417		CO		150			VC	7.637989	
9406	17.98	SW	16.55	225			VC	8.544003	
9311		FO	0	150			VC	11.32768	
9311		FO	0	150			VC	11.32768	
8503	17.65	SW	16.32	225			VC	36.05551	1 in 240
0515		FO		100			VC	5.577366	
0515		FO		100			VC	5.577366	
0403	19.22	SW	17.32	225			VC	68.10294	1 in 175
0403	19.22	SW	17.32	225			VC	68.10294	1 in 175
9403	17.98	SW	0	225			VC	37.33631	
9513		CO		150			VC	27.38451	
0509		FO	0	225			VC	58.8517	
9314		SW	0	600			VC	17.07885	
9314		SW	0	600			VC	17.07885	
8400	17.79	FO	0	225			VC	33.83785	
0302	19.06	SW	0	375			CO	68.54196	
0511		FO		150			VC	7.5449	
8403	17.55	FO	15.72	225			VC	52.49762	1 in 262
8513		FO		150			CI	4.879072	
9312		FO	0	225			VC	38.66962	
9312		FO	0	225			VC	38.66962	
9402	18.57	SW	16.67	225			VC	27.45906	
9402	18.57	SW	16.67	225			VC	27.45906	
9306	17.94	FO	14.55	225			VC	51.08816	
9307	18.28	FO	15.6	225			VC	52.80151	1 in 52
9307	18.28	FO	15.6	225			VC	52.80151	1 in 52
8501	17.67	SW	16.15	225			VC	38.8973	1 in 169
9409		CO		100			VC	6.345841	
9410		CO		100			VC	9.464212	
0501	18.99	SW	0	375			CO	48.61557	
0501	18.99	SW	0	375			CO	48.61557	
8301	17.5	SW	0	525			CO	73	
8416		FO		150			VC	19.32677	
8401	17.72	SW	16.21	225			VC	40.49691	1 in 135
8405	17.19	SW	15.42	225			VC	4.472136	
7504		FO	0	225			VC	14	
0410		FO		150			VC	11.46373	
0410		FO		150			VC	11.46373	
9313		SW	0	600			CO	9.751273	
9313		SW	0	600			CO	9.751273	
0405	19.25	FO	17	225			VC	55.54278	1 in 105
0405	19.25	FO	17	225			VC	55.54278	1 in 105
8414		FO		150			VC	19.51754	
7503	16.65	FO	13.94	375			VC	138.5905	1 in 495
9300	17.74	SW	0	225			VC	29.42788	
8404	17.35	FO	0	225			VC	25.14614	
8902	14.29	FO	12.06	375			CO	63	1 in 420
8902	14.29	FO	12.06	375			CO	63	1 in 420
0303	18.97	FO	16.42	225			VC	60.53924	1 in 78

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

Abandoned
Foul
Surface Water
Combined

- Public Sewer
- Private Sewer
- Section 104
- Rising Main
- Sludge Main
- Overflow
- Water Course
- Highway Drain

All point assets follow the standard colour convention:
red - combined blue - surface water
brown - foul purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
GRC	Glass Reinforecd Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

Address or Site Reference:

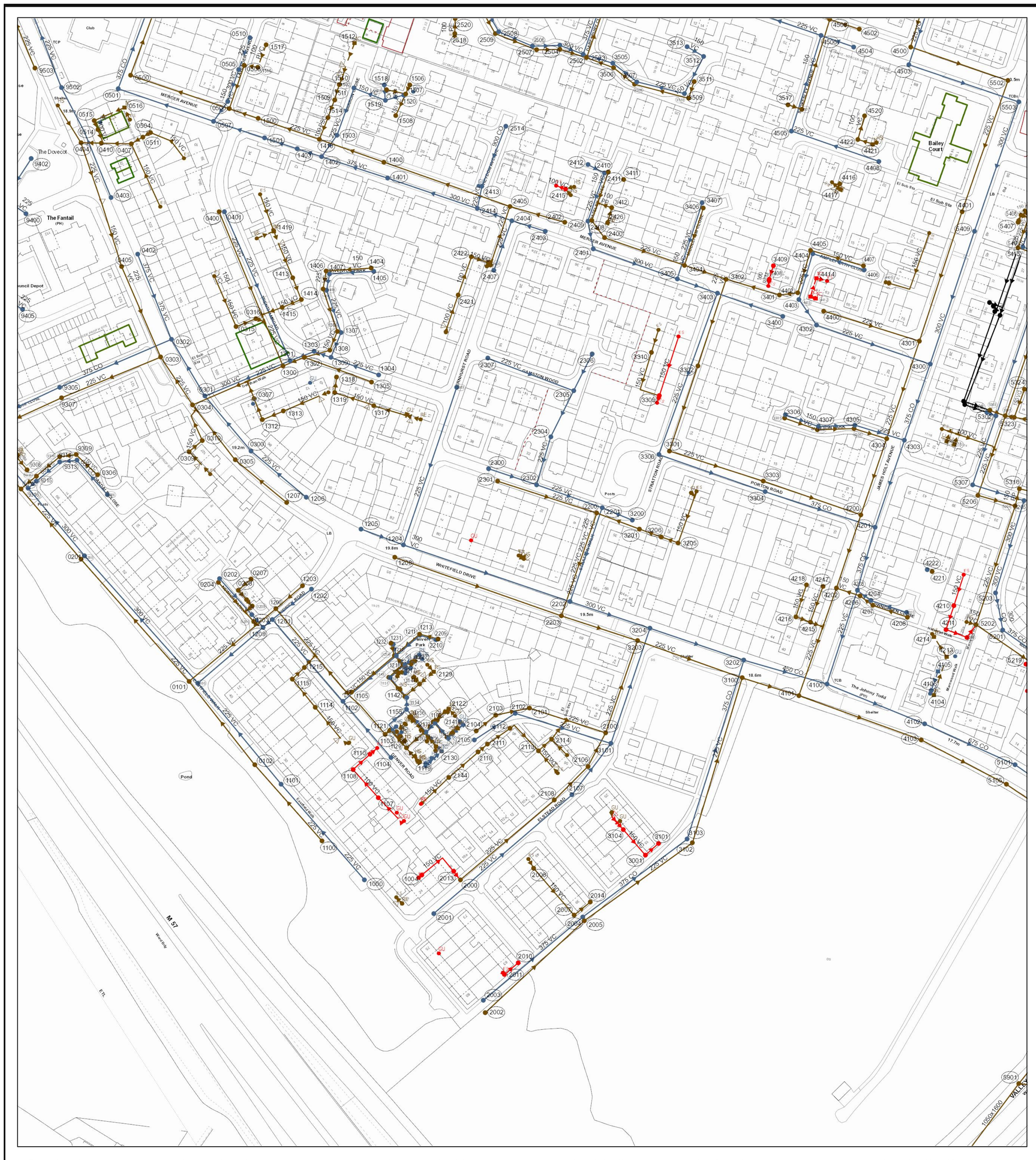
HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ3998SE
Scale: 1:1250 **Date:** 31/07/2019
Nodes: 118
Sheet: 8 of 9

Printed by: Property Searches

SEWER RECORDS

United Utilities
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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
1153		FO		0			UN	2.013427	
1502	20.98	SW	19.13	225			VC	28.21424	1 in 66
3511	22.17	FO	20.53	150			VC	9.943239	1 in 110
9305	18.14	SW	16.4	375			CO	51.89412	
9305	18.14	SW	16.4	375			CO	51.89412	
1402	20.5	SW	17.99	375			VC	14.54518	20.5
9400	18.5	SW	16.58	225			VC	14.4222	
9400	18.5	SW	16.58	225			VC	14.4222	
2504	22.03	SW	20.44	300			VC	14.04902	1 in 176
1104	19.3	SW	17.67	225			VC	41.642	19.3
4302	20.52	SW	18.8	225			VC	67.6757	1 in 141
2502	22.02	SW	20.32	375			VC	48.19424	1 in 161
4306	20.48	FO	18.35	150			VC	20.69323	1 in 74
3104		CO		150			VC	19.08839	
3101	19.49	FO	17.19	225			VC	45.22168	1 in 146
2402	20.69	FO	0	225			VC	32.28003	
1103	19.31	FO	17.15	225			VC	33.99535	1 in 177
3309		CO		150			VC	1.197858	
4402	20.51	FO	18.65	150			VC	15.54545	1 in 117
2506	21.92	SW	20.55	300			VC	15.57827	1 in 142
1142		FO		0			UN	14.15104	
1232		FO		0			UN	7.320569	
2007		FO		150			VC	11.72824	
2007		FO		150			VC	11.72824	
1401	21.02	SW	18.35	375			VC	39.13205	1 in 109
3402	20.79	FO	0	225			VC	51.5461	
4101	18.33	FO	14.81	225			VC	73.38937	
4309	20.46	SW	18.19	375			CO	45.31562	1 in 78
1415		FO		150			VC	12.16044	
4403	20.44	SW	18.92	225			VC	17.56783	1 in 251
1102	18.95	FO	0	225			VC	60.98309	
2104	19.61	FO	17.35	225			VC	14.21267	1 in 237
9502	19.03	SW	16.92	225			VC	61.09828	1 in 255
9502	19.03	SW	16.92	225			VC	61.09828	1 in 255
1205	19.55	SW	0	225			VC	25.63201	19.55
2422		FO		150			VC	0.866335	
1201	19.42	FO	0	225			VC	40.49986	
1201	18.99	SW	0	225			VC	6.840902	
1305	20.52	FO	18.48	225			VC	40.38182	1 in 46
1305	19.28	FO	16.95	225			VC	39.20459	1 in 123
4306	20.01	FO	18.07	150			VC	19.27453	1 in 26
1406	20.58	FO	19.2	150			VC	25.08279	1 in 114
1409	20.48	SW	19.03	225			VC	25.3004	1 in 120
3509	22.08	SW	20.81	225			VC	27.54458	1 in 125
2210		FO		0			UN	10.76778	
0404	19	FO	16.85	225			VC	37	
0404	19	FO	16.85	225			VC	37	
4407	21.35	FO	19.24	150			VC	31.10838	1 in 89
1306	20.44	FO	18.98	150			VC	11.52553	1 in 40
4405	21.19	FO	18.88	150			VC	25.007	1 in 109
2301	20.18	FO	18.19	225			VC	58.82177	1 in 95
2110		FO		0			VC	7.00199	
1108		FO		100			VC	13.01272	
1404	20.92	FO	19.55	150			VC	25.32404	1 in 97
2001	18.87	SW	17.49	225			VC	102.8251	1 in 219
2001	18.87	SW	17.49	225			VC	102.8251	1 in 219
1303	20.12	SW	17.99	225			VC	14.5752	
0909		FO		0			VC	58.8517	
2133		SW		0			UN	7.366146	
5901	16.05	FO	11.22	1050			BR	134.9978	1 in 900
5901	16.05	FO	11.22	1050			BR	134.9978	1 in 900
4409		FO		150			VC	1.834444	
9312		FO	0	225			VC	38.66962	
9312		FO	0	225			VC	38.66962	
2003	18.18	SW	0	375			VC	73.1095	
2003	18.18	SW	0	375			VC	73.1095	
0209		FO		100			VC	5.234568	
4400	20.4	FO	18.28	225			VC	56.61272	
4202	22.04	FO	16.33	225			VC	64.26118	18.64
4505	22.76	SW	21.46	225			VC	56.36341	1 in 91
3510	22.03	FO	20.44	150			VC	31.5998	1 in 144
3302	20.38	FO	17.74	225			VC	50.59644	1 in 163
4501		FO		100			VC	13.79682	
2303	20.77	SW	19.17	225			VC	93.92018	1 in 72
3303	19.42	FO	17.07	225			VC	58.18935	1 in 162
0509		FO		300			VC	13.66445	
1507		FO		150			VC	13.43119	
5205	19.5	SW	17.34	300			VC	54.40588	1 in 42
1400	20.95	FO	17.97	225			VC	38.6817	
2412	20.76	SW	19.42	225			VC	10.44264	1 in 75
1200	19.09	FO	16.57	225			VC	63.89053	1 in 290
1000	18.64	SW	17.28	225			VC	71.5891	
2409	20.51	SW	18.99	225			VC	15.98182	1 in 123
2411	20.83	SW	19.28	225			VC	28.73112	1 in 106
2408	20.54	FO	18.53	150			VC	12.06409	1 in 57
1204	19.68	SW	17.8	300			VC	99.29753	1 in 301
2403	20.77	SW	0	300			VC	19.92486	
1313		FO		150			VC	12.81414	
4207	18.38	FO	16.93	150			VC	8.890022	1 in 23
0510		SW		225				19.00853	
1154		SW		0			UN	14.70551	
0504		FO		150			VC	4.987774	
5502		FO	0	225			VC	78.43554	
4301	20.43	SW	18.67	225			VC	20.51011	1 in 82
3507	21.92	SW	20.59	300			VC	17.1256	1 in 143
2006		FO		150			VC	34.92025	
2421		FO		100			VC	22.85014	
0307		FO		150			VC	10.42618	
1410		FO	0	225			VC	36.47485	
1410		FO	0	225			VC	58.18935	
5316		FO		100			PP	16.90009	
4502	23.03	FO	20.49	225			VC	17.44629	1 in 103
3304	19.28	SW	0	375			CO	65.14599	
1407	20.58	FO	19.09	225			VC	0.299949	1 in 155
1143		FO		100			UN	10.76773	
9405	18.4	SW	16.96	225			VC	34.1321	1 in 88
9405	18.4	SW	16.96	225			VC	34.1321	1 in 88
9309		FO	0	150			VC	9.378772	
9309		FO	0	150			VC	9.378772	
5324		FO		150			VC	16.91735	
1301	20.28	SW	0	300			VC	52	
9310		FO	0	150			VC	17.04485	
9310		FO	0	150			VC	17.04485	
1514		FO		100			PSC	13.26945	
0202		SW		225			VC	27.32517	
1212	19.35	SW	17.9	225			VC	39.60245	1 in 66
2005	18.26	FO	15.94	225			VC	75.21303	
2005	18.26	FO	15.94	225			VC	75.21303	18.26
2413	21.06	SW	18.98	225			VC	12.75943	1 in 142
2108	19.47	FO	16.83	225			VC	26.87006	1 in 537
3405	20.82	SW	18.61	300			VC	24.09003	
3101		CO		150			VC	10.98586	
2011		CO		150			VC	10.08586	
1207	19.38	FO	0	225			VC	37.64306	
3102		FO	0	225			VC	97.12363	
2400	20.62	FO	18.31	225			VC	47.79844	1 in 184
1307	20.43	SW	18.82	225			VC	15.10865	1 in 29
0407		FO		150			VC	16.96986	
0407		FO		150			VC	16.96986	
3310		FO		150			VC	33.2211	
9316		SW	0	300			VC	45.60844	
9316		SW	0	300			VC	45.60844	
2209		SW		0			UN	9.459296	
1211	20.1	FO	18.45	225			VC	17.61868	1 in 50
5105		FO	0	225			VC	66.28725	
3201	19.93	SW	17.68	225			VC	25.63201	1 in 160
1155		SW		0			UN	6.597276	
3100	18.63	FO	0	225			VC	33.52611	
1114		FO		150			VC	20.37773	
9311		FO	0	150			VC	11.32768	
9311		FO	0	150			VC	11.32768	
5206	19.44	FO	16.99	225			VC	21.84033	1 in 137
1414		FO		150			VC	11.67436	
1156		SW		0			UN	16.87407	
4205	18.22	SW	17.26	225			VC	21.143	1 in 163
1130		FO		0			UN	13.53476	
3400	20.66	SW	18.77	225			VC	39.21734	
1510		FO		100			PSC	8.892412	
1227		FO		0			UN	5.399405	
2111		FO		0			VC	15.45494	
1403	20.28	SW	0	375			CO	19.35118	
0505		SW		300			VC	19.20266	
2414	21.03	SW	18.82	300			VC	53.45624	1 in 144
4406	21.39	SW	19.68	225			VC	30.51405	1 in 74
3204	19.15	SW	16.5	375			CO	55.97321	1 in 175
1208	19.72	FO	0	225			VC	99.62429	
3203	19.07	FO	15.99	225			VC	62.62587	
2200	19.91	FO	17.52	225			VC	61.38145	1 in 92
1216		SW		100			UN	6.924065	
2410	20.87	FO	18.98	150			VC	28.91838	1 in 69
1214	19.3	FO	17.6	150			VC	31.61762	1 in 57
2106	19.38	FO	16.75	225			VC	21.47091	1 in 358
5302	20.35	SW	18.46	225			VC	41.07877	1 in 46
4206	18.48	FO	16.54	150			VC	14.05954	1 in 67
2518		FO		100			PE	8.434606	
4506	22.63	SW	20.82	225			VC	50.36296	1 in 201
2103	19.48	FO	17.27	225			VC	19.41549	1 in 216
4210		CO		150			VC	14.12785	
3508	21.9	FO	20.22	150			VC	15.0446	1 in 137
1304	20.44	SW	0	225			VC	28.74632	
2102	19.4	SW	17.69	225			VC	56.61272	1 in 177
4303	19.68	SW	17.61	375			CO	51.76683	
1217		FO		100			UN	6.964092	
1516		FO		100			PVC	7.760666	
5204	19.38	FO	16.81	225			VC	70.5195	1 in 50
3407	21.02	SW	19.42	225			VC	45.18977	1 in 56
4203	18.5	SW	16.73	225			VC	55.4964	18.5
2505	22.03	FO	20.12	150			VC	15.92188	1 in 122
5203	17.97	SW	15.99	300			VC	10.15804	1 in 146
5201	17.72	SW	15.76	375			CO	57.42822	1 in 302
2307	20.99	SW	19.43	225			VC	51.74609	1 in 96
0514		FO		100			VC	8.113119	
0514		FO		100			VC	8.113119	
0204		FO	0	150			VC	29.77362	
0507		SW	17.62	375			CO	56.86266	
9503	18.83	FO	0	225			VC	52	
9503	18.83	FO	0	225			VC	52	
1209		SW		0			VC	48.47636	
4301		FO	0	225			VC	58.09763	
3101	19.17	SW	16.77	300			VC	58.62215	1 in 343
2407	20.85	SW	19.24	225			VC	29.73214	
2508	22.07	SW	20.69	300			VC	20.95091	1 in 147
4211		CO		150			VC	12.56196	
9315		SW	0	150			VC	6.043146	
9315		SW	0	150			VC	6.043146	
0500	18.94	FO	0	225			VC	40.49691	
0500	18.94	FO	0	225			VC	40.49691	
1121		FO		100			UN	3.979373	
0400	19.99	FO	17.88	225			VC	94.15434	1 in 294
1231		SW		0			UN	5.659174	
0401	19.86	SW	18.31	225			VC	91.7878	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
3200	19.74	SW	18.1	225			VC	18.38478	
3305	20.29	SW	18.97	225			VC	19.78034	1 in 66
0304	19.11	FO	16.62	225			VC	32.44996	1 in 155
2001		FO	0	225			VC	76.41989	
2002		FO	0	225			VC	76.41989	
3512	22.33	SW	20.97	225			VC	23.58324	1 in 147
5408		FO		150			VC	4.523649	
2302	19.96	SW	18.46	225			VC	39.21734	
2013		CO		150			VC	6.114699	
0316		FO		150			VC	5.094981	
2113		FO		0			VC	9.782475	
2304	20.15	SW	18.7	225			VC	28.16026	1 in 122
1319		FO		150			VC	8.899934	
3505	22.01	SW	20.47	300			VC	17.53525	1 in 159
0200	18.81	FO	15.08	225			VC	52.11584	
0200	18.81	FO	15.08	225			VC	52.11584	
1406	20.59	FO	19.29	150			VC	10.46709	1 in 116
2420		FO		150			VC	2.063432	
2401	20.64	SW	18.86	300			VC	50.24042	1 in 209
3408		CO		100			RPM	3.776175	
4217		FO		150			VC	21.43623	
3306	20.25	FO	18.58	150			VC	19.51165	1 in 85
2105	19.55	SW	17.81	225			VC	27.45906	1 in 305
3401	20.64	FO	18.44	225			VC	31.32092	
1213	20.1	FO	17.92	150			VC	18.73706	1 in 59
2123		FO		0			UN	11.75186	
1110		CO		100			VC	5.283685	
1215		FO		150			VC	9.239074	
3202	18.69	SW	15.42	450			CO	48.70123	
2201	19.79	SW	0	225			VC	55.97321	
1115		FO		150			VC	9.428757	
4304	19.45	FO	0	225			VC	45.30933	
1519		SW		300			VC	18.90105	
5409	21.96	SW	20.2	300			VC	79.05694	1 in 49
5415	22.19	FO	20.48	225			VC	24.19824	1 in 151
2305	20.54	SW	18.89	225			VC	29.04484	1 in 153
5210		CO		150			VC	8.858676	
5407		FO		150			VC	4.309632	
0309		FO		150			VC	9.845066	
1107		CO		100			VC	21.25615	
1105	19	FO	17.05	150			VC	2.581203	
1312		FO		150			VC	12.86958	
3506	22.01	FO	20.11	150			VC	16.17632	1 in 135
4204	18.4	SW	17.13	225			VC	9.550131	1 in 24
0403	19.22	SW	17.32	225			VC	68.10294	1 in 175
0403	19.22	SW	17.32	225			VC	68.10294	1 in 175
3404	20.67	FO	18.05	225			VC	24.77139	
1504		FO		150			VC	11.17078	
1300	20.26	FO	18.01	225			VC	55.54278	1 in 40
0102	18.77	FO	0	225			VC	59.81639	
1308	20.2	FO	18.69	150			VC	14.86221	1 in 99
2509	22.07	FO	20.4	150			VC	25.02492	1 in 132
0211		FO		100			VC	4.964791	
9307	18.28	FO	15.6	225			VC	52.80151	1 in 52
9307	18.28	FO	15.6	225			VC	52.80151	1 in 52
5307	19.38	SW	17.53	300			VC	30.36445	1 in 202
1100	18.63	FO	0	225			VC	57.38467	
3205		FO		150			VC	10.09529	
0315		FO		150			VC	11.97998	
1309	20.29	SW	0	225			VC	9.928858	
4215		FO		150			VC	7.501253	
4216		FO		150			VC	8.750779	
3403		SW	0	225			VC	96.79878	
4408	22.77	SW	21.81	225			VC	52.16333	1 in 153
0207		FO		100			VC	9.565463	
2107	19.36	SW	17	225			VC	36.40055	1 in 202
2004	18.26	SW	0	375			CO	73.60027	
2004	18.26	SW	0	375			CO	73.60027	
4504	22.97	SW	20.96	225			VC	19.52982	1 in 150
1162		FO		0			UN	1.915553	
2405	20.93	FO	18.37	225			VC	75.27283	1 in 198
2406	20.95	FO	18.7	225			VC	34.78505	1 in 109
1141		FO		0			UN	10.88804	
3001		CO		150			VC	9.930977	
0303	18.97	FO	16.42	225			VC	60.53924	1 in 78
3300	19.83	SW	0	225			VC	63.56886	
2112		FO		0			VC	22.83689	
0101	18.69	FO	0	225			VC	92.09777	
4201	18.97	SW	0	375			CO	37.04642	
1413		FO		150			VC	13.11877	
1302	20.24	FO	17.6	225			VC	13.02996	
5101		SW	0	675			CO	63.24555	
3206		FO		150			VC	13.20963	
1202	19.21	SW	0	225			VC	27.80288	
0206		SW	0	600			CO	25.98385	
0206		SW	0	600			CO	25.98385	
0508		FO		150			VC	25.9286	
0402	19.26	SW	0	375			VC	51.62364	
0402	19.26	SW	0	375			VC	51.62364	
0306		FO		150			VC	16.59257	
0306		FO		150			VC	16.59257	
4102	17.79	SW	0	675			CO	55.9464	
0501		FO		225			VC	76.84399	
5301	20.46	FO	18.03	225			VC	47.4343	1 in 49
2415		CO		100			VC	5.564246	
2514	19.09	SW	17.45	300			VC	47.43417	1 in 216
1503	20.54	SW	18.7	225			VC	14.96527	1 in 29
4305	20.02	SW	18.42	225			VC	29.27846	1 in 52
4507	22.62	FO	20.85	150			VC	53.1128	1 in 111
3103		SW	0	375			CO	105.9481	
0208		FO		100			VC	7.107531	
4208	18.17	FO	17.11	150			VC	20.70398	1 in 115
0515		FO		100			VC	5.577366	
0515		FO		100			VC	5.577366	
1520		SW		150			VC	10.94098	
9314		SW	0	600			VC	17.07885	
9314		SW	0	600			VC	17.07885	
4503	23.24	SW	21.13	300			VC	65.45992	1 in 242
1501	20.12	SW	17.62	375			CO	30.26011	
0511		FO		150			VC	7.5449	
1405	20.94	SW	19.3	225			VC	24.95688	1 in 119
9402	18.57	SW	16.67	225			VC	27.45906	
9402	18.57	SW	16.67	225			VC	27.45906	
2503	22.02	FO	19.99	150			VC	25.90677	1 in 130
0301	19.09	SW	17.15	300			VC	37.21559	
2306	20.58	SW	19.1	225			VC	23.29915	1 in 111
0501	18.99	SW	0	375			CO	48.61557	
0501	18.99	SW	0	375			CO	48.61557	
1517		FO		100			PVC	13.48511	
1120		FO		100			UN	13.5926	
2203	19.52	FO	16.78	225			VC	45.22168	1 in 174
4218		FO		150			VC	18.97775	
4200	18.86	FO	16.7	225			VC	43.57935	1 in 118
2507	21.91	FO	20.21	150			VC	13.11383	1 in 146
1151		SW		0			UN	11.04056	
5303		FO	0	225			VC	9.406052	
0203		SW	0	225			VC	9.625153	
4508	22.88	FO	20.32	225			VC	55.2861	1 in 158
2520		FO		100			PE	5.258845	
2114		FO		0			VC	13.71752	
3412		FO		100			PP	8.404153	
0410		FO		150			VC	11.46373	
0410		FO		150			VC	11.46373	
9313		SW	0	600			CO	9.751273	
9313		SW	0	600			CO	9.751273	
4404	21.15	SW	19.26	225			VC	26.98609	1 in 79
1101	18.97	SW	0	225			VC	73.87828	
1203	19.16	FO	16.97	225			VC	19.84943	1 in 58

LEGEND

Abandoned · Foul · Surface Water · Combined

- Public Sewer
- Private Sewer
- Section 104
- Rising Main
- Sludge Main
- Overflow
- Water Course
- Highway Drain

All point assets follow the standard colour convention:
red - combined · blue - surface water
brown - foul · purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
GRC	Glass Reinforced Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

Address or Site Reference:

HUNTERS HOUSE AINTREE LANE,
LIVERPOOL,
L10 8LQ

OS sheet Number: SJ4098SW
Scale: 1:1250 **Date:** 31/07/2019
Nodes: 368
Sheet: 9 of 9

Printed by: Property Searches

SEWER RECORDS

United Utilities — helping life flow smoothly

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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APPENDIX D: LPA/LLFA CORRESPONDENCE

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Megan Berry

From: Lead Local Flood Authority <LLFA@knowsley.gov.uk>
Sent: 09 August 2019 12:13
To: Megan Berry
Subject: RE: Historical Flood Risk Information
Attachments: Knowsley MBC - Sustainable Drainage and Surface Water Management - Guida....pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Megan,

Thank you for your email.

With regards to historical flooding; Aintree Lane has experienced flooding at various times over the past few years. Part of the investigatory work undertaken by Knowsley Council Highways, identified 2no 300dia drains crossing the development site.
The highway drainage from Aintree Lane, as well as the surface water from the nearby Haven Road housing state outfall into the River Alt via these drains.

The designation and ownership of the drains are not clear, however 1no is noted on the United Utilities asset maps as a 300dia watercourse.
The condition of both drains have previously been identified to be poor and will likely need repair or replacement.
I am in possession of a historical drainage plan which shows a number of land drains crossing the development site, together with the approximate locations of the 2no drains and their manholes.

As the LLFA, we would support the de-culverting of the watercourse if this was proposed.
We would also recommend that the drains are repaired / replaced as part of the wider aspirations of the development, and even diverted to facilitate comprehensive development.

Could I therefore request that you liaise with me as the LLFA on the proposals from a very early stage to ensure that an integrated sustainable drainage system is proposed, that encompasses the wider drainage issues.

As you are likely aware, the River Alt is classified as main river and any works on or near main rivers is regulated by environmental permitting by The Environment Agency.

With regards to local policy and specific guidance:
Please take a look at our Strategic and Preliminary Flood Risk Assessments.
They can be found on Knowsley Council's Lead Local Flood Authority website.

The Strategic Flood Risk Assessments provide an overview of flood risk in Knowsley. The SFRA Part 1 focuses on future development in the borough but does not focus upon individual properties or sites. The SFRA Part 2 provides more detailed information regarding the nature of flood risk at a number of sites allocated within the Local Plan. The Preliminary Flood Risk Assessment (PFRA) report was submitted to the Environment Agency and approved in October 2011. According to the guidelines set by the Environment Agency / DEFRA, Knowsley does not have a nationally significant flood risk.

In addition, I have attached Knowsley MBC's 'Sustainable Drainage & Surface Water Management - Technical Guidance for Developers' document for your information.

Guidance on the production of Flood Risk Assessments can be found here:
https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

From the limited information provided: the LLFA considers the development site to be greenfield and will require the surface water discharge rate be restricted to greenfield (Qbar) runoff rates, in accordance with our technical guidance and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards.

If the development is classified as Major Development under Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2015; the development must include Sustainable Urban Drainage Systems (SuDS) unless it can be demonstrated that it is inappropriate for the site.

If the development is classified as Major Development; the LLFA will require a comprehensive and detailed Flood Risk Assessment and Drainage Strategy, together with a corresponding detailed surface water drainage scheme to be submitted, together with hydraulic drainage calculations for a 1:2yr, 1:30yr and a 1:100yr plus an appropriate climate change allowance design storm event. (summer and winter storms, for all storm durations from 15mins to 10080mins). The drainage plan should be annotated with the pipe numbers from the calculations and show any attenuation, restricted discharge, exceedance storage and overland flow routes.

Any works on or near a main river may need an Environmental Permit for Flood Risk Activities from the Environment Agency (EA).
Any works on or near an ordinary watercourse will need Ordinary Watercourse Consent (OWC) from the Lead Local Flood Authority.

With regards to Surface Water, Groundwater, Coastal flooding; I have directed you towards our Strategic and Preliminary Flood Risk Assessments for this information. We do not have any additional information or knowledge at this time.

Knowsley MBC do not have any modelling for the area and SuDS will not be adopted by the Lead Local Flood Authority.

If I can be of further assistance, please contact me on 0151 443 2704.

Thank you,
Kevin.

Kevin McKeown

Principal Engineer – Drainage / Lead Local Flood Authority (LLFA)

Major Development Team / Invest Knowsley

Knowsley Metropolitan Borough Council

1st Floor, Huyton Library,

Civic Way, Huyton, Liverpool, L36 9GD

Email: kevin.mckeown@knowsley.gov.uk

Tel: 0151 443 2704

Mobile: 07766 500 208

www.knowsley.gov.uk

From: Megan Berry <meganberry@betts-associates.co.uk>
Sent: 24 July 2019 16:30
To: Lead Local Flood Authority <LLFA@knowsley.gov.uk>
Subject: Historical Flood Risk Information

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/ office

To whom it may concern,

Kirkby Valley Golf Club, Valley Road, Liverpool

Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan

attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry BSc(Hons) GradCIWEM
Graduate Flood Risk Analyst

BETTS HYDRO
Consulting Engineers

Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
Chester +44 (0)1244 289041

meganberry@betts-associates.co.uk
www.betts-associates.co.uk

CIVIL | STRUCTURAL | GEO-ENVIRONMENTAL | HYDROLOGY | FLOOD RISK MANAGEMENT
SUDS | STRUCTURAL SURVEYS | PARTY WALL DUTIES | INFILTRATION | GEOTECHNICAL

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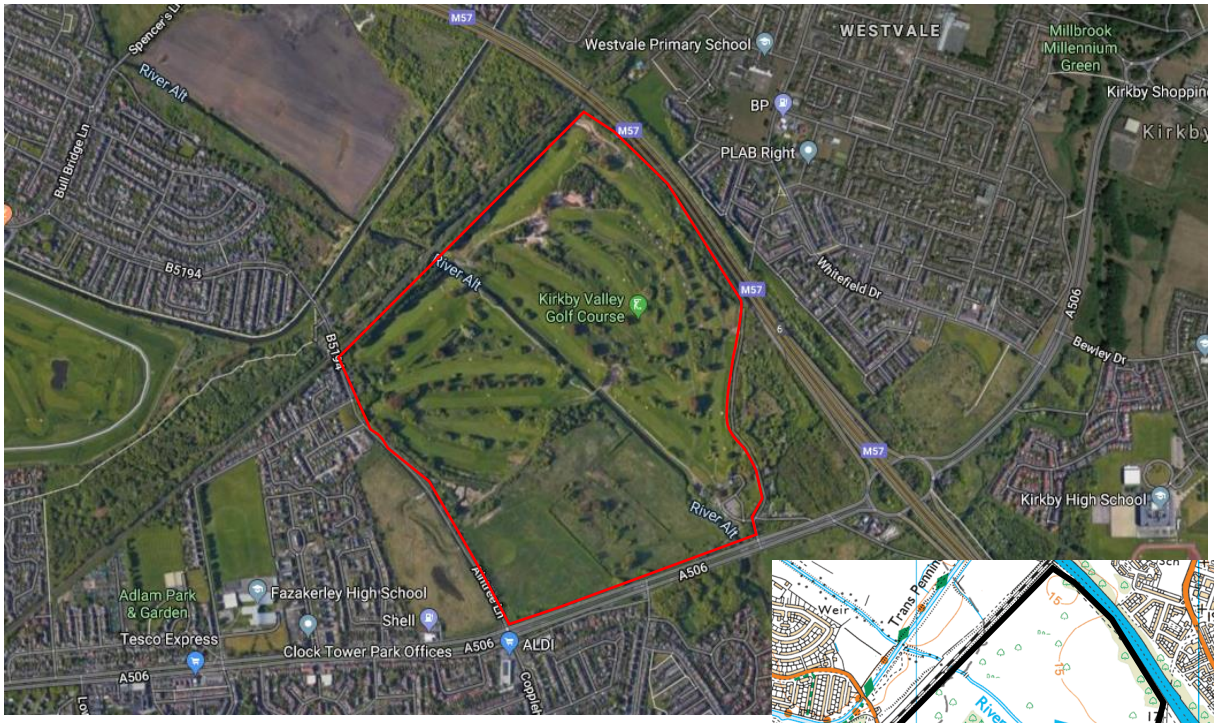
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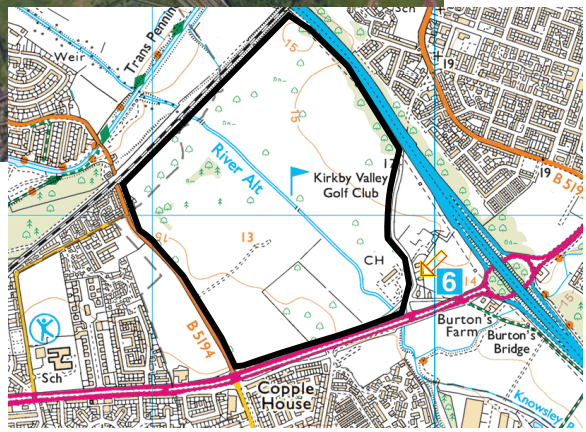
APPENDIX E: LOCATION PLAN

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LOCATION PLAN

Kirkby Valley Golf Club, Kirkby





OS X (Eastings)	339329
OS Y (Northings)	397949
Nearest Post Code	L10 8LQ
Lat (WGS84)	N53:28:29 (53.474757)
Long (WGS84)	W2:54:56 (-2.915559)
Lat,Long	53.474757,-2.915559
Nat Grid	SJ393979 / SJ3932997949
mX	-324558
mY	7036941

APPENDIX F: TOPOGRAPHIC SURVEY

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APPENDIX G: PROPOSED PLANNING LAYOUT

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N

SITE SPECIFIC HAZARDS

IN ACCORDANCE WITH THE REQUIREMENTS OF THE CDM REGULATIONS 2015 THE FOLLOWING SIGNIFICANT RESIDUAL HAZARDS HAVE NOT BEEN DESIGNED OUT OF THIS PROJECT AND MUST BE TAKEN INTO CONSIDERATION BY CONTRACTORS PLANNING TO UNDERTAKE THE WORKS SHOWN ON THIS DRAWING:

ORDNANCE SURVEY LICENCE

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NOTES

SITE BOUNDARY 80.3055 HECTARES

OTHER LAND IN THE OWNERSHIP OF THE CLIENT

SCALE 1:2500

0m 25 50 75 100 125 150

ROOT PROTECTION AREA

CATEGORY B TREE

CATEGORY C TREE

CATEGORY U TREE

CROWN SPREAD

TREE/SHRUB REMOVED

REV.	DATE	NOTES	INIT.
A	15.12.20	UPDATED	RSL

CLIENT / PROJECT

MAGHULL DEVELOPMENTS LTD

KIRKBY GOLF CLUB - VALLEY ROAD

KIRKBY

DRAWING TITLE

PROPOSED ESTATE PLAN

STATUS

PLANNING

DATE	DRAWN	SCALE @ A1
17.11.20	RSL	1:2500

PROJECT NUMBER	UNIT / BLOCK	CE / SFB CODE	TYPE & NUMBER	REVISION LETTER
9627			L22	A

Site Location Plans	L	OA Plans	P	Elevations	E
Sections	S	Details	D	Prelim Colour	C

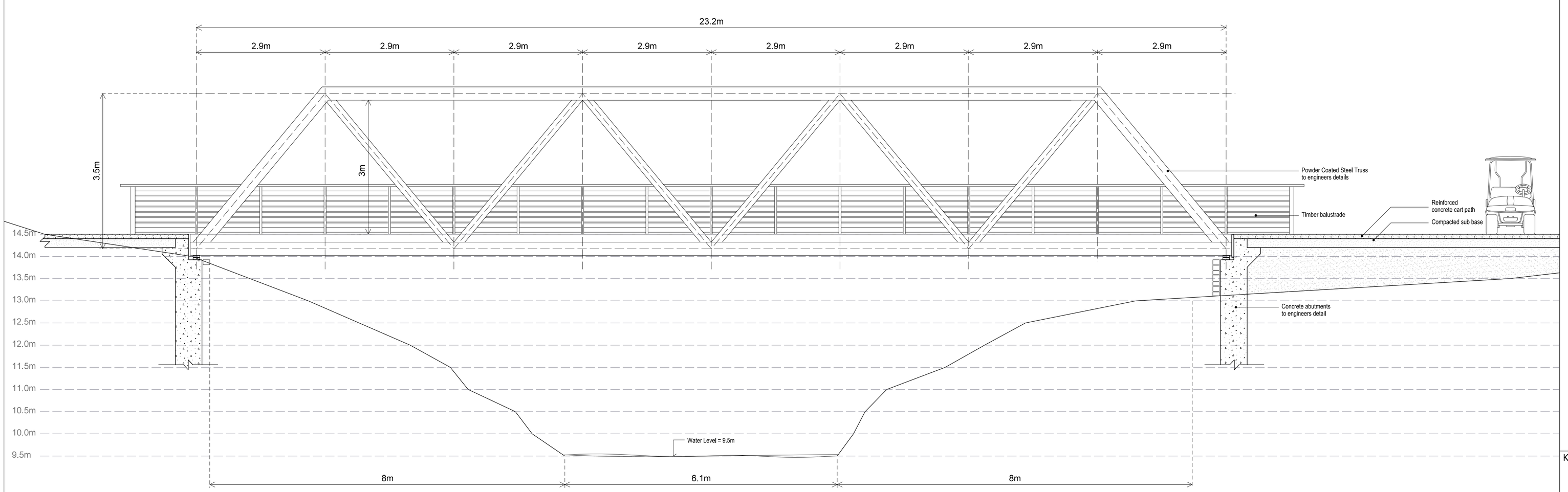
THE RATCLIFFE GROVES PARTNERSHIP

MANCHESTER
105 MANCHESTER ROAD
BURY LANCASHIRE BL9 0TD
T. 0161 797 6000 E. manchester@rgp.uk.com
www.rgp.uk.com

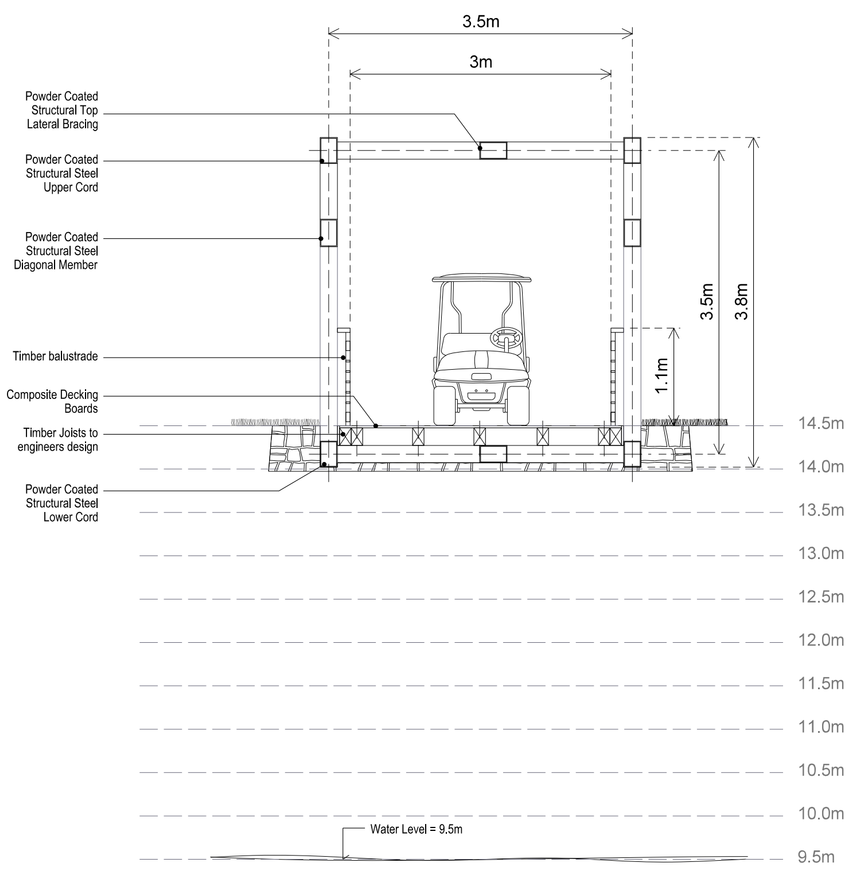
LONDON
19 BEDFORD ROW
LONDON WC1R 4EB
T. 020 7600 6666 E. london@rgp.uk.com

RGP architects

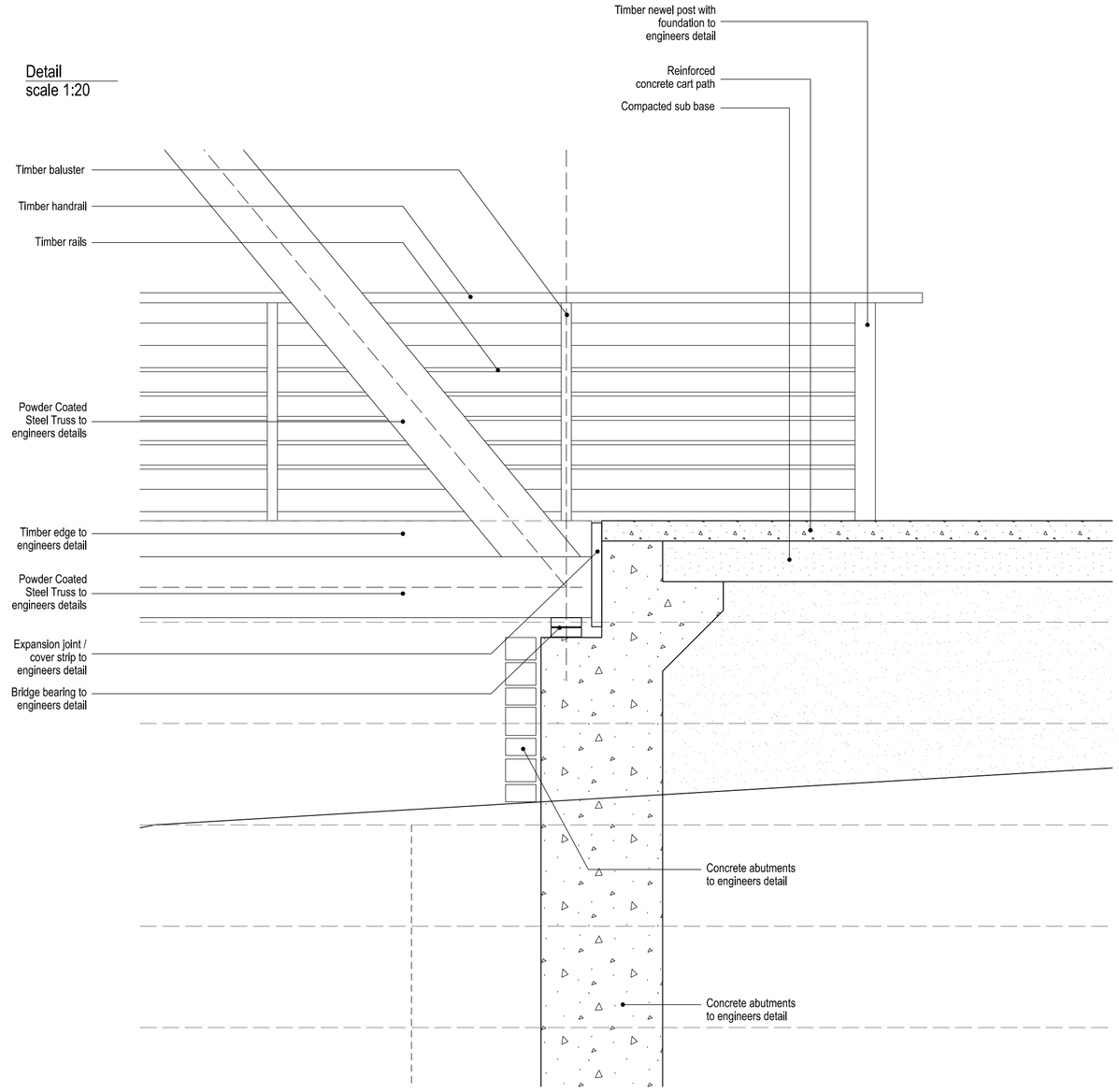
Elevation
scale 1:50



Section
scale 1:50



Detail
scale 1:20



GENERAL NOTES

01.

02.

03.

04.

05.

REVISIONS

REV	DATE	DESCRIPTION	REV BY	CHK BY

KEY PLAN

CONSULTANT

International Design Group

LEAD CONSULTANT

CLIENT

ISSUED FOR

Planning Application
(90% submittal)

PROJECT

Kirkby Valley Golf Club

DRAWING TITLE

Bridge Construction Details 2 of 2

Drawn	PA	Checked	AC	Approved	JH
Date	29.08.19	Sheet Size	A1	Scale	1:50 / 1:20

Drawing No.
G935 231 BRIDGE CONSTRUCTION DETAILS 2

Rev.
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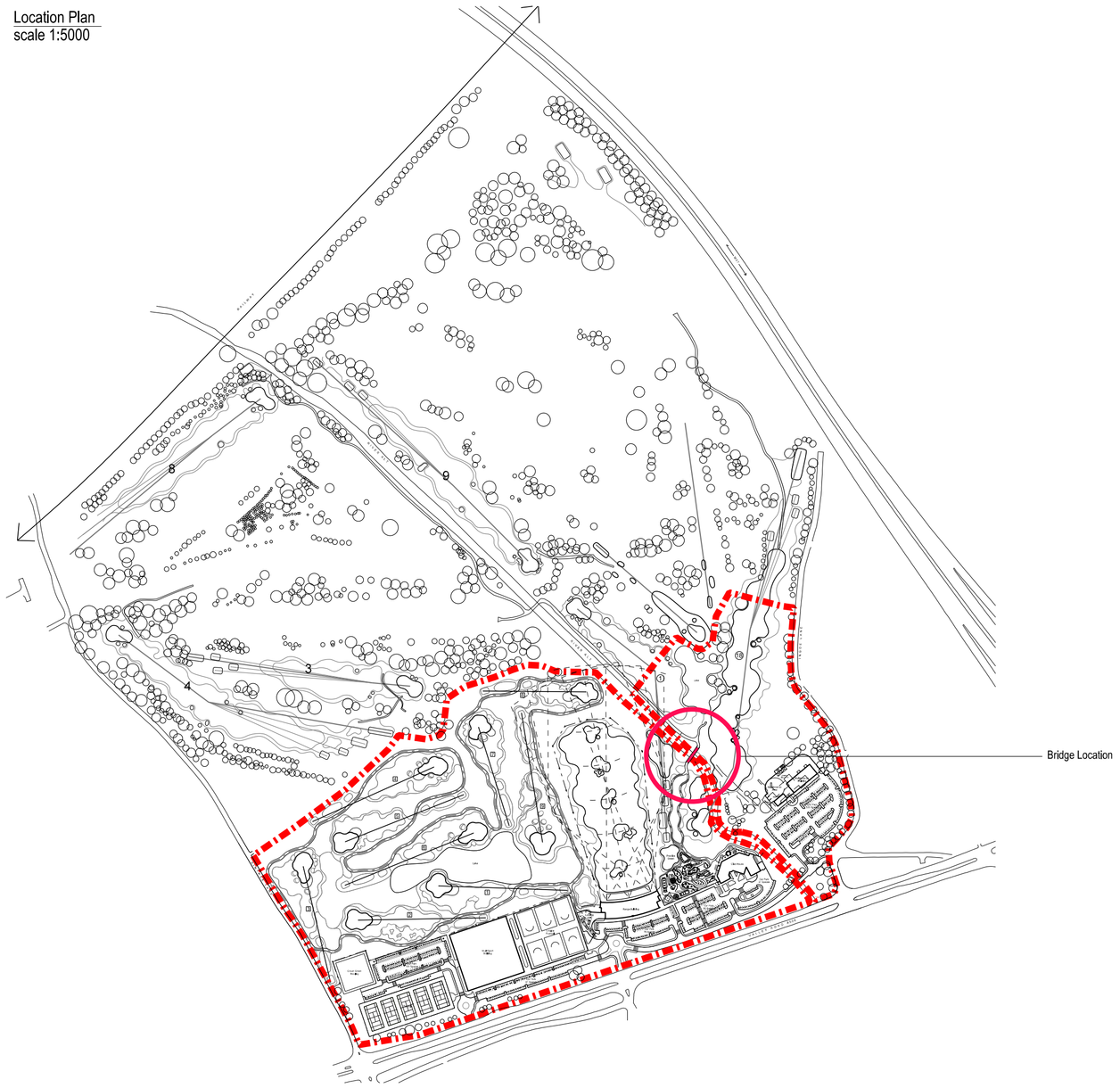
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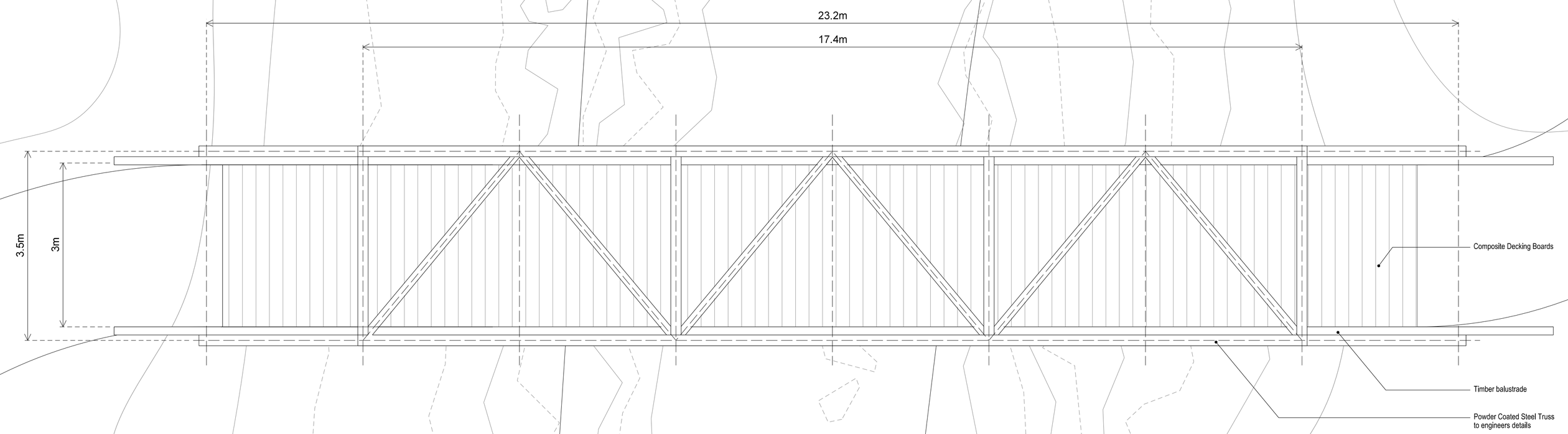
Location Plan
scale 1:5000



Location Plan
scale 1:1000



Plan Detail
scale 1:50



NORTH

GENERAL NOTES

01.

02.

03.

04.

05.

REVISIONS

REV	DATE	DESCRIPTION	REV BY	CHK BY

KEY PLAN

CONSULTANT

International Design Group

LEAD CONSULTANT

CLIENT

ISSUED FOR

Planning Application
(90% submittal)

PROJECT

Kirkby Valley Golf Club

DRAWING TITLE

Bridge Construction Details 1 of 2

Drawn	PA	Checked	AC	Approved	JH
Date	29.08.19	Sheet Size	A1	Scale	1:5000 / 1:1000 / 1:50

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APPENDIX H: PHOTOGRAPHS

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Kirkby Valley
Golf Club
0151 546 5435









































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APPENDIX I: HYDRAULIC ASSESSMENT REPORT & OUTPUTS

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BETTS HYDRO
CONSULTING ENGINEERS

KIRKBY VALLEY GOLF CLUB
KIRKBY

HYDRAULIC ASSESSMENT



For

L32 Trading Ltd
22 Pall Mall
Liverpool
Merseyside
L3 6AL

FEBRUARY 2021

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KIRKBY VALLEY GOLF CLUB
KIRKBY
HYDRAULIC ASSESSMENT

Document Tracking Sheet

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Specialist Software

- TUFLOW 2016-03-AA-iDP-w64
- Flood Modeller 4.2.6050
- QGIS 3.4 Madeira
- SMS 9.2

Abbreviations & Acronyms

AEP	Annual Exceedance Probability	mAOD	Metres Above Ordnance Datum
FZ	Flood Zone	NGR	National Grid Reference
CC	Climate Change	NPPF	National Planning Policy Framework
EA	Environment Agency	OS	Ordnance Survey
FEH	Flood Estimation Handbook	TWL	Top Water Level
FRA	Flood Risk Assessment	LLFA	Lead Local Flood Authority

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1.0 INTRODUCTION

1.1 Commission

1.1.1 This Hydraulic Assessment was commissioned by L32 Trading Ltd in support of course improvements and redevelopment at Kirkby Valley Golf Course in Kirkby.

1.1.2 The Hydraulic Assessment was required to evidence that proposed levels changing on the golf course and a proposed new footbridge would not increase flood risk elsewhere.

1.1.3 Betts Hydro has been commissioned to assess the risk of flooding to the site and provide a technical review on whether the proposals would increase flood risk elsewhere in the 1% AEP + 35% climate change.

1.2 Outline of Assessment

1.2.1 Betts Hydro obtained the EA ISIS-TUFLOW model of the River Alt, produced in 2013 by JBA. The model covers a reach of the upper River Alt from Huyton to the railway line embankment to the north of Kirkby Valley Golf Course. The model was constructed to help understand the current and future levels of flood risk within the catchment.

1.2.2 The model has been run in the 1% AEP, 1% AEP + 35% CC and 0.1% AEP fluvial events for the existing scenarios. The results of these events are scenarios are presented as flood depth and levels plans and discussed in section 4.0.

1.2.3 The model was then used to assess the development proposals which included ground raising for new greens and tees and a footbridge.

1.2.4 Mitigation proposals were determined using the model to adequately provide the required flood compensatory storage.

2.0 EXISTING SITE

2.1 Location

2.1.1 The site is accessed from the A506 in Kirkby. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 339329, N: 397949 and the nearest postcode is L10 8LQ. The location plan is shown in Appendix A.

2.1.2 Kirkby Valley Golf Course consists of a club house to the south-east and golf course on the east and north-west of the site. Undeveloped land is located to the south-west of the site. The River Alt runs through the centre of the site running from south to north.



Figure 1: Development Site Extents

2.2 Site Topography

2.2.1 The levels within the site gently slope towards the River Alt directly or to the existing land drainage features which ultimately discharge into the River Alt. Ground levels at the western and eastern boundaries are approximately 16mAOD, falling towards the River Alt top of bank at approximately 10mAOD. The existing car park and club house are at a level of around 13mAOD. The lowest area of the site is the land to the north of the site adjacent to the River Alt at 11mAOD. An elevation plan is included in Appendix B.

2.3 Proposed development

2.3.1 The planning proposals consist of two applications which have been assessed together within this modelling exercise (more plans are shown in Appendix C). The two proposals assessed are;

- Proposed course alterations consisting of levels changes to green 1, green 8, tee 9 and tee 16 (as tee 16 is not affected by the flood risk from the River Alt it is not considered within the assessment).

- New development fronting the A506, consisting of car parking, a new clubhouse, sports centre and outdoor sporting facilities. This development also includes a proposed new bridge crossing over the River Alt.



Figure 2: Development Proposals

2.4 Environment Agency Flood Map

2.4.1 The Environment Agency Flood Map is shown in Figure 3. It can be seen that the site is shown to be within Flood Zones 1, 2 and 3. These Flood Zones are representative of the extents of the 1% and 0.1% Annual Exceedance Probability. No EA designated defences are present near to the site. As seen in Figure 3, Flood Zone 3 is shown to only effect the north-western area of the site, while Flood Zone 2 also extends to areas near the eastern banks of the River Alt.

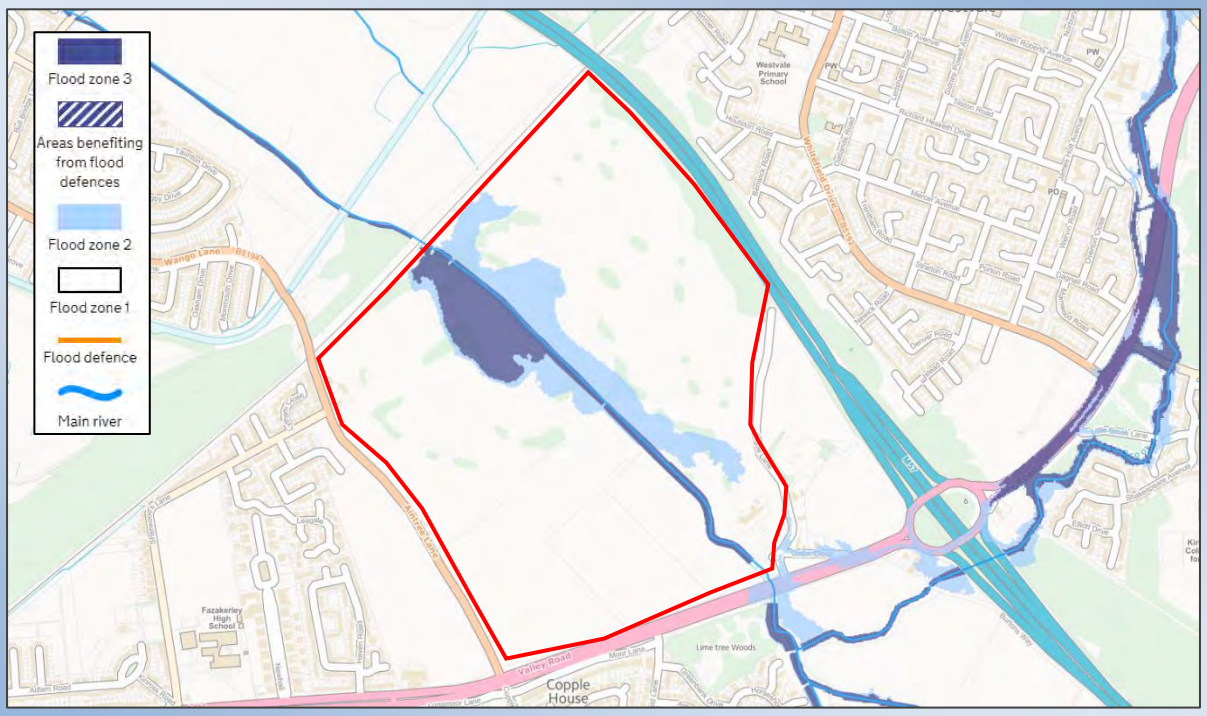


Figure 3: Environment Agency Flood Map (Gov.uk 2019)

3.0 ENVIRONMENT AGENCY MODEL

3.1 Background

3.1.1 The Environment Agency (EA) hydraulic model was completed in 2013 to understand the current and future flood risk in the catchment.

3.1.2 The modelling was undertaken using ISIS and TUFLOW. The 2-D grid size was 4m and provides sufficient resolution to model food conveyance along flow routes. The key aspects of the model scope, methodology and results are included in the JBA model report (2013), in which extracts are located in Appendix D.

3.2 Model Boundary Data

3.2.1 In accordance with the JBA modelling report for the Alt model, the boundary conditions for the model have been incorporated using the ReFH and Statistical analysis, the model also considers discharge flows from UU sewer models within the catchment.

3.2.2 The extent of the 1D - 2D river model runs from near the source in Huyton to the downstream boundary at the railway embankment at Kirkby Valley Golf Course. The model includes Deys Brook and Fazakerley Brook tributaries. Figure 4 shows the extents of the 2-D domain and 1-D network.

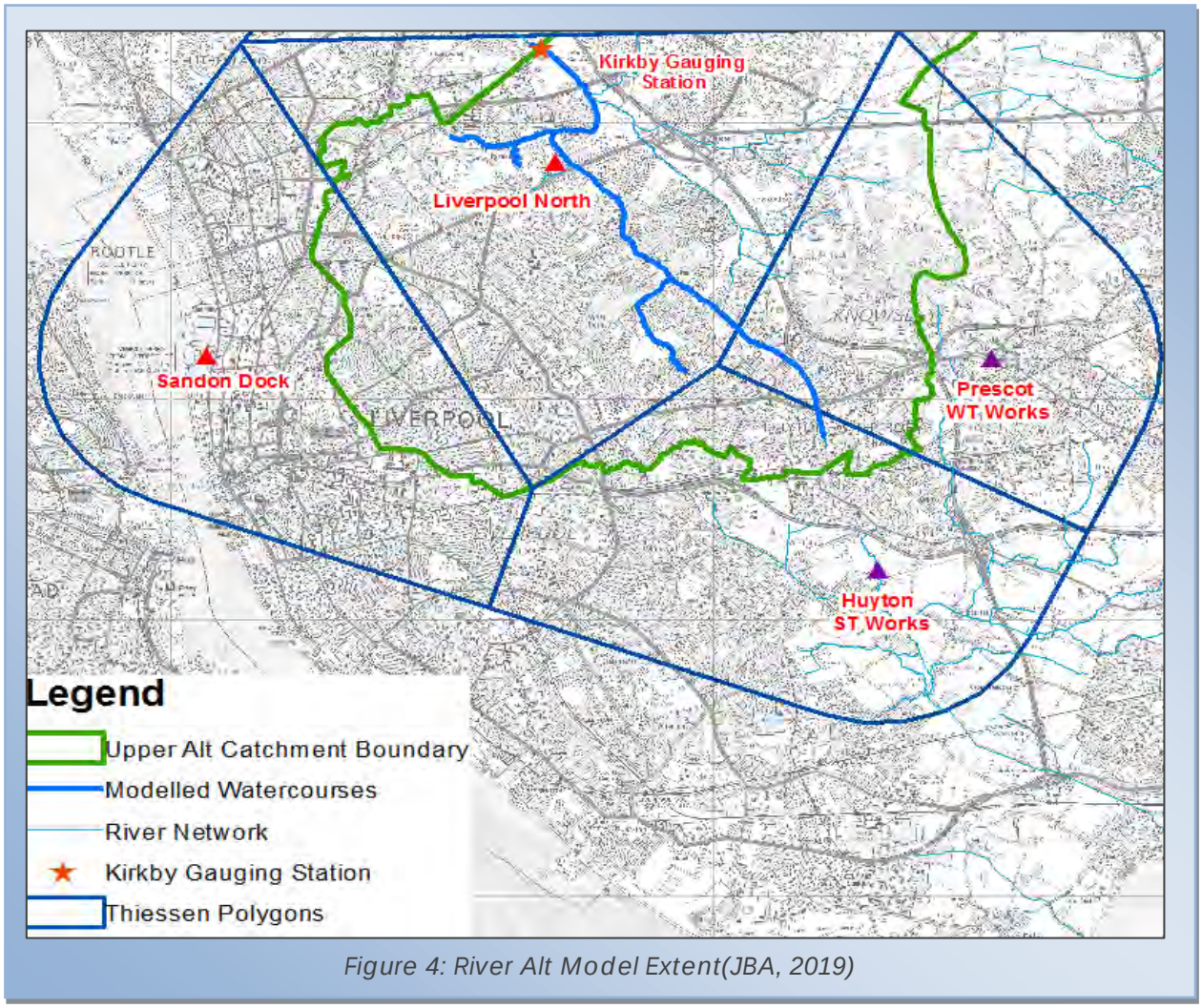


Figure 4: River Alt Model Extent(JBA, 2019)

3.3 Model Review

3.3.1 The EA model was constructed between 2013 using the latest available information at the time. The ground model was created from LiDAR data, flown in 2010. The sensitivity of the model has been tested by using the following tests 20% increase in flow, changes to manning's, changes to 2d roughness values, impact of downstream boundary condition, hard bed model, and sensitivity of predicted flows from UU sewer models. For limitations of the modelling data presented in this report, refer to Appendix D.

3.4 Model modifications

3.4.1 Some modifications have been made to the existing EA to more accurately determine the existing flood risk to the site and future flood risk elsewhere after development.

3.4.2 There is a requirement to consider climate change and an increase in flows. In accordance with the EA guidance on climate change (2016) allowances an increase of 35% has been added to peak flows in the 1 in 100

3.4.3 An area downstream of the site near to the confluence with Kirkby Brook was showing a 2d instability. When ran in the climate change event, the modelled bank level in this location was shown to be lower than the ZP bank value. A ZLN line was added to rectify this and represent the correct bank levels.

3.4.4 The existing situation was modelled incorporating the latest available LiDAR for the site flown in 2009 in a 1m resolution.

3.4.5 The proposed bridge was added at the location shown on the planning. The soffit of the bridge was based on the minimum required level of 600mm above the 1 in 100 year plus 35% climate change. As this level was below the bank the level of the watercourse a level of 13.5mAOD was chosen based on the existing ground levels. This level may be subject to change. The bridge was represented within the model using an arch bridge unit (RALT411_BRUS) and two new cross sections (RALT4006A, RALT4006B) either side which were interpolated using the nearest nodes. A spill unit was added with the 1d as there was little risk of overtopping. The proposed bridge will be clear span

3.4.6 Levels changes to the greens and tee were modelled in the 2-D floodplain using ZTIN points, line and region as displayed in Figure 5. Levels were crossed referenced against proposed level plans seen in Appendix C.

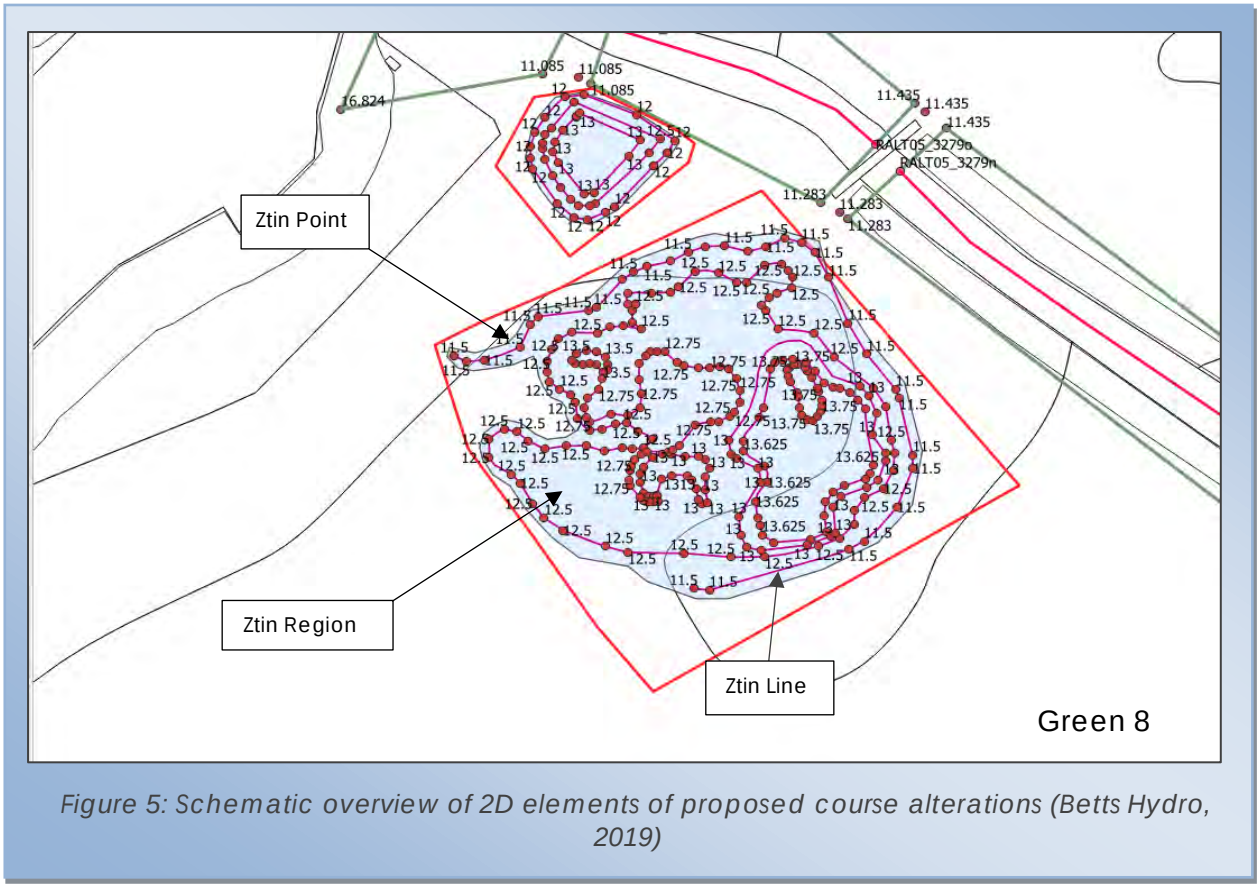


Figure 5: Schematic overview of 2D elements of proposed course alterations (Betts Hydro, 2019)

3.5 Model Scenarios

3.5.1 The model was run in three different annual exceedance probabilities, as shown in Table 1. The model was ran in four scenarios of existing, with proposed bridge, with proposed green and tee changes as well with proposed mitigation. The 1% AEP climate change with a 35% allowance for climate change is determined to be the design event based on EA guidance on Climate Change (2016).

Table1: Modelled returned periods (Betts Hydro 2019)

MODELLED AEP (%)
1
1 + 35% Climate Change
0.1

4.0 RESULTS

4.1 Existing Scenario

4.1.1 In the existing scenario plans have been produced for the 1% AEP, 1% AEP + CC and 0.1% AEP. Plans are located within Appendix E.

Table 2: Drawing outputs of modelled events

SCENARIO	RETURN PERIOD	DEPTH	LEVEL
EXISTING	1% AEP	HYD444_101	HYD444_102
	1% AEP + 35% CC	HYD444_103	HYD444_104
	0.1% AEP	HYD444_105	HYD444_106
PROPOSED BRIDGE	1% AEP	HYD444_107	HYD444_108
	1% AEP + 35% CC	HYD444_109	HYD444_110
	0.1% AEP	HYD444_111	HYD444_112
PROPOSED COURSE IMPROVEMENTS	1% AEP	HYD444_113	HYD444_114
	1% AEP + 35% CC	HYD444_115	HYD444_116
	0.1% AEP	HYD444_117	HYD444_118

1% AEP (1 in 100 year Return Period)

4.1.2 In this event the flood extent is seen to encroach to exceed the river banks in the northern part of the site, the flood extent correlates with that of the published flood map with flooding concentrated to the west bank of the river. Flood depths onsite range from 0.16m to the south of the east of the watercourse to 0.97m to the west as seen in drawing no. HYD444_101. The onsite flood level is 11.55mAOD.

1% AEP + 35% CC (1 in 100 year Return Period 35% Climate Change)

4.1.3 When climate change is considered, predicted flooding mainly occurs to the north of site. In comparison to the 1% AEP event. Some flooding is identified to occur adjacent to the eastern bank towards the existing golf club house. Relative to the wider site, as a result of levels raising up from the River Alt, the flood extent is constricted to areas near to the river as seen in Figure 6. Flood depths onsite range from 0.1m to the south-east of the watercourse to 1.2m to the north west as seen in drawing Figure HYD444_103. The onsite top flood level is 11.95mAOD.

0.1% AEP (1 in 1000 year Return Period)

4.1.4 The 0.1% AEP event is predicted to have a larger flood extent than that of the other return periods with the flood extents shown to cover the existing club house as flows from north and south join on the eastern bank. The modelled flood extent is also different to the map outputs and Flood Zone 2 on the published Flood Map for Planning, with predicted flooding extending further south. There is no explanation within the model report why the modelled results and published flood maps differ. Flood depths onsite range from 0.05m to the south east of the site to 1.7m to the north as seen in drawing Figure HYD444_105. The onsite top flood level is 12.8mAOD near Valley Road.

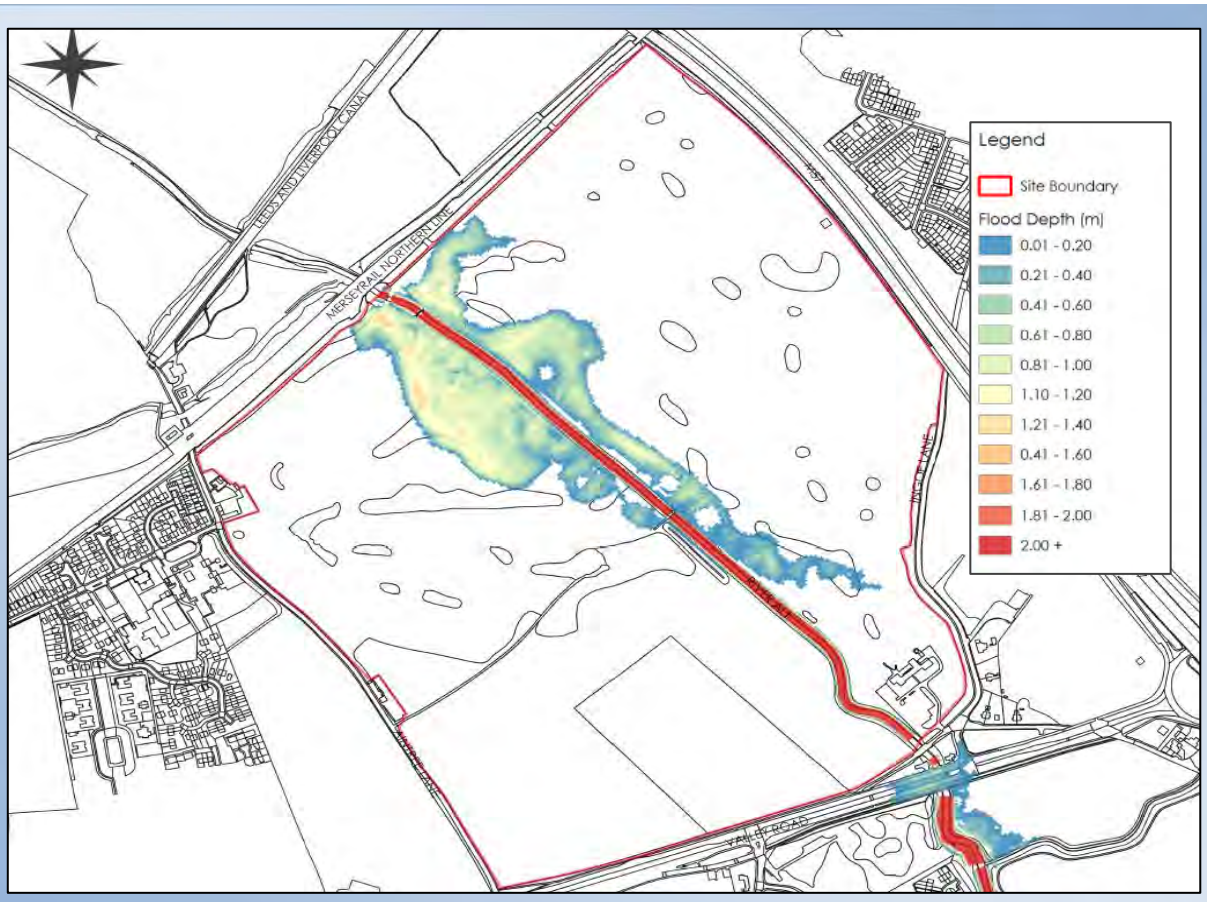


Figure 6: Existing 1% AEP + CC Flood Depth Plan (Betts Hydro, 2019)

4.2 Proposed Bridge

4.2.1 In the proposed bridge scenario plans have been produced for the 1% AEP, 1% AEP + 35%CC and 0.1% AEP. Plans are located within Appendix F.

1% AEP (1 in 100 year Return Period)

4.2.2 In the proposed 1% AEP, the flood extent is very similar to that of the existing situation with a slight increase of flood extent as shown in HYD444_107. Flood depths range from 0.01m to the east of the watercourse to 0.9m to the west of the watercourse. A comparison at the last 1d node shows flow and water level at node: RALT05_3204n remain the same as in the existing scenario. The top onsite flood level is 11.56mAOD.

1% AEP + 35% CC (1 in 100 year Return Period 35% Climate Change)

4.2.3 In the proposed 1% AEP plus an allowance of 35% for climate change, the bridge is shown to have no effect on the flood extent and depth in comparison with the existing situation. Flooding mainly effects the northern area of site adjacent to the watercourse with some areas on the eastern bank also at risk. Flood depths range from 0.01m to the east of the watercourse to 1.3m to the west of the watercourse. The predicted top onsite flood level is 11.91mAOD.

0.1% AEP (1 in 1000 year Return Period)

4.2.4 In the proposed 0.1% AEP event with the addition of the bridge it is shown that the flood extent increases within the site extents, beyond the existing club house to the south

west of the site. Flood depths onsite range from 0.1m near the clubhouse to 1.7m to the west of the watercourse as seen in drawing Figure HYD444_111.

4.3 Proposed Course Works

4.3.1 In the proposed course improvements works scenario levels raising has taken place at greens 1, 8 and tee 9, plans have been produced for the 1% AEP, 1% AEP + 35%CC and 0.1% AEP. Plans are located within Appendix G.

1% AEP (1 in 100 year Return Period)

4.3.2 In the 1% AEP with the proposed levels raising on the course there is shown to be a predicted increase in flood extent within the site with a predicted area of shallow depth located to the south of the existing extent. Flood depths onsite range from 0.02m in the centre of the site to 1.0m to the west of the flood extent as seen in drawing Figure HYD444_113. The predicted onsite top water level is 11.59mAOD.

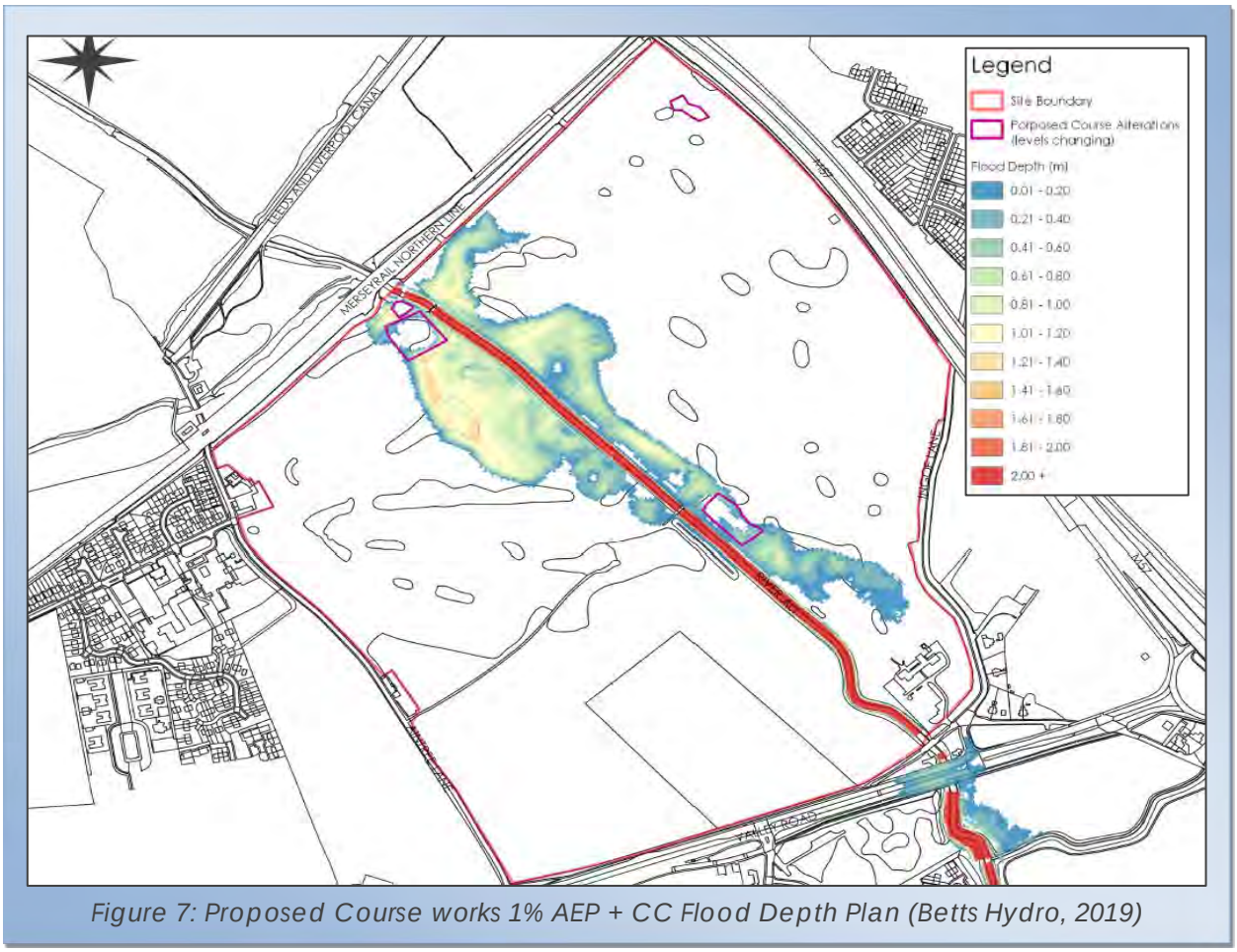


Figure 7: Proposed Course works 1% AEP + CC Flood Depth Plan (Betts Hydro, 2019)

1% AEP + 35% CC (1 in 100 year Return Period 35% Climate Change)

4.3.4 In comparison with the existing 1% AEP plus climate change, the predicted scenario with the proposed course works are seen to change the flood extent within the site due to the displacement from the levels raising. The flood level at the last downstream node within the site (RALT05_3204n) is seen to increase by 0.001m. The flood flow within the channel remains the same. Flood depths range from 0.09m in the south-east to 1.4m as seen in Figure 7. The predicted onsite top water level is 12.17mAOD.

0.1% AEP (1 in 1000 year Return Period)

4.3.5 The predicted 0.1% AEP is shown to have a similar flood extent to the existing situation. As a result of displacement by the levels raising of the greens and tee the flood extent is shown to increase in the area of the existing club house. The flood level at the downstream node within the site is shown to increase by 0.007m. Flood depths range from 0.06m in the south-east to 1.6m to the west of the watercourse. The onsite top water level is predicted to be 12.85mAOD.

4.4 Proposed scenarios comparison

4.4.1 Comparison of flood depths has been undertaken using depth difference plans produced on GIS software. Plans show that there is generally an increase in flood depth on the site for the proposed bridge scenario and levels raising, although at the downstream boundary flood depth decreases slightly relative to the existing scenario. Depth difference plans are located in Appendix H.

4.5 Mitigation

4.5.1 It is required that any levels raising within Flood Zone 3 be compensated for to avoid increasing flood risk downstream or upstream. Green 8 and Tee 9 are located within Flood Zone 3, compensatory storage has been included to mitigate the levels raising. The proposed levels raising displaces the floodplain in the 1% AEP by 0.6m.

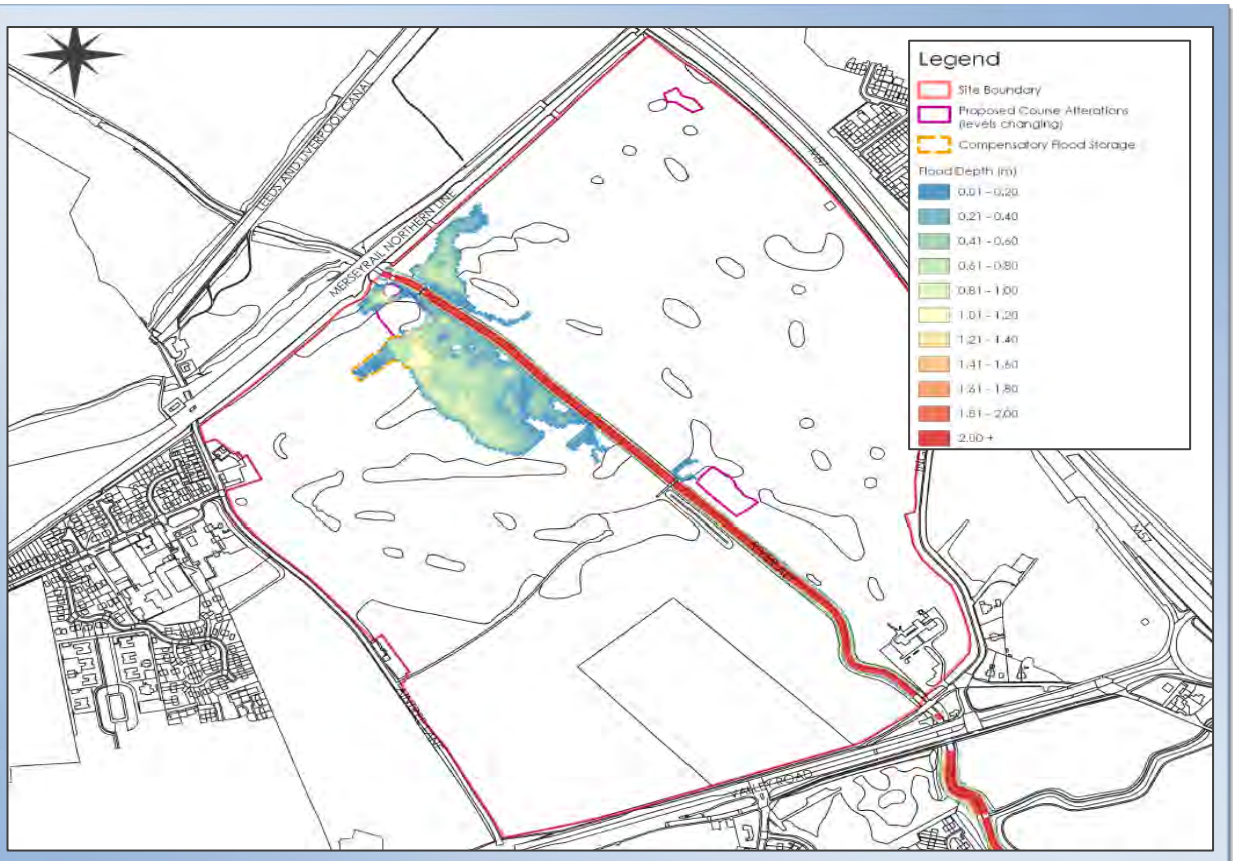


Figure 8: Proposed Course works and compensatory flood storage 1% AEP Flood Depth Plan (Betts Hydro, 2019)

4.5.2 HYD444_204/Appendix I shows the areas of site proposed to be lowered. When the mitigation measures are considered it is predicted that there will be no increase in in-channel flood level and flow offsite to the north in the 1% AEP as seen in Figure 8 which shows the peak flow in the 1% AEP. A depth difference plan has been produced (HYD444_205) showing the mitigation scenario relative to the existing situation. It is shown that flood depths generally increase on the site, although some betterment is seen at the downstream point of the River Alt within the site. Upstream of the site flood depths increase by approximately 14mm, 1km upstream as seen in HYD444_205. No dwellings are impacted by an increase in flood extent or flood depth.

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1 This assessment has utilised the existing hydraulic modelling for the River Alt (2013) to determine the design levels for the proposed bridge and confirm proposed levels raising on the golf course does not increase flood risk elsewhere.

6.1.2 The existing EA model has been utilised and modified where appropriate and re-run in for a range of return period including the 1% AEP, 1% AEP + 35%CC and 0.1% AEP. Modelling of the existing situation shows the predicted 0.1% AEP flood extent to differ from the online published Flood Map for Planning.

6.1.3 The proposed footbridge is located within Flood Zone 2. The 1% AEP + 35% allowance for climate change is shown to remain and bank when a freeboard of 600mm is applied (13.2mAOD) this is lower than the left bank.

6.1.4 The proposed levels changes on the greens and tee are shown to change the onsite flood extent. There is predicted to be a increase in flood level and flood flow at the downstream node within the site with no compensatory flood storage.

6.1.5 Flood storage compensation is proposed within the site to mitigate the impact of levels raising within Flood Zone 3 with levels being lowered on the eastern side of the watercourse.

6.1.6 When the proposed mitigation (compensatory storage) is considerd there is a minimal offsite increase in flood depth as a result of the development (upto 14mm).

6.2 Recommendations

6.2.1 An environmental permit will be required for works within 8m of an EA designated Main River.

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National Planning Policy Framework, CLG (2012).
Planning Practice Guidance, CLG (2014)

References

JBA Consulting. (2013). *2011s5080 - Upper Alt Final Modelling Report. Warrington.JBA Consulting*

Web-based References

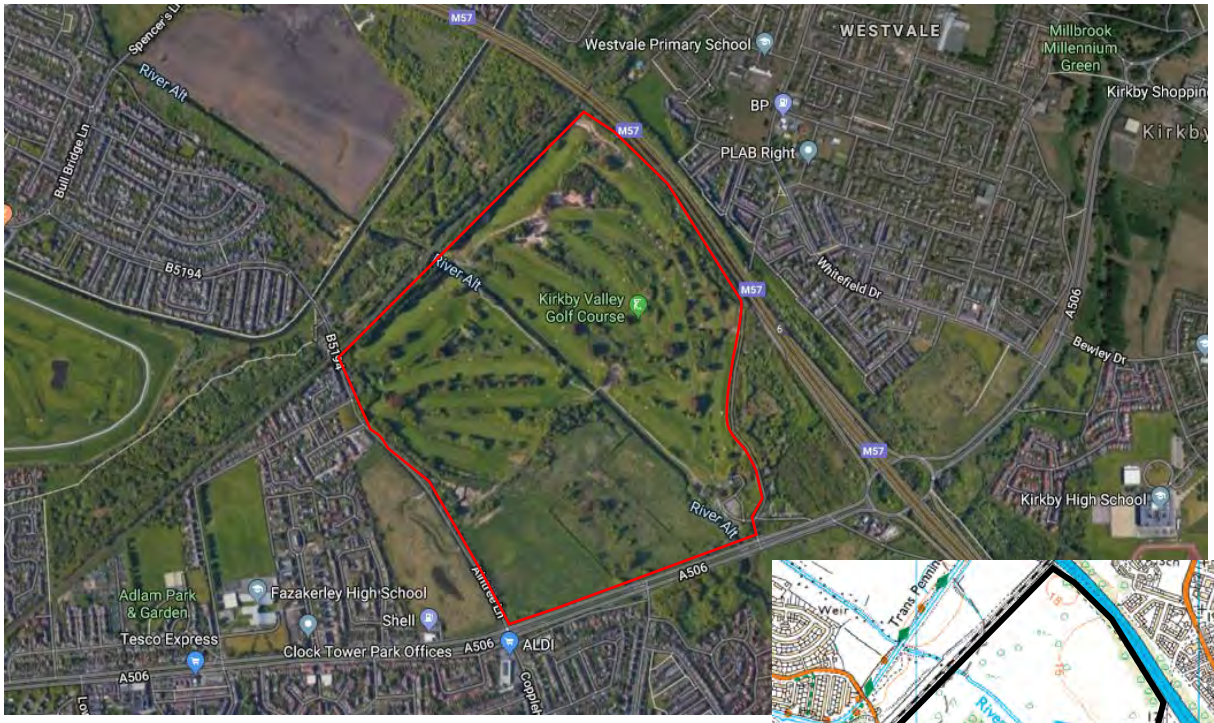
Bingmaps – http://www.bing.com/Maps/
Environment Agency – www.environment-agency.gov.uk/
EA Flood Map for Planning - https://flood-map-for-planning.service.gov.uk/

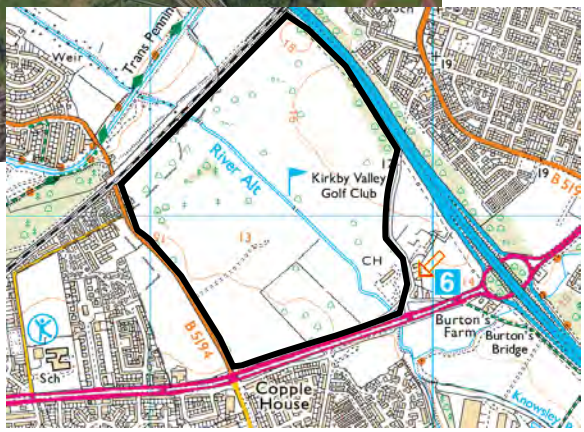
APPENDIX A: LOCATION PLAN

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LOCATION PLAN

Kirkby Valley Golf Club, Kirkby

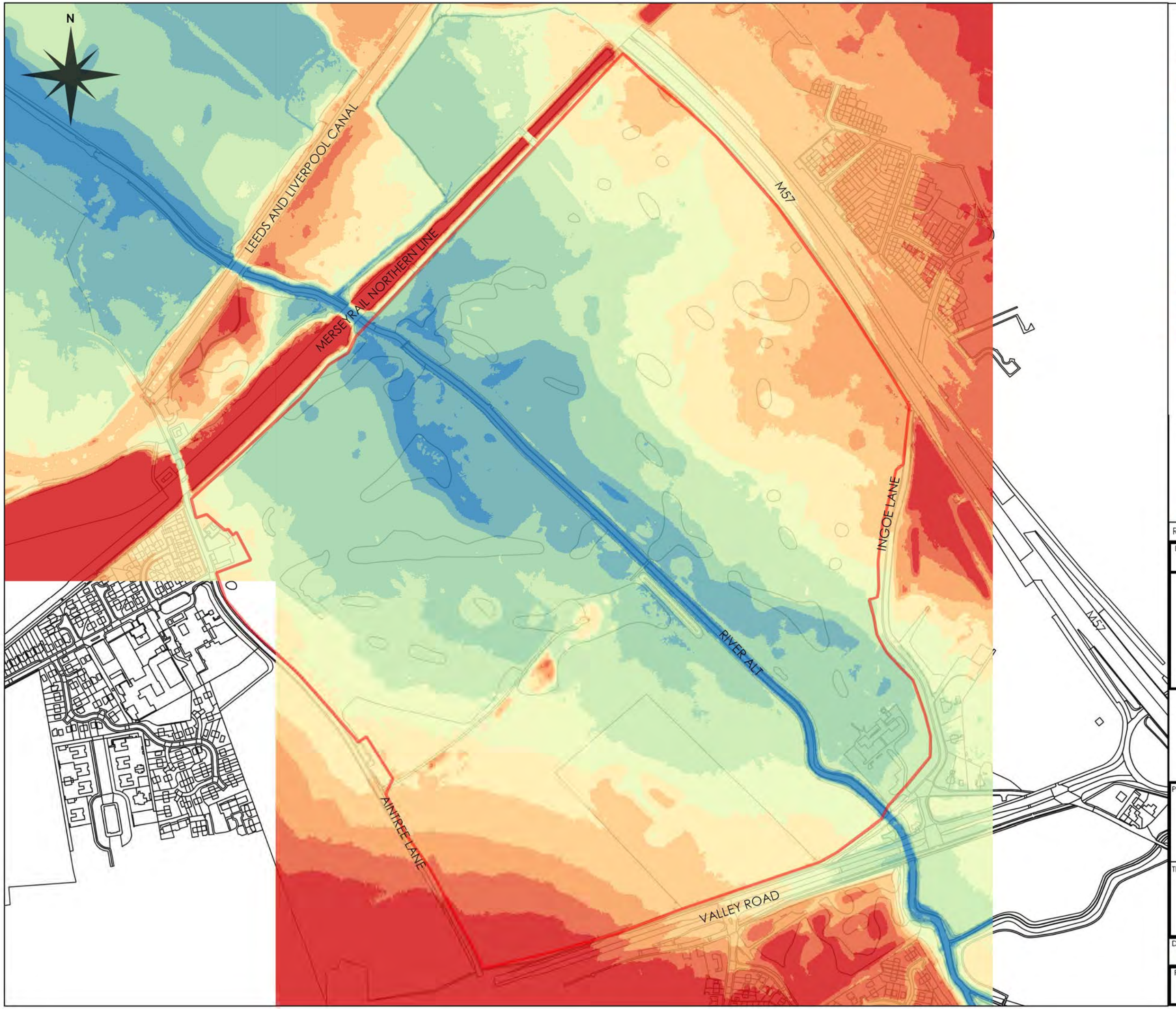




OS X (Eastings)	339329
OS Y (Northings)	397949
Nearest Post Code	L10 8LQ
Lat (WGS84)	N53:28:29 (53.474757)
Long (WGS84)	W2:54:56 (-2.915559)
Lat,Long	53.474757,-2.915559
Nat Grid	SJ393979 / SJ3932997949
mX	-324558
mY	7036941

APPENDIX B: TOPOGRAPHICAL SURVEY AND ELEVATION PLAN

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DO NOT SCALE

Legend

- Site Boundary

Elevation (mAOD)

- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- inf

REV	DATE	BY	DESCRIPTION	CHK
A	28/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: ELEVATION PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	199	A

APPENDIX C: PROPOSED PLANS

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N

SITE SPECIFIC HAZARDS

IN ACCORDANCE WITH THE REQUIREMENTS OF THE CDM REGULATIONS 2015 THE FOLLOWING SIGNIFICANT RESIDUAL HAZARDS HAVE NOT BEEN DESIGNED OUT OF THIS PROJECT AND MUST BE TAKEN INTO CONSIDERATION BY CONTRACTORS PLANNING TO UNDERTAKE THE WORKS SHOWN ON THIS DRAWING:

ORDNANCE SURVEY LICENCE

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NOTES

SITE BOUNDARY 80.3055 HECTARES

OTHER LAND IN THE OWNERSHIP OF THE CLIENT

SCALE 1:2500

0m 25 50 75 100 125 150

ROOT PROTECTION AREA

CATEGORY B TREE

CATEGORY C TREE

CATEGORY U TREE

CROWN SPREAD

TREE/SHRUB REMOVED

REV.	DATE	NOTES	INIT.
A	15.12.20	UPDATED	RSL

CLIENT / PROJECT

MAGHULL DEVELOPMENTS LTD

KIRKBY GOLF CLUB - VALLEY ROAD

KIRKBY

DRAWING TITLE

PROPOSED ESTATE PLAN

STATUS

PLANNING

DATE	DRAWN	SCALE @ A1
17.11.20	RSL	1:2500

PROJECT NUMBER	UNIT / BLOCK	CE / SFB CODE	TYPE & NUMBER	REVISION LETTER
9627			L22	A

Site Location Plans	L	OA Plans	P	Elevations	E
Sections	S	Details	D	Prelim Colour	C

THE RATCLIFFE GROVES PARTNERSHIP

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105 MANCHESTER ROAD
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LONDON
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LONDON WC1R 4EB
T. 020 7600 6666 E. london@rgp.uk.com

RGP architects

Kirkby Valley Golf Course

Proposed works to Greens 1,8 and Tees 9 and 16



25.09.19

Introduction

This application is proposed to enable the reconstruction of Golf Greens Number 1, Number 8, Golf Tees Numbers 9 and Number 16.

The proposed works are necessary for safety (improving visibility of and for golfers), drainage and playability of the Golf Course. The proposed works are typical of winter works undertaken on a golf course. Such work provide winter employment for greenkeepers (as there is less maintenance work to do) and enables the golf course to rejuvenate and improve during quieter months. The greens and tees will be constructed to the USGA Greens specification.

The combined application areas amount to 9237 sqm.

The proposed works will make the following earthwork amendments:

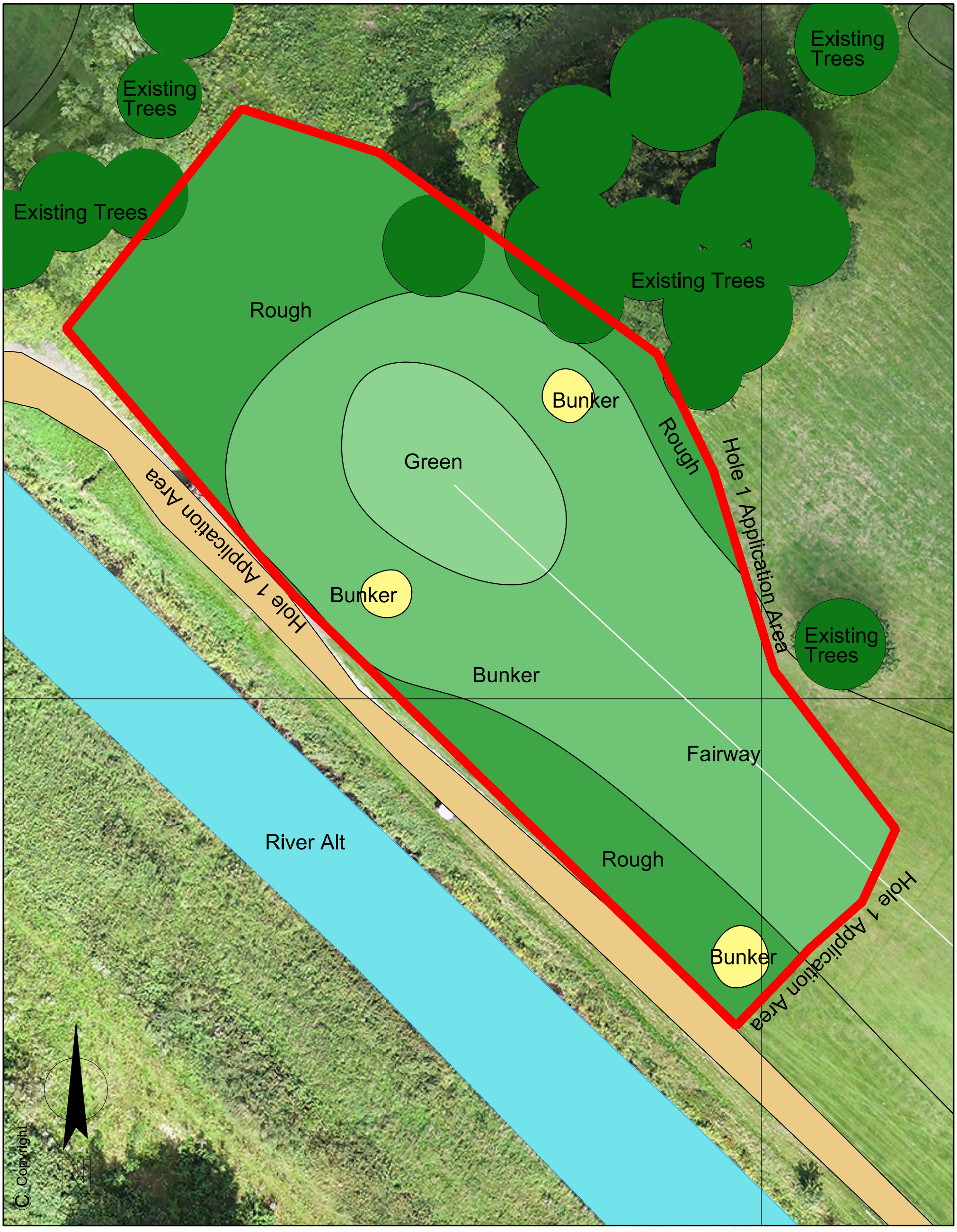
Hole 1 Green
Cut: 1 cu m
Fill: 3995 cu m

Hole 8 Green
Cut: 7 cu m
Fill: 3597 cu m

Hole 9 New Tee
Cut: 4 cu m
Fill: 478 cu m

Hole 16 News Tee x 2
Cut: 196 cu m
Fill: 1985 cu m

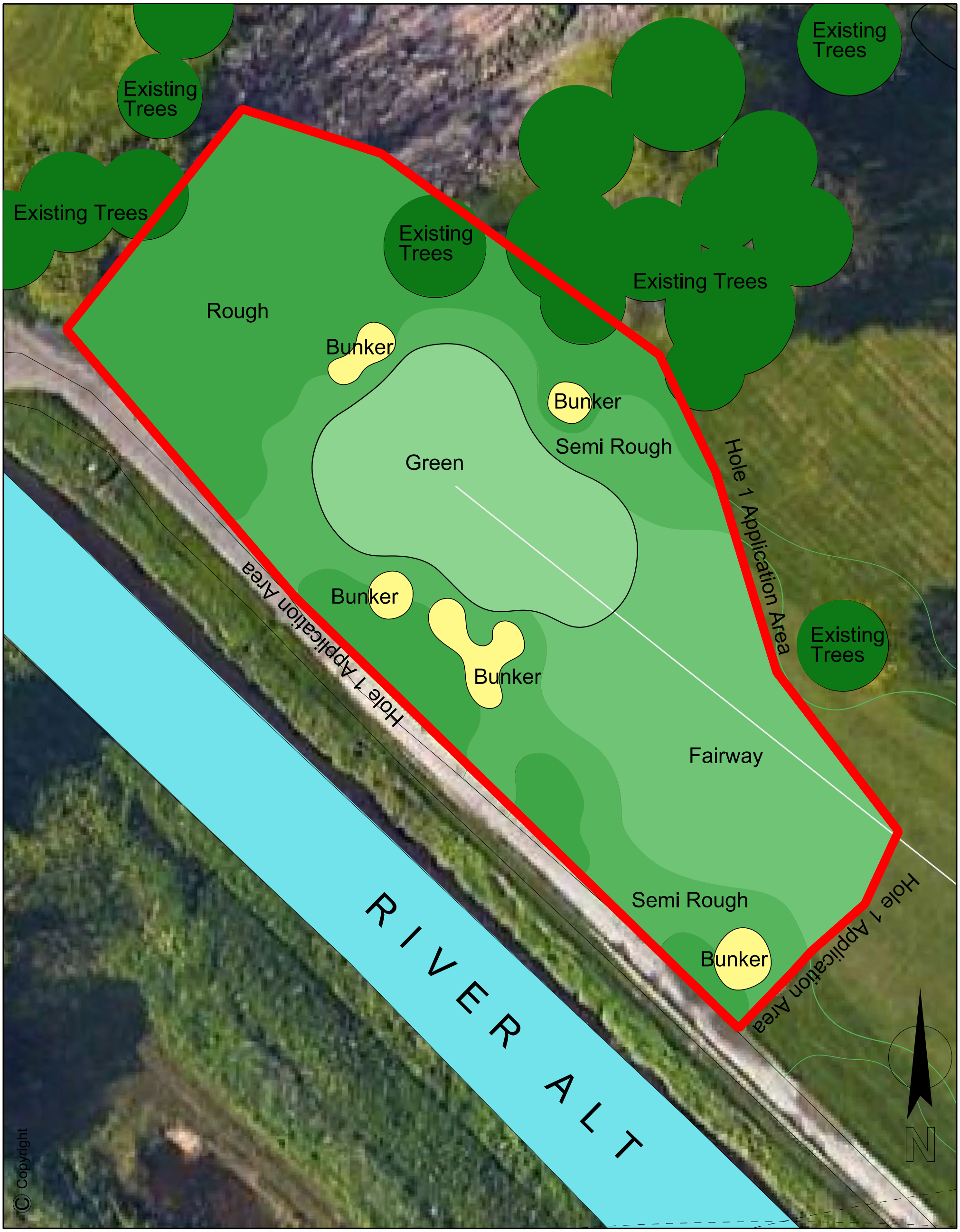




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Drawn	JH	Project	Kirkby Valley Golf Club	
Scale	1:500 @ A4	Drawing	Green 1_Existing	
Date	25/09/18	Number	G935 315-1	Rev *



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Drawn	JH	Project	Kirkby Valley Golf Club	
Scale	1:500 @ A4	Drawing	Green 1_Proposed	
Date	25/09/18	Number	G935 319-1	Rev *

Green 1

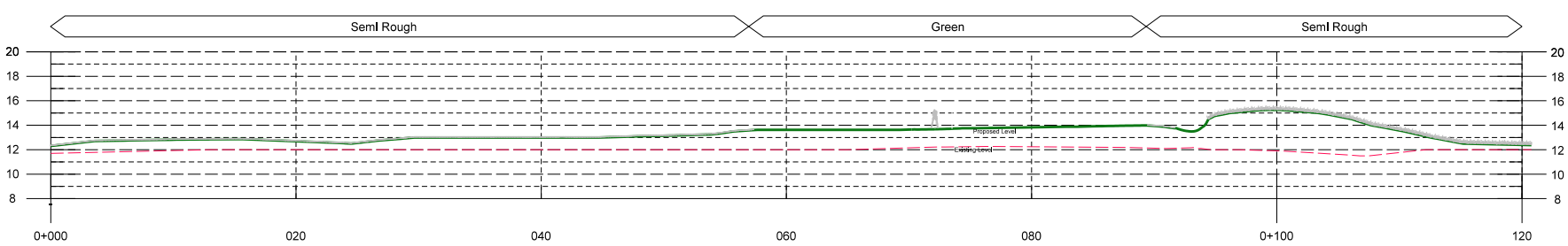
Existing Green

The 1st green is a flat and unappealing target. The flatness of the green contributes to the poor drainage. Due to the topography of the golf green the green has large areas of dead dying diseased and unusable putting surface. The Golf Green has no shaping around it so does not ‘contain’ shots to the target area. This arrangment is poor in temrs of playability and the health of the grass

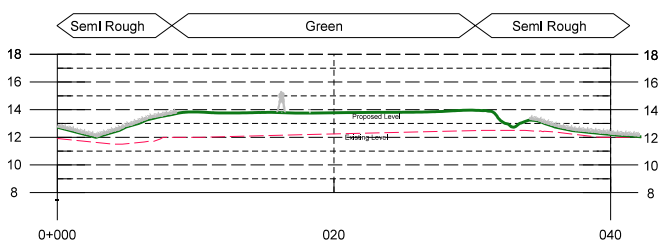
Proposed Green

The proposal for Green 1 is to raise the main green surface so that it is not the gathering place for water. The putting surface will be reshaped to shed water. Behind the green is placed a mound to contain shots and help protect the green on the other side. A line of sight bunker has been added to the rear to improve the playability of the golf green.
The green is raised so surface run off will harmlessly run off the green without further damaging the green.
This new layout should present a more sustainable and useable golf green.

Hole 1 - Section A-A



Hole 1 - Section B-B



Legend



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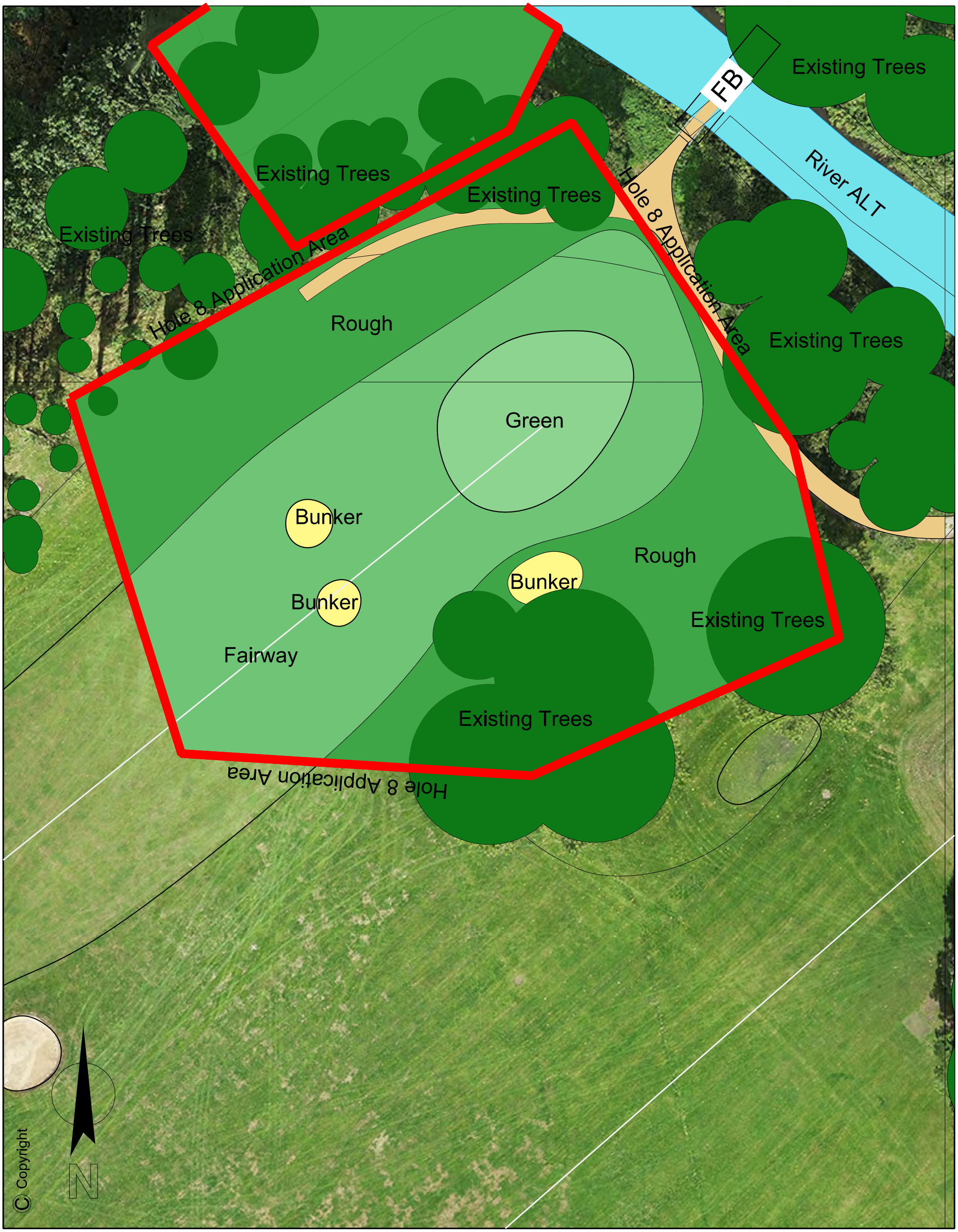
PROJECT
Kirkby Valley Golf Club

DRAWING TITLE
Holes 1 Sections

Drawn	MV	Checked	AC	Approved	JH
Date	19/09/19	Sheet Size	A2	Scale	1:250

Drawing No. 0455 (H)-01 SITE SECTIONS — Rev. –
CAD File No. 0455 (H)-01 SITE SECTIONS — Consultant Project No.

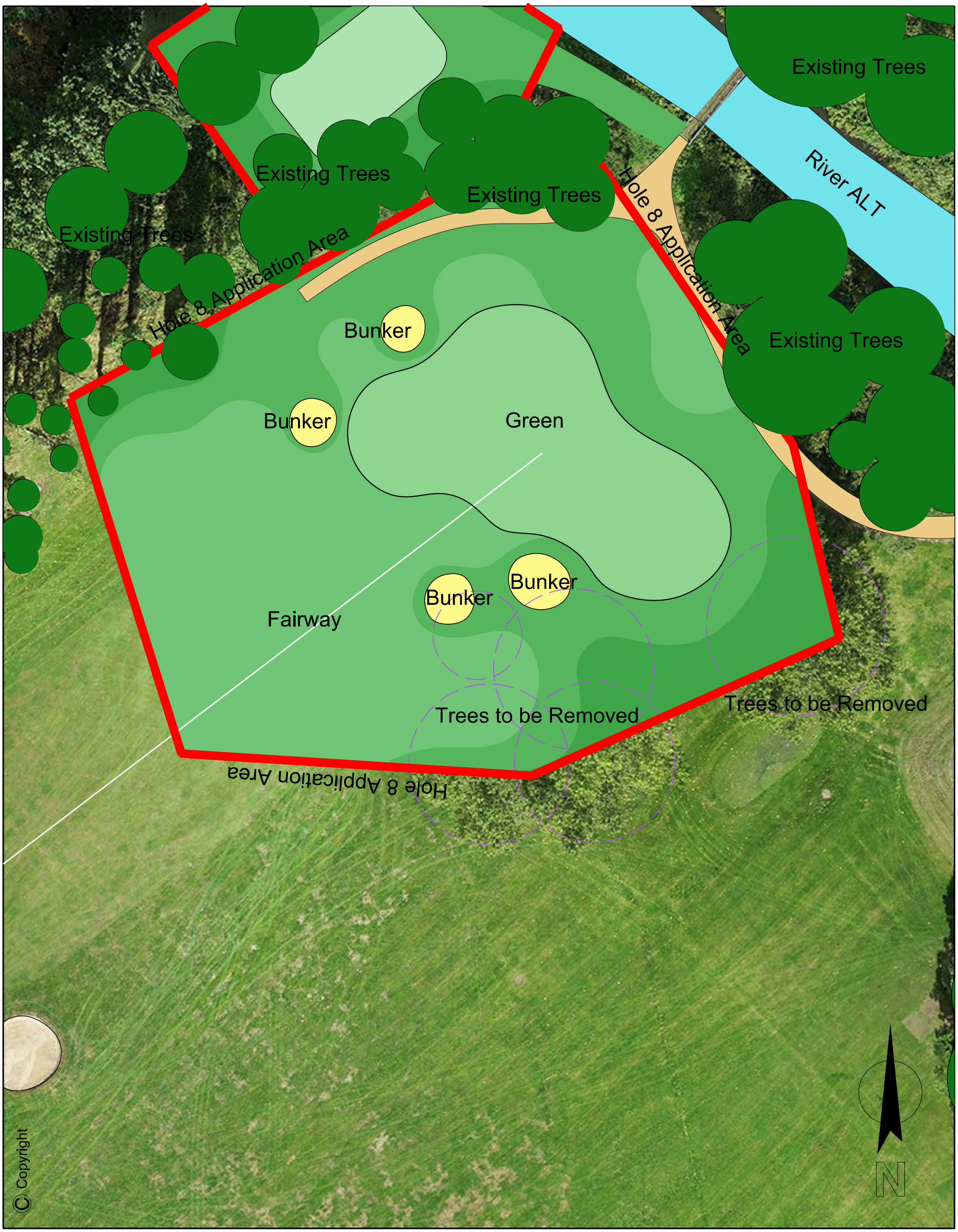
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Drawn	JH	Project	Kirkby Valley Golf Club
Scale	1:500 @ A4	Drawing	Green 8_Existing
Date	25/09/18	Number	G935 314-1 *



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Drawn	JH	Project	Kirkby Valley Golf Club	
Scale	1:500 @ A4	Drawing	Green 8_Proposed	
Date	25/09/18	Number	G935 318-1	Rev *

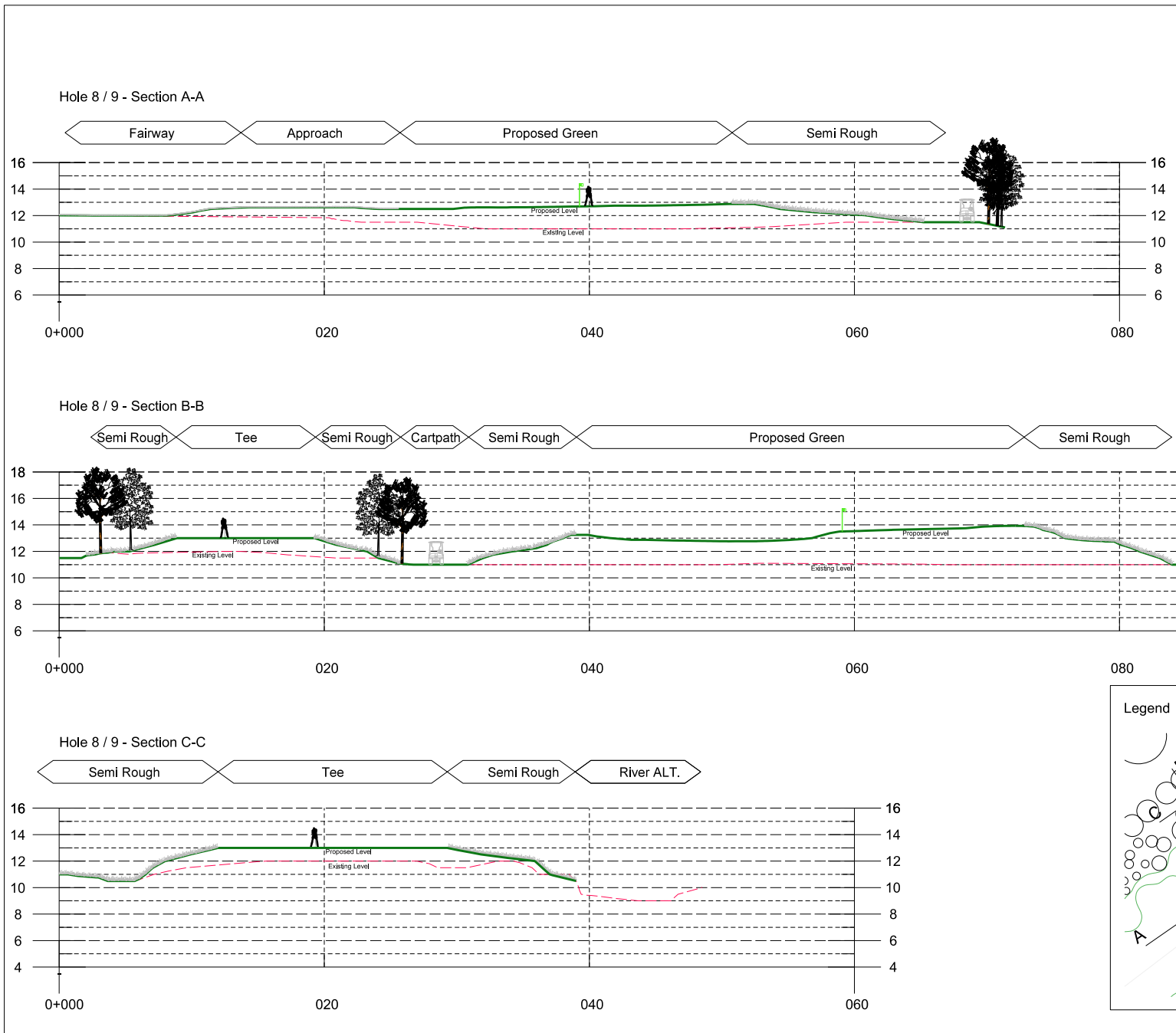
Green 8

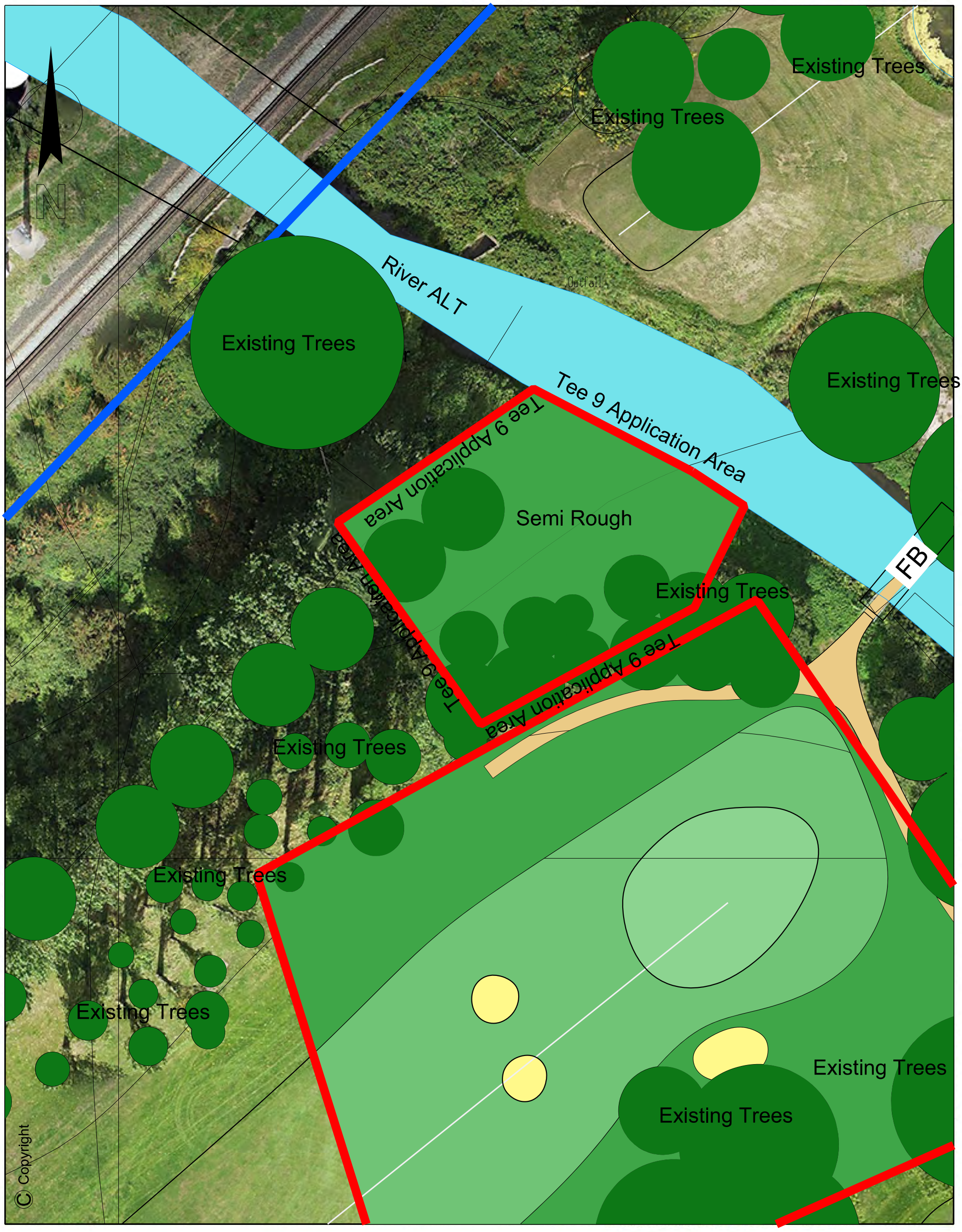
Existing Green

The most significant issue with Green 8 is that it is overshadowed by trees. Through successive years the surrounding trees to the south have grown up to block out both light and air flow, these two conditions kill grass. During winter months large areas of the green see no direct sunlight at all for many weeks at a time. The green is also low and flat so suffers from poor drainage and the associated diseases this creates. The small surface area of the green offers few locations to cut flags, resulting in heavy wear and tear.

Proposed Green

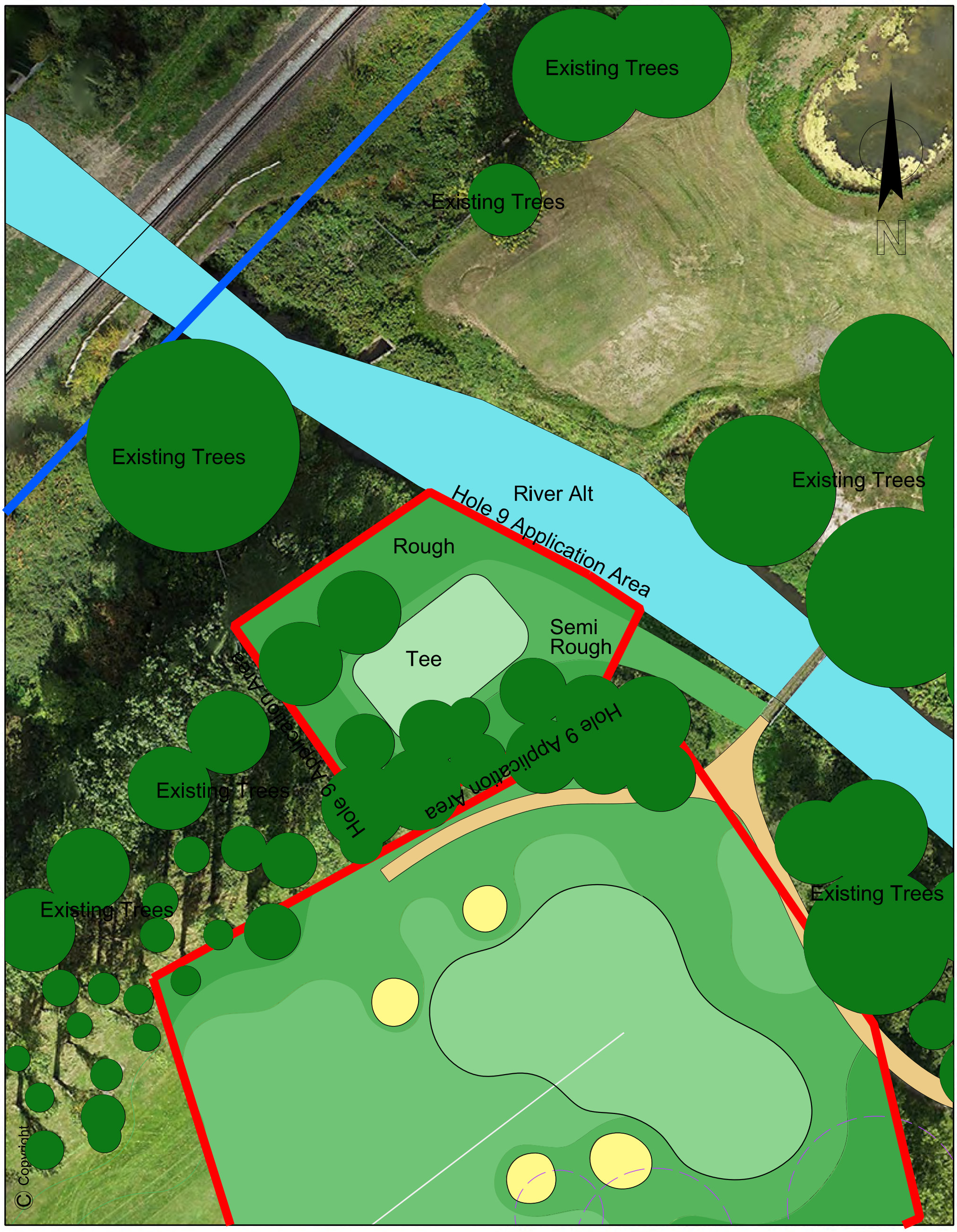
To alleviate the issue of the surrounding tree encroachment the nuisance trees are to be removed and replaced with a greens putting surface at a higher level, this is known as a Mckenzie green.
The proposal provides containment to the left of the green, with four bunkers inset into the mounding to improve the strategy and plability of the golf hole.





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Drawn	JH	Project	Kirkby Valley Golf Club		
Scale	1:500 @ A4	Drawing	Tee 1_Existing		
Date	25/09/18	Number	G935 316-1	Rev	*



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Drawn	JH	Project	Kirkby Valley Golf Club
Scale	1:500 @ A4	Drawing	Tee 9_Proposed
Date	25/09/18	Number	G935 320-1

green circle

Rev *

Tee 9

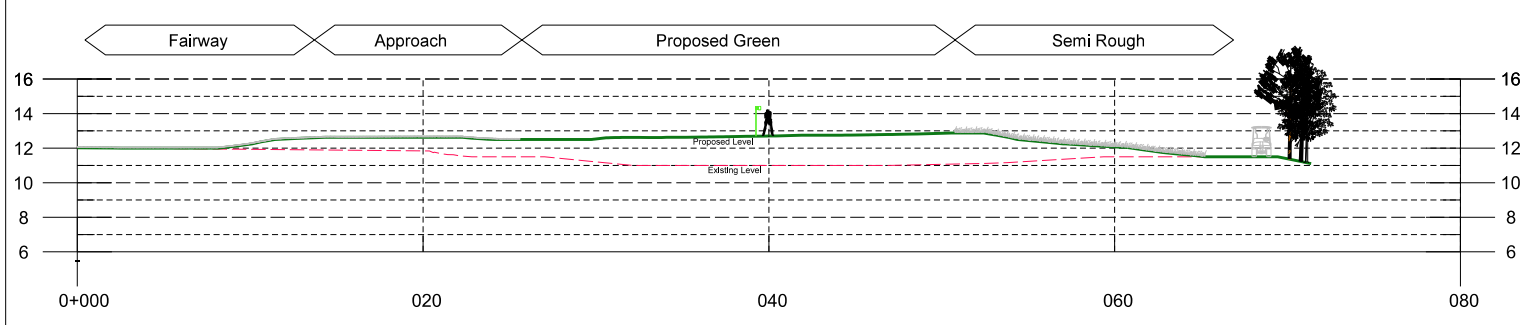
Existing Tee

There is no tee in this current location. This is currently an unused clearing. This unused area of amenity grassland is managed but doesn not currently come into play.

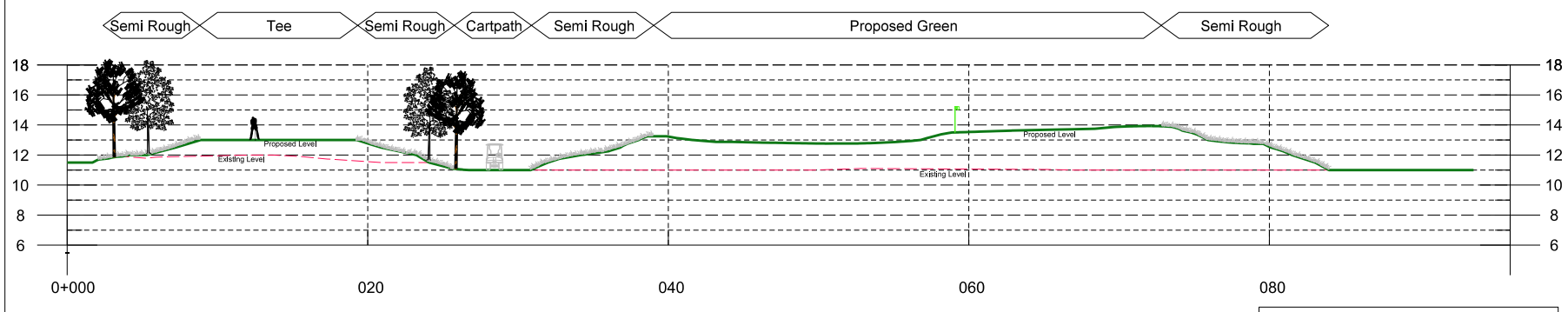
Proposed Tee

The proposal is to create a fit for purpose platform to play tee shots from. Ideally elevated 1m to improve visibility making shots safer, and also to improve drainage and by association the health of the turf grass.
The tee will be accessiblefromt he cartpath via the open grassland, the banks of hte tee will not be greater than 1:4 to allow for ease of maintenance.

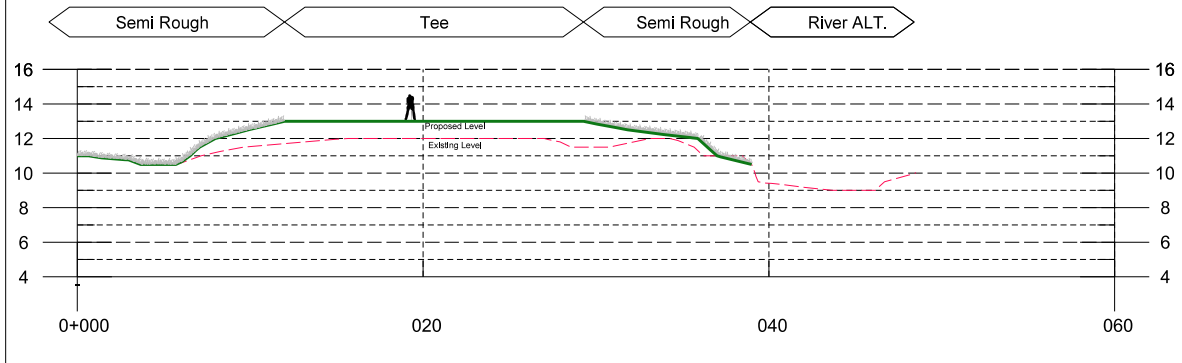
Hole 8 / 9 - Section A-A



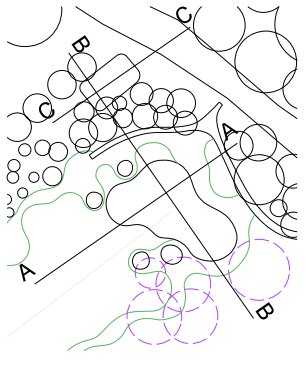
Hole 8 / 9 - Section B-B



Hole 8 / 9 - Section C-C



Legend



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PROJECT
Kirkby Valley Golf Club

DRAWING TITLE
Holes 8 and 9 Sections

Drawn	MV	Checked	AC	Approved	JH
Date	19/09/19	Sheet Size	A2	Scale	1:200

Drawing No. GB08 SY04 SEE SECTIONS — Rev. –
CAD File No. GB08 SY04 SEE SECTIONS — Consultant Project No.

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Drawn	JH	Project	Kirkby Valley Golf Club		
Scale	1:500 @ A4	Drawing	Tee 16_Existing		
Date	25/09/18	Number	G935 317-1	Rev	*



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Drawn	JH	Project	Kirkby Valley Golf Club		
Scale	1:500 @ A4	Drawing	Tee 16_Proposed		
Date	25/09/18	Number	G935 321-1	Rev	*

Green 16

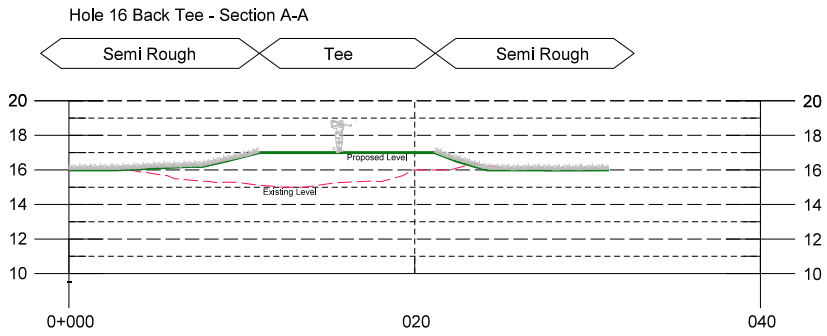
Existing Green

There are no tees in this current location. This is currently an unused clearing. This area is managed but out of play.

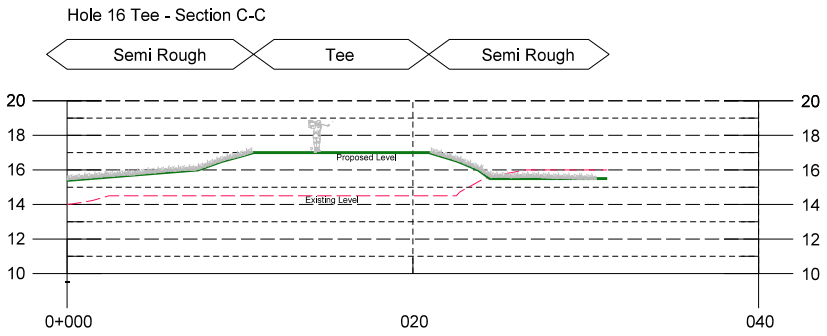
Proposed Green

The proposal is to create two fit for purpose platforms to play tee shots from. Elevated by 1m to improve visibility making shots safer, and also to improve drainage and by association the health of the turf grass. The new tees will increase the playability of this hole.
The two fit for purpose tees make this golf hole more accessible as htese give large level teeing off areas. The banks of the tees in this location allows golfers to enjoy a greater area of the open space.

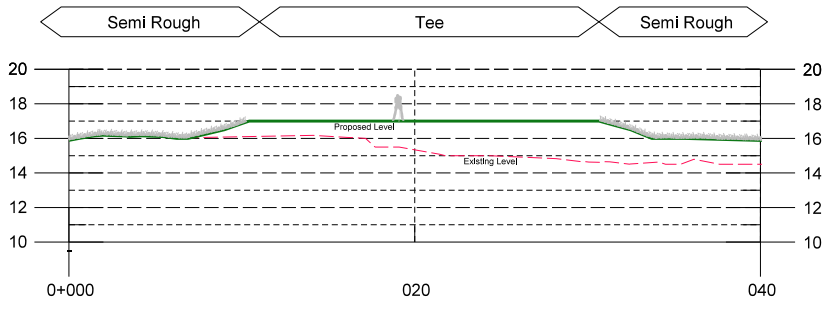
Hole 16 Back Tee - Section A-A



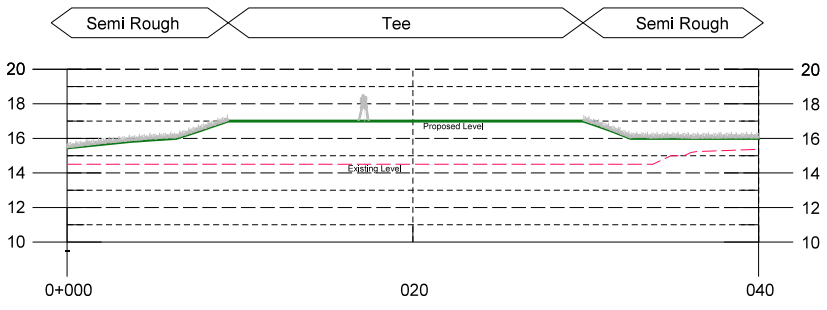
Hole 16 Tee - Section C-C



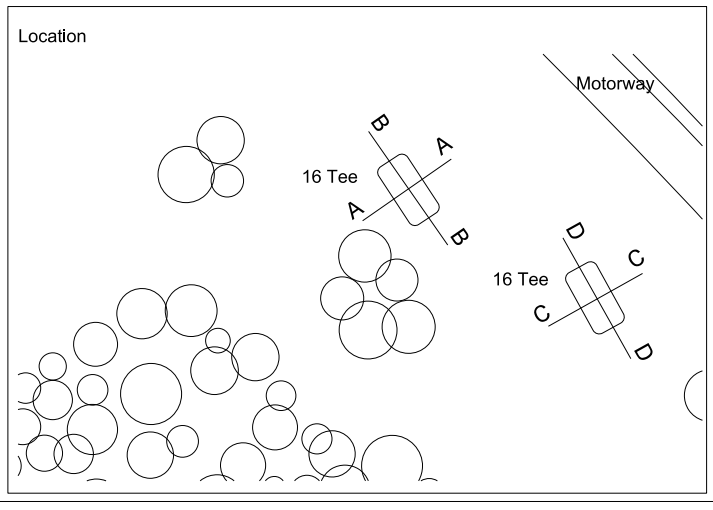
Hole 16 Back Tee - Section B-B



Hole 16 Tee - Section D-D



Location



GENERAL NOTES
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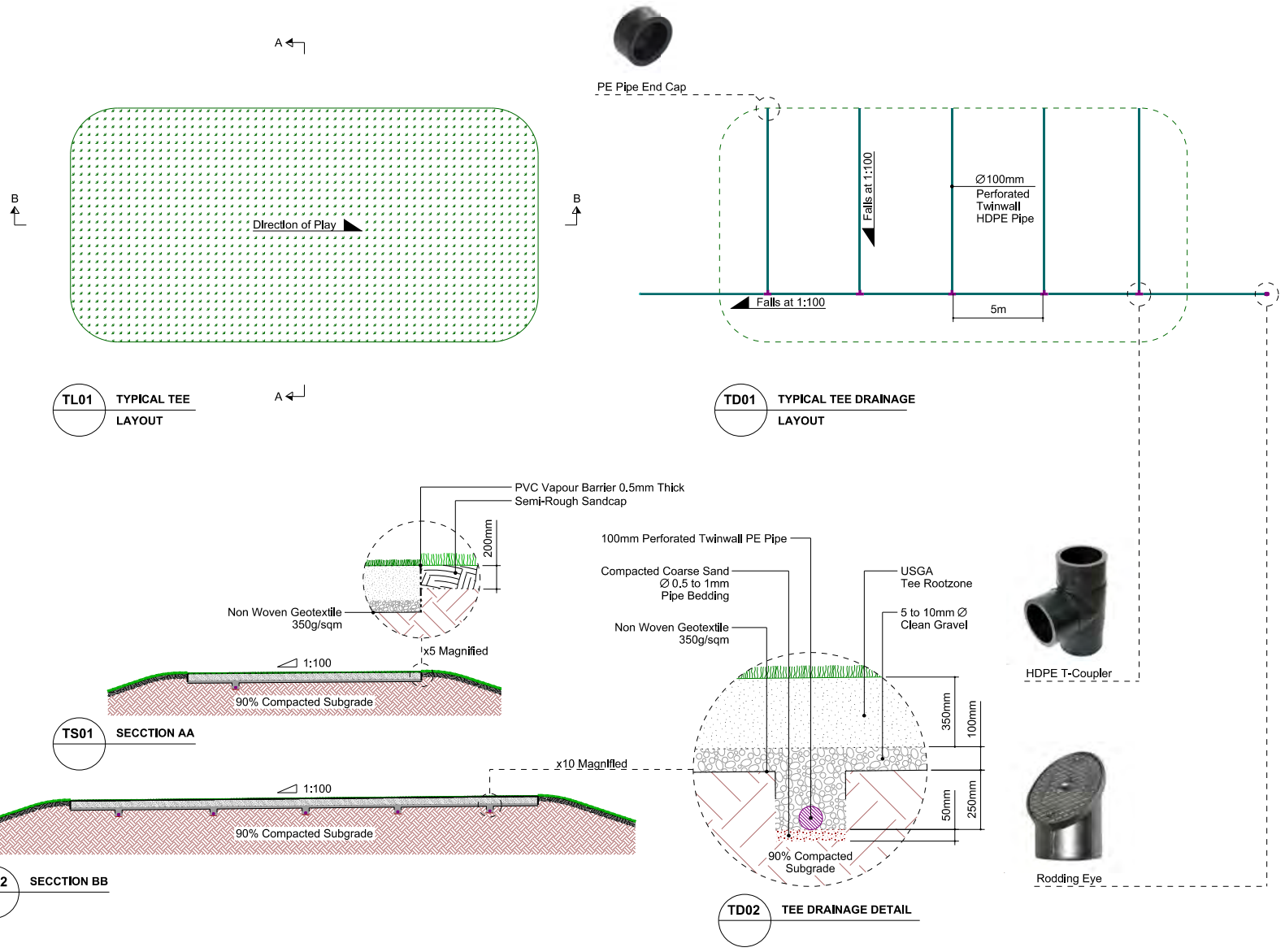
DRAWING TITLE
Holes 16 Tees

Drawn	MV	Checked	AC	Approved	JH
Date	19/09/19	Sheet Size	A2	Scale	1:200

Drawing No. GEB 0164 SITE SECTIONS — Rev. –

CAD File No. GEB 0164 SITE SECTIONS — Consultant Project No.

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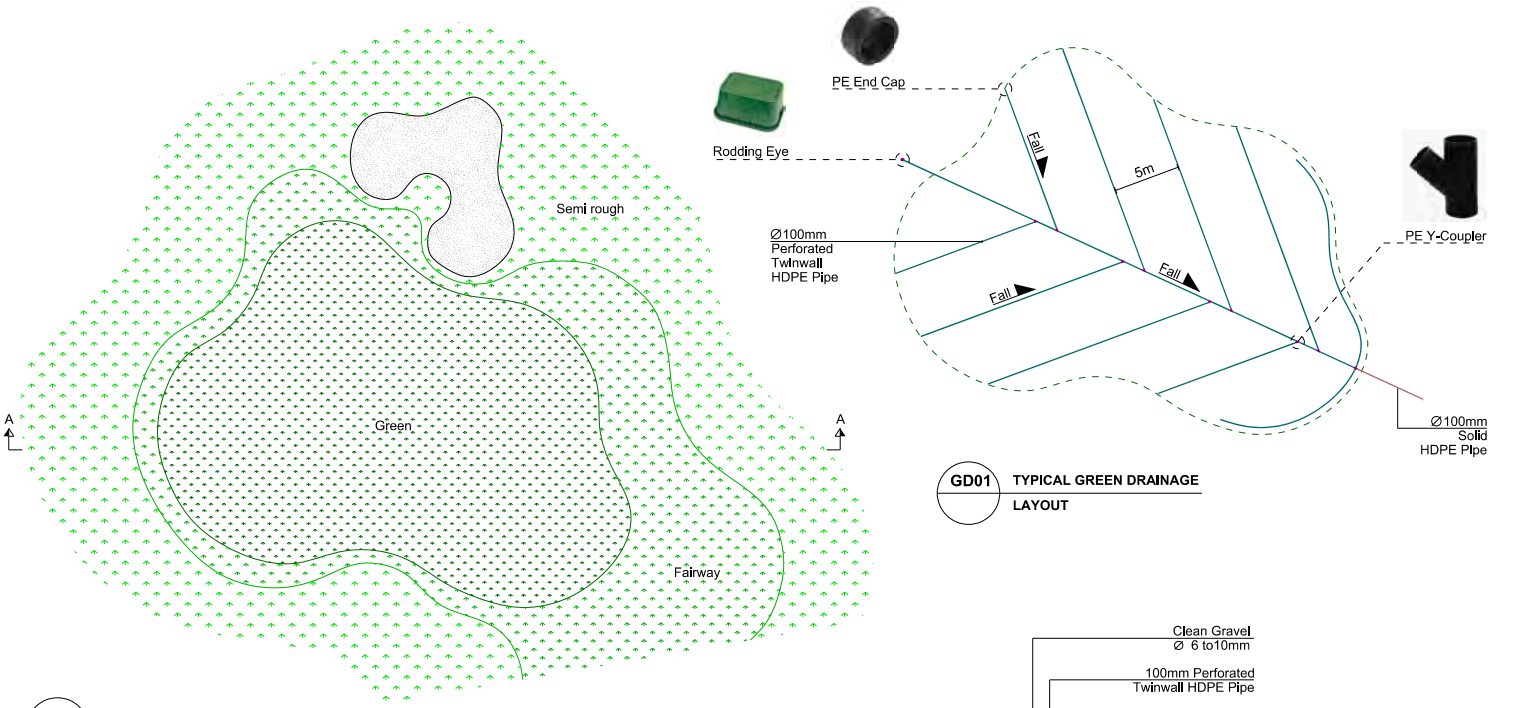
PROJECT
Kirkby Valley Golf Club

DRAWING TITLE
232 Tees Details

Drawn	PA	Checked	AC	Approved	–
Date	29.08.19	Sheet Size	A3	Scale	NTS

Drawing No. G936 232 TEES DETAILS — Rev. –
CAD File No. G936 232 — Consultant Project No.

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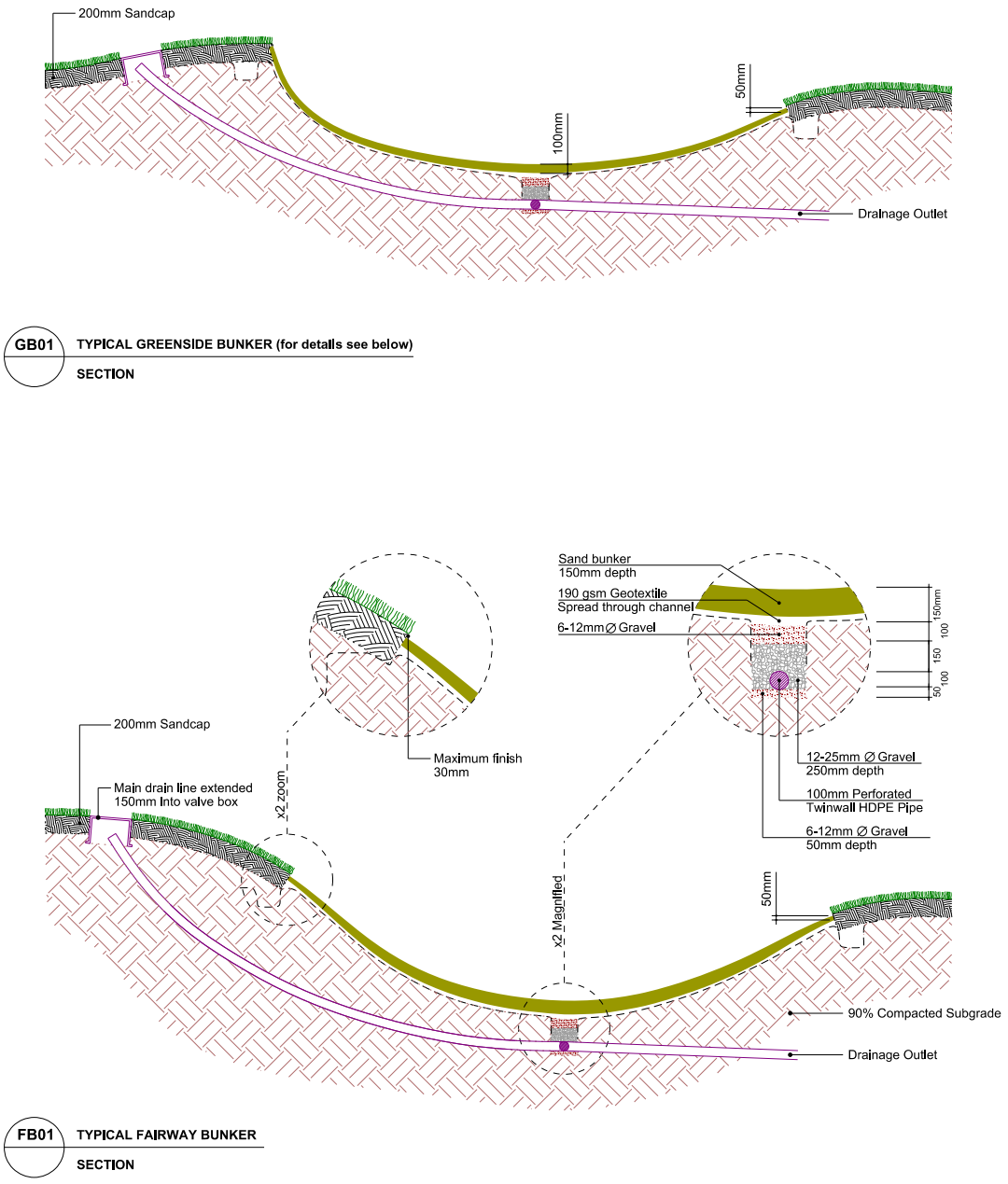
PROJECT
Kirkby Valley Golf Club

DRAWING TITLE
234 Greens Contruction Details

Drawn	PA	Checked	AC	Approved	–
Date	29.08.19	Sheet Size	A3	Scale	NTS

Drawing No. G935 234 GREENS CONSTRUCTION DETAILS — Rev. –
CAD File No. G935 234 — Consultant Project No.

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Planning Application

PROJECT
Kirkby Valley Golf Club

DRAWING TITLE
233 Bunker Construction Details

Drawn	PA	Checked	AC	Approved	–
Date	29.08.19	Sheet Size	A3	Scale	NTS

Drawing No. G936 233 BUNKERS CONSTRUCTION DETAILS — Rev. –
CAD File No. G936 233 — Consultant Project No.

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Methodology

Access to all four areas will make use of the existing maintenance path network. Materials will be stored in appropriately shaped overburden mounds no higher than 2m. All storage areas will be reinstated to their original conidition.

In general there will be no importation of fill materials which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage building structures, the surrounding environment, or create instability in the filling.

The use of recovered material for re-contouring conforms with the spirit of the European Landfill Directive and PPS10 and aims to improve the way waste is managed by diverting it away from landfill. The development can therefore be classified as a sustainable use of recovered waste that may otherwise have been diverted to landfill, which is the last preferred option of the waste hierarchy.

Topsoil will be stripped and stored prior to reshaping works. Topsoil will be re spread after reshaping to a depth of 250mm. Grass areas will be seeded or turfed as appropriate.

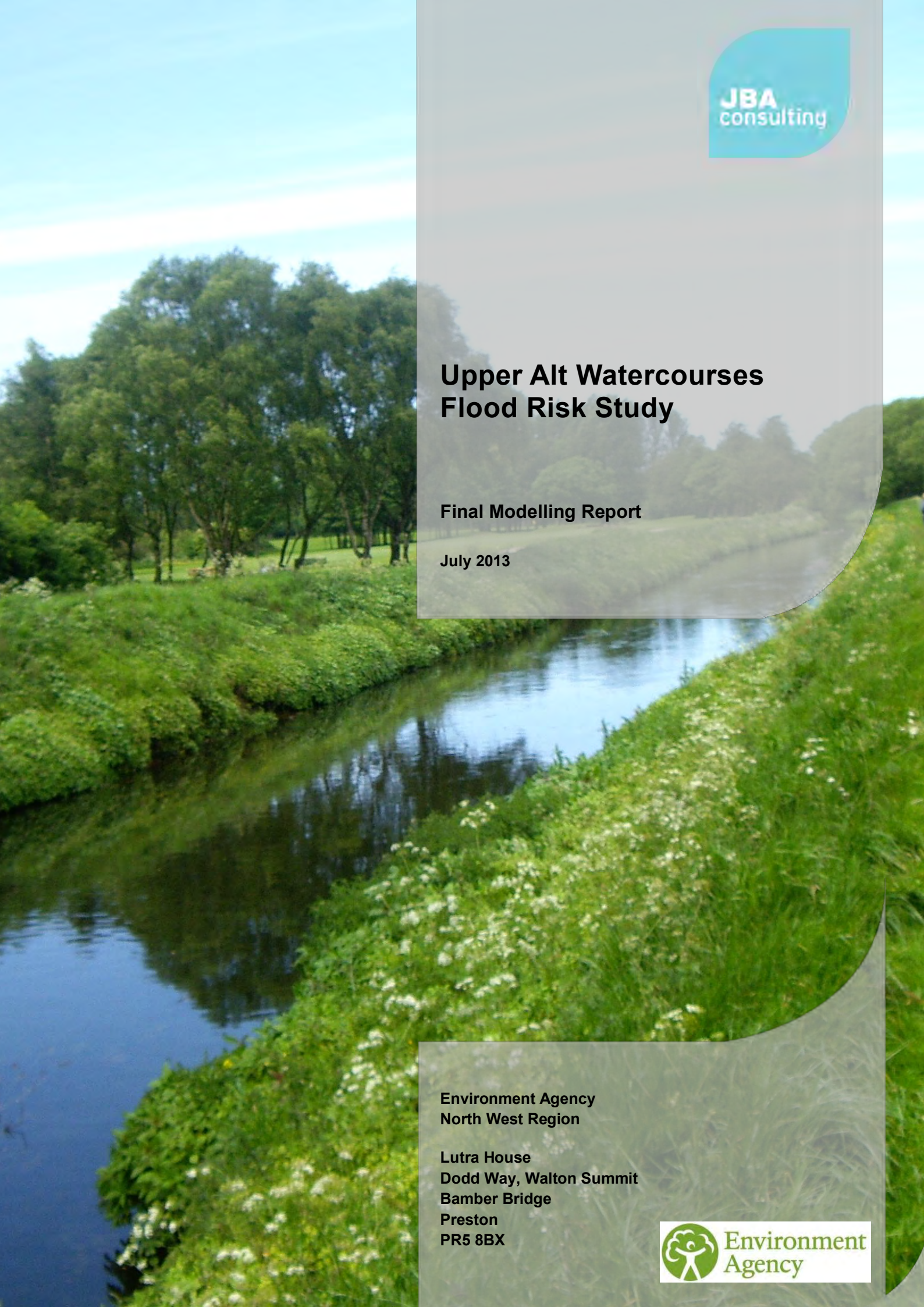
The operator will work with a local haulage company to source locally available material, the haulage contractor will import clean soil as A1 fill, with a mix of stone or small rubble upto 100mm in size. All soil importation will be signed off by the Environment Agency.

	Imported Materials
Greens Root Zone (USGA spec and peat)	1,755 cum
Inert Fill Material	7,482 cum
Drainage Gravel	195 cum
Total of Imported Material (excl. turf or bunker sand)	9,237 cum

END IDG 2019

APPENDIX D: EA RIVER ALT MODEL REPORT (JBA, 2013)

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Upper Alt Watercourses Flood Risk Study

Final Modelling Report

July 2013

Environment Agency
North West Region

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Dodd Way, Walton Summit
Bamber Bridge
Preston
PR5 8BX

JBA Office

JBA Consulting
Bank Quay House
Sankey Street
Warrington
WA1 1NN

JBA Project Manager

Krista Davies

Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft Modelling Report		Dominic Nickson March 2013
Final Modelling Report		Dominic Nickson July 2013

Contract

This report describes work commissioned by Dominic Nickson, on behalf of Environment Agency North West, by a letter dated 13th May 2011. The Environment Agency's representative for the contract was Dominic Nickson. Krista Davies and Mairéad Conlon of JBA Consulting carried out this work.

Prepared by .....Mairéad Conlon BEng MEngSc
Engineer

Reviewed by .....Krista Davies BSc MSc CSci CEnv CWEM MCIWEM
Chartered Senior Analyst

Purpose

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JBA Consulting has no liability regarding the use of this report except to Environment Agency.

Executive Summary

The purpose of the Upper Alt Watercourses Flood Risk Study is to undertake a detailed assessment of the fluvial risk associated with the designated Main River sections of the Upper Alt, Fazakerley, Deys and Tue Brooks to help understand the current and future levels of flood risk within the catchment. The River Alt has historically been split at Kirkby Gauging station into the Upper Alt and Lower Alt sections. This study follows on from a similar modelling study completed for the Lower Alt in 2010.

The study has considered the fluvial flood risk associated with the 20%, 10%, 6.66%, 5%, 4%, 3.33%, 2%, 2.5%, 1.33%, 1%, 1% plus climate change, 0.5%, 0.2%, 0.1% AEP events using a linked 1D-2D ISIS-TUFLOW model developed for the study.

The hydrological assessment completed for the study has been complicated by the urban nature of the Upper Alt and has been based primarily on the available flow record at Kirkby Gauging Station. Approximately 38km^2 of the 96km^2 catchment area draining to Kirkby Gauging Station is represented by existing sewer models made available by United Utilities for the purposes of the study. Utilising these models, a 'hybrid' approach to design peak flow estimation has been taken using ReFH based inflows to represent the missing open / natural parts of the catchment not covered by a sewer model. The 'hybrid' approach adopted has been calibrated using past observed events at the station and has been scaled to fit FEH Statistical Single Site peak flow estimates for higher frequency, lower magnitude events up to the 3.33% AEP event. The scaling adopted for the 3.33% AEP event has been retained for the larger events considered by the study as it was not appropriate to use the peak flow estimates produced by the Single Site Statistical assessment because of the length of flow record (33 years) available at Kirkby Gauging Station. Adopting this hybrid approach has helped refine the both the magnitude of design event flows and hydrograph shape, that are now more representative of the catchment and are supported by observed flow data.

Survey data collected by the Environment Agency between 2009 and 2011 has been used to develop a 1D ISIS model extending along the Main River sections of the Upper Alt, Fazakerley, Deys and Tue Brook. This has been linked to a 2D TUFLOW model representing the floodplain within the study area. The linked ISIS-TUFLOW model has been used to predict flood risk information (extent, depth, velocity and flood hazard) for the range of defended and undefended events considered by the study.

During the defended 1% AEP event, the output from the modelling shows that flooding within the catchment is limited to isolated pockets of flood risk that are constrained by rising topography with 2 properties shown to be at flood risk. There are 69 properties shown to be at flood risk during the 0.1% AEP event. These are predominantly located in West Derby, with the flood risk originating from the River Alt.

The undefended modelling shows that the removal of the raised defences on the section of the River Alt and Deys Brook at the confluence of both watercourses results in some additional flooding with 8 properties shown to be within the 1% AEP undefended event extent, increasing to 97 properties during the 0.1% AEP event.

The flood extents produced by this study are generally smaller than the flood extents produced by the previous S105 study and shown on the Environment Agency's Flood Map, with 40 properties removed from the flood extent for the 1% AEP event. This is as a result of the more sophisticated modelling methods used by the study that has helped to refine and improve the flood risk information available within the catchment.

As part of the study, a blockage assessment has been undertaken to assess the impact of blockage on flood risk at six key structures, identified as being prone to blockage. The assessment indicates that a blockage to the culvert under Croxteth community school playing fields, the culvert at Deysbrook Lane and the culvert under Stockbridge Village have the most potential to affect a significant number of properties (up to 300) during a large flood event.

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Abbreviations

Abbreviation	Description
ABD	Area Benefiting from a Defence
ADCP	Acoustic Doppler Current Profiler
AEP	Annual Exceedance Probability
CCTV	Closed Circuit Television
CDOG	Culvert Design & Operation Guide
EA	Environment Agency
FEH	Flood Estimation Handbook
JBA	JBA Consulting
ISIS	One-dimensional Hydraulic Modelling software
LiDAR	Light Detecting and Ranging
LCC	Liverpool City Council
NFCDD	National Flood & Coastal Defence Database
OS	Ordnance Survey
SFRM	Strategic Flood Risk Management
ReFH	Revitalised Rainfall Runoff Method
SFRM	Strategic Flood Risk Management
SIRS	Sewerage Incident Report System
S105	Section 105 Study
TSSG	Trash & Security Screen Guide
TUFLOW	Two-dimensional Unsteady Flow software
UPM Study	Urban Pollution Management Study
WIRS	Wastewater Incident Report Register
WWTW	Waste Water Treatment Works

1 Background and Overview

1.1 Purpose and Scope of Study

JBA have been commissioned by the Environment Agency to undertake a Flood Risk Mapping Study in the Upper Alt catchment. Initially the scope of the study covered the Main River section of the Upper Alt that extends downstream from Huyton to Kirkby Gauging Station. Throughout this report, this is referred to as the Upper Alt. Since its original commission, the scope of work has been extended to include the Fazakerley Brook, Tue Brook and Deys Brook tributaries of the Upper Alt. The work follows on from a similar modelling study recently completed on the Lower Alt downstream of Kirkby Gauging Station to support the Lower Alt with Crossens Pumped Drainage Catchment Flood Risk Management Strategic Plan[1].

The methodology used by the study has been previously outlined in the Upper Alt Watercourses Inception Report produced in August 2011 and the Interim Hydrology Report produced in December 2012 for the study. The models developed will replace the existing Section 105 model[2] of the Upper Alt developed by Atkins in 2000. Defended and undefended versions of the model will be developed. These will be used to delineate the Area Benefitting from a Defence (ABD). The study will derive flood extent, depth and velocity information for the 20%, 10%, 6.66%, 5%, 4%, 3.33%, 2.5%, 2%, 1.33%, 1%, 1% plus climate change, 0.5%, 0.2% and 0.1% AEP events

The outputs from the modelling will be used to update the Flood Map. The deliverables will be provided in NFCDD compatible formats and will also be used to inform of possible flood warning areas within the study area. The updated hydrology and hydraulic model developed could also be used to reconsider the hydrology for the Lower Alt study.

1.2 Catchment Understanding

The River Alt catchment covers an area of approximately 235km^2 and has historically been split at Kirkby Gauging Station into the Upper Alt and Lower Alt sections. One reason for this is the varying nature of the watercourse and land use throughout its length. The upper section of the River Alt draining to Kirkby Gauging Station is typically heavily urbanised. With distance downstream of Kirkby Gauging Station, the Upper Alt becomes predominantly rural and flatter in nature and is drained by a complex network of ditches and pumping stations to provide high grade agricultural land.

Details of the watercourses included in the study, as given in the statement of requirements are summarised in Table 1-1 and shown in Figure 1-1 below.

Table 1-1 Extents of Study

Watercourse	Description	Grid Reference
Upper Alt	Extending from its source in Huyton to the Liverpool Ship Canal Bridge located a short distance downstream of Kirkby Golf Course	SJ43861 91326 to SJ38954 98436
Fazakerley Brook	Extending from Higher Lane to its confluence with the Upper Alt	SJ37619 96776 to SJ39338 96843
Tue Brook	Extending a short distance upstream from its confluence with Fazakerley Brook	SJ38742 96215 to SJ38702 96646*
Deys Brook	Extending from Alundale Road to its confluence with the Upper Alt	SJ41570 92484 to SJ41285 94194

* Note: the grid reference relates to the section of Tue Brook classed as Main River

[1] JBA, on behalf of the Environment Agency, December 2010. Lower Alt Hydraulic Modelling Report. Lower Alt with Crossens Pumped Drainage Catchment Flood Risk Management Strategic Plan

[2] Atkins on behalf of the Environment Agency, June 2000. River Alt Final Modelling Report

The Upper Alt catchment is heavily urbanised and is situated in and around the suburbs of Liverpool, encompassing the urban areas of Huyton, Tue Brook, Anfield and Kirkby. The upstream extent of the study is located immediately downstream of the Alt Road Culvert in Huyton. Here the Upper Alt drains a relatively small area of 3.3km^2. Even the upper extents of the watercourse are heavily urbanised with several culverts present, sections of engineered channel and many properties in close proximity (Figure 1-2).

The first main tributary to the Upper Alt is Deys Brook, which enters the river on the left hand bank approximately 4km downstream of the Alt Road culvert. The designated Main River section of Deys Brook is approximately 2.4km in length and drains parts of West Derby and Knotty Ash. The brook runs through the centre of West Derby Golf Course. There is substantial culverting downstream of the golf course including a long culvert between Deysbrook Lane and Croxteth Hall Lane. There have been past incidents of flooding from the combined sewer system at Crawford Close (reported in UU SIRS incident data) and this area is also prone to surface water flooding as the impermeable clay geology prevents infiltration and results in rapid surface runoff. Hall Brook and Thornhead Brook are 'non main' tributaries of Deys Brook.

Sugar Brook also enters the Upper Alt further downstream. This tributary is again heavily urbanised and receives most of its runoff from the surface water system. This includes the runoff from the Showcase Cinema Complex on the A580 (East Lancs Road). This tributary is not modelled as part of the study.

The third left bank tributary joining the Upper Alt is Fazakerley Brook. This drains an area of approximately 11km^2 and joins the Upper Alt immediately downstream of Fazakerley Waste Water Treatment Works (WWTW). At its upstream extent (at the railway culvert), the watercourse is known as Lower Tue Brook, which historically carried runoff from the Tue Brook and Anfield areas. The upper extent of Tue Brook (shown on Figure 1-1) is culverted along most of its length and has been diverted into a disused brick sewer that joins Fazakerley Brook approximately 500m upstream of its confluence with the Upper Alt. Inflows into the upstream of Fazakerley Brook have therefore reduced. There have been past problems in the Russian Drive, Richmond Road and Rockbank Road areas of Tue Brook. Through this section, properties have been built over the culverted watercourse and siltation problems thought to be caused by the trash screen arrangement has caused past flood incidents. There have also been past issues with fly-tipping along Fazakerley Brook, which could further reduce channel capacity and result in blockages during extreme events (Figure 1-3).

Figure 1-1 Upper Alt Watercourses

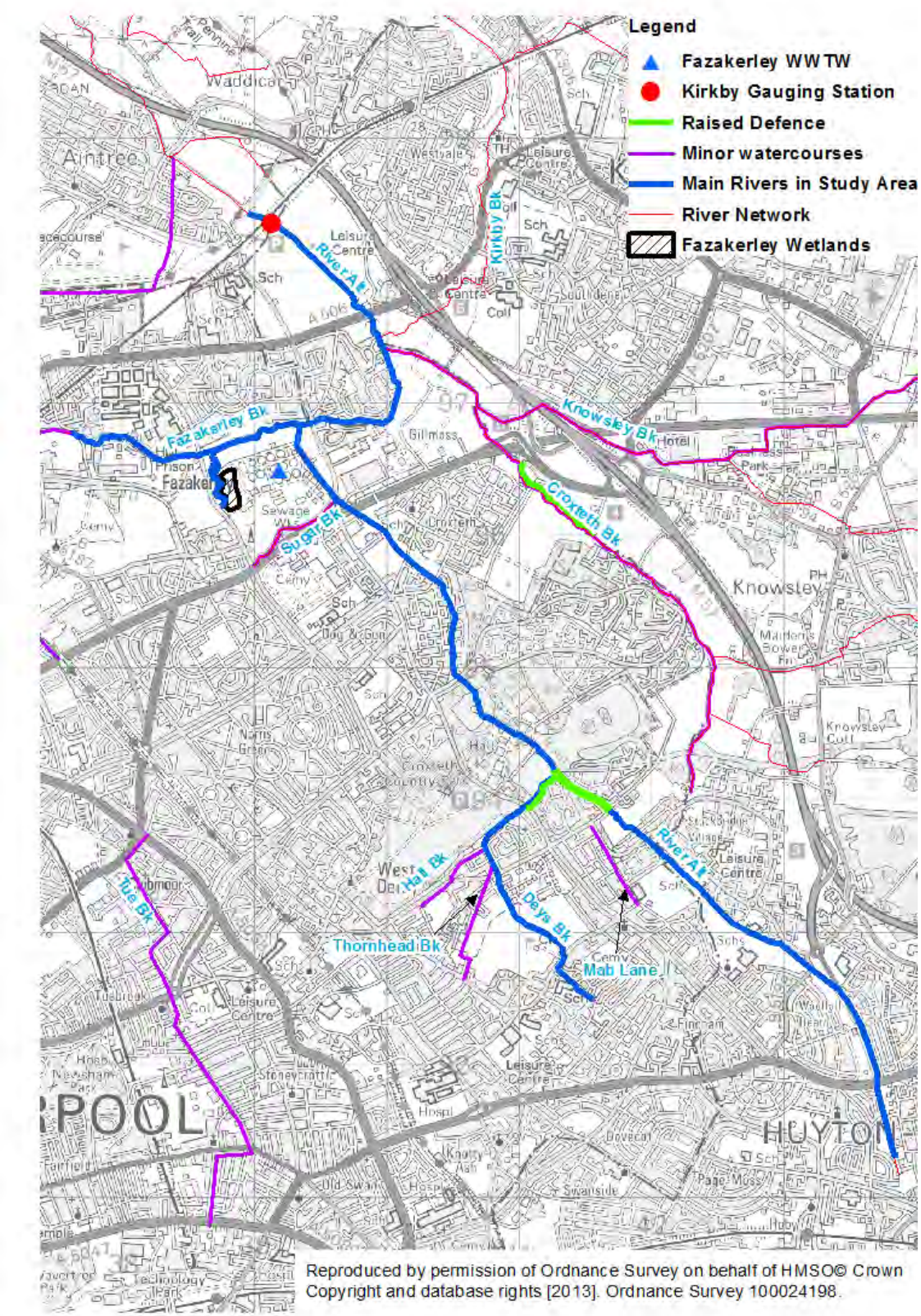


Figure 1-2 Heavily Urbanised Upper Catchment



Figure 1-3 Fly-tipping along Fazakerley Brook



At the Tue Brook and Fazakerley Brook confluence, a wetland area has been created. This was put in place to treat the storm flow from Tue Brook before the watercourse discharges into Fazakerley Brook.

Approximately 1.3km downstream of the Fazakerley Brook confluence, the Upper Alt is joined by Knowsley Brook on the right hand bank. The brook has an approximate catchment area of

17km^2 and includes Croxteth Brook. This catchment is more rural than other catchments in the study area, although there are some urban areas such as Knowsley Business Park and Knowsley village within the catchment. Kirkby Brook enters the Upper Alt a short distance downstream of Knowsley Brook. In its upstream reaches, the brook is known as Simonswood Brook and drains a predominantly rural area. Downstream of this, the watercourse drains though the town of Kirkby before its confluence with the Upper Alt. The brook has a catchment area of approximately 32km^2. Neither of these watercourses are directly modelled as part of this study but remain important due to their catchment size and the impact they will have on the catchment hydrology.

Kirkby Gauging Station (SJ 39200 98300) is the only Environment Agency monitoring station present within the Upper Alt catchment and marks the downstream extent of the study area.

1.2.1 Flood History

There is a known history of flooding in the Upper Alt catchment, in part due to the age and lack of maintenance of some of the culverted watercourses in the catchment. This has been exacerbated over time as watercourses have been culverted in a 'piecemeal' manner as urban areas have expanded with some culverts now unable to cope with increased runoff.

Areas of historical flooding have been included on an annotated plan (Figure 1-4) located at the back of the report. This has been developed using local Environment Agency knowledge, information collected for past studies and United Utilities Sewerage and Wastewater Incident Register Systems (SIRS and WIRS) data. The SIRS (pre April 2008) and WIRS (post April 2008) datasets provide a register of all incidents related to United Utilities assets from 1983. The Environment Agency's Flood Map is also shown on this figure.

Figure 1-4 Upper Alt Historical Flood and Incident Map (located at the back of the report)

For the clarity of the figure, only WIRS data has been shown, as this highlights the more recent incidents. This clearly illustrates that the main UU incidents in the catchment are related to blockage, which includes blockage caused by siltation, tree roots and man-made debris.

1.2.2 Defences

There are four designated defences within the study area all of which are raised defences. These are shown in Figure 1-1. The first two of these are located on the Upper Alt, immediately upstream of the confluence with Deys Brook. The defences in this location extend approximately 520m upstream of the confluence (from Deysbrook Lane to Coachmans Drive) on the left and right bank of the watercourse and are earth embankments with a concrete core. The third defence is located on the right bank of Deys Brook at its confluence with the Upper Alt. The defence is approximately 360m in length and extends from the Deysbrook Lane culvert to the confluence of Deys Brook with the Upper Alt. The fourth defence is located on Croxteth Brook, although this is located outside of the modelled extent of the study. All defences in the study area are estimated to have an approximate 50 year Standard of Protection (SoP) from NFCDD.

1.2.3 Links with other studies

There is an existing Section 105 ISIS model of the Upper Alt that was developed by Atkins in 2000. A brief review of this study is outlined in the Inception Report. Findings from this study have been useful in terms of gaining a greater understanding of the catchment, particularly the impact of urban drainage system on inflows into the Upper Alt and therefore there are several references to this study throughout this report.

The present study is also heavily linked to recent work completed by JBA in the Lower Alt catchment, as part of the Strategic Plan. Outputs from the Lower Alt study have been used to develop a downstream boundary condition for the Upper Alt model. There is also a knock on implication for the Lower Alt Study as the hydrology at Kirkby Gauging Station has been updated by the present study.

United Utilities (UU) have developed a set of sewer models which cover the storm, foul and combined system draining to Fazakerley and Huyton Treatment Works and the Tue Brook surface water system. Surface water outfalls and Combined Sewer Overflows (CSOs) will contribute flow into the watercourses included in the study and hence these models are relevant to the hydrological assessment. The InfoWorks CS models of the sewer system have been provided by UU for use within the study. These are described in greater detail in Section 2.6.

1.3 Deliverables

The project deliverables required by the Environment Agency are specified in the statement of requirements. The key project deliverables of the study include:

- Hydrological flows using FEH software Version 3 for the following design events: 50%, 20%, 10%, 5%, 4%, 2%, 1.33%, 1%, 1% + 20% increase in flows to allow for climate change, 0.5%, and 0.1% AEP events. The scope of the study was also later extended to include the 3.33% 6.66%, 2.5% and 0.2% events.
- The development of defended and undefended hydraulic models of the Upper Alt. Outputs from the modelling will be used to derive flood risk data for the events specified above in NFCDD compatible formats. This will include the production of depth and velocity grids using the output from the 2D model in both MapInfo and ArcGIS formats.
- Blockage Assessment.
- Interim Hydrology and Hydraulic Modelling Reports in both draft (for EA review) and final formats (included in the final deliverables) in accordance with SFRM specification and the statement of requirements.

1.4 Report Format

This report is split into six sections.

The first (present) section of the report provides an introduction and the background to the study. This is followed by two sections on the hydrological analysis completed for the study (taken from the Interim Hydrology Report). Section 2 presents the preliminary hydrological analysis undertaken to help inform the detailed modelling methodology that has been used by the study. Much of this preparatory work was completed at the inception stage of the study. This assessment was necessary to understand the hydrological response of the catchment (given its complexity) that is unlikely to be correctly represented using standard flood estimation methods. The preliminary assessment considered;

- The performance of Kirkby Gauging Station, including a review of the rating curve used at the station.
- The gauged hydrological response of the catchment.
- Outputs from standard FEH based methodology and how peak flow estimates relate to observed flows within the catchment.
- Hydrological sub-catchment assessment based on catchment topography and the sewer network.
- The potential use of the UU sewer models.

Section 3 of this report works through the development of the hydrology completed for the study including the use of the UU sewer models and documents how the modelling has been calibrated using flow data recorded at Kirkby Gauging Station.

Section 4 outlines the development of the ISIS and TUFLOW models and how the models have been dynamically linked. The predicted flood risk using the model is described in Section 5 of the report with Section 6 summarising the conclusions and recommendations from the study.

2 Preliminary Hydrology

2.1 Available Hydrometric Data

There is one flow gauging station present within the study area at Kirkby, located at the downstream limit of the Upper Alt catchment. The use of the recorded flow data from this gauge has been very important in informing the hydrological response within the catchment. This has enabled a realistic set of design event inflow hydrographs to be produced and an effective calibration exercise to be undertaken.

There are 5 raingauges within or neighbouring the catchment. These are located at Liverpool North, Huyton Treatment Works, Prescott Treatment Works, Sandon Dock and Melling Point Pumping Station. The locations of these stations are shown in Figure 2-1 below. Liverpool North is the only raingauge within the catchment and the Thiessen Polygon for the station covers a large part of the study area. The raingauges at Liverpool North and Sandon Dock are tipping bucket gauges for which 15 minute rainfall data is available. The remaining gauges at Huyton Treatment Works, Prescott Treatment Works and Melling Point Pumping Station record daily data. There are several periods of missing data in the rainfall records received for Prescott and Huyton Treatment works.

2.2 Kirkby Gauging Station Review

Given the potential importance of recorded flow data at Kirkby Gauging Station within the hydrological analysis and following recommendations made by the Environment Agency and the Lower Alt Hydraulic Modelling undertaken for the Strategic Plan, the rating curve used at Kirkby Gauging Station has been reviewed. This review has helped to understand the performance of the station, in particular the accuracy of recorded flows.

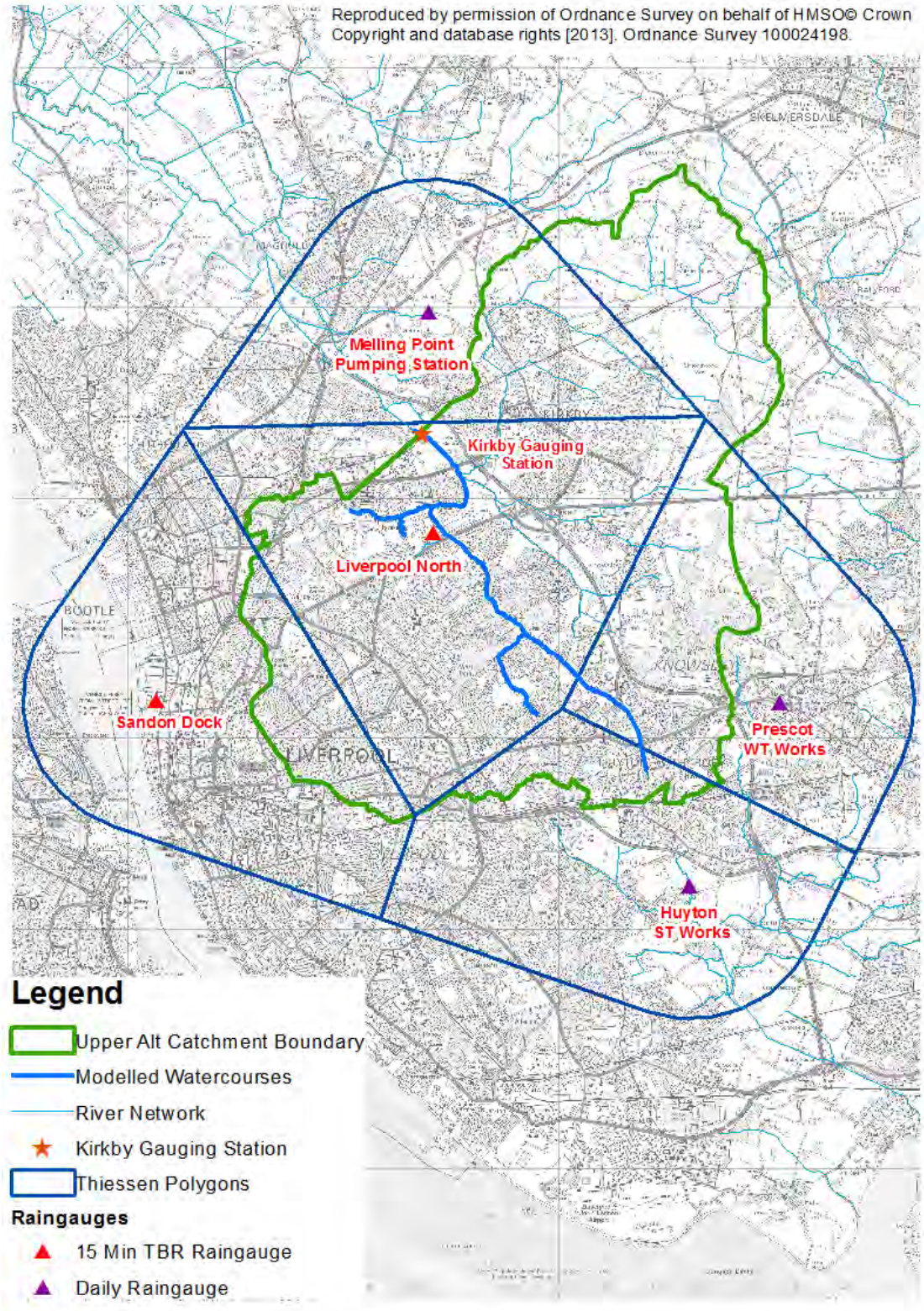
Spot gauging data provided for the study and the current rating curve at Kirkby are shown in Figure 2-2. In total, 49 spot gaugings have been collected since 2007. The rating curve used at the station has been derived from current meter gaugings and is valid for stages between 0.15m to 1.48m (with equivalent flows of between 0.23m^3/s and 16.9m^3/s). The rating curve currently used at the station has been in place from 2004 and is given in Table 2-1 (rating ref 2).

Table 2-1 Rating Curve for Kirkby Gauging Station

Ref	Limb	Details	Equation	Start Date	Max Stage	End Date
1	a	NSW027601	Q = 6.585*(h - 0.190)^1.684	17/05/1963	0.87	07/09/1977
2	a	Updated 04	Q = 15.690*(h - 0.020)^2.059	07/09/1977	0.26	01/01/2100
2	b	Updated 04	Q = 14.994*(h - 0.0970)^1.580	07/09/1977	0.45	01/01/2100
2	c	Updated 04	Q = 9.189*(h + 0.0220)^1.498	07/09/1977	999	01/01/2100

The Environment Agency's Hydrometry team have advised that the bank full stage at the station is approximately 2.2m, although the banks upstream and downstream of the gauge are not level. By extrapolating the upper limb of the rating curve an equivalent flow of 30.4m^3/s has been calculated for bank full. The HiFlows UK website does not report any observed bypassing at the station although the large flood events that occurred in August 2004 and July 2010 have recorded maximum stage values in excess of the bank full stage.

Figure 2-1 Hydrometric Stations Within or Neighbouring the Upper Alt Catchment



The Environment Agency's Hydrometry team collected 7 spot gaugings during the July 2010 event, which are shown on Figure 2-2. The largest spot gauging recorded during the event was 29.3m^3/s and had a stage of 1.93m. The Environment Agency has confirmed that there was no evidence of flooding to the golf course during the event although the river level was very close to bankfull. The Environment Agency did observe a visible backwater effect that may have been created by an obstruction downstream. This is thought to have increased water velocities and the flow measured during the event.

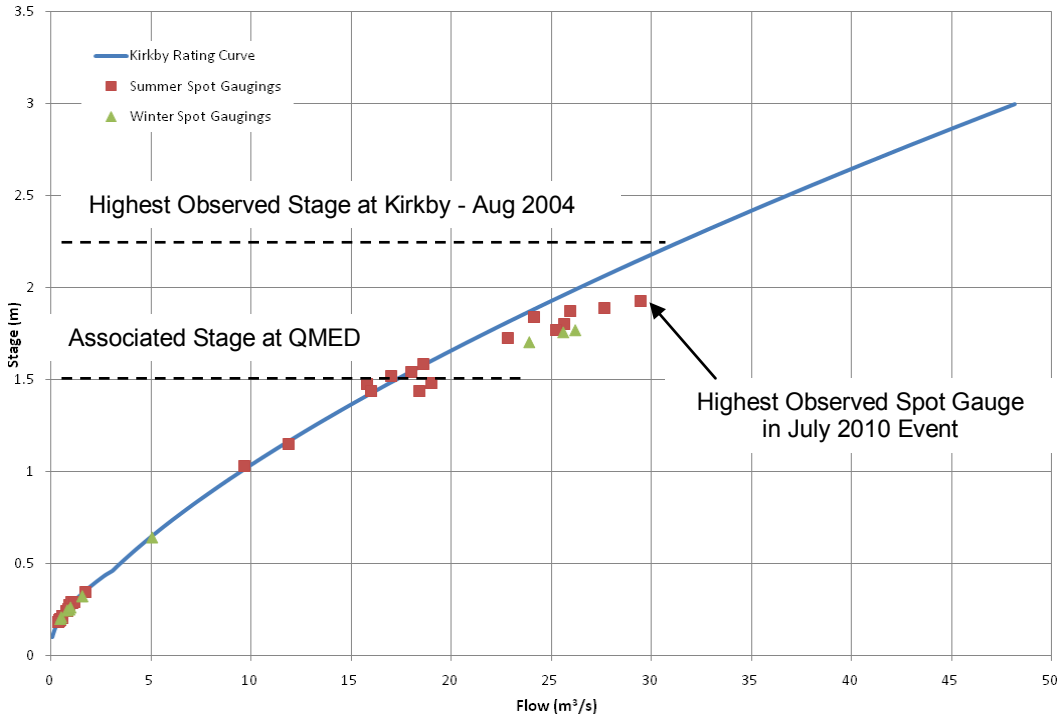
There have been several stage-discharge reviews undertaken by the Environment Agency in 2005, 2007 and 2010. The 2010 review concluded that the current rating is acceptable and applicable but recognised that there may be some underestimation in flows, especially around the change point between the first and second limbs of the curve and at stages above 1.7m.

Other known issues (as noted by the S105 study and the Environment Agency's Hydrometry team) at the station include;

- Past siltation at the inlet to the stilling well that has affected stage measurement by slowing down water entering the stilling well. The Atkins (2000) study, that installed a temporary level transducer at the station, found that water levels could be under-recorded and delayed as a result of this. The 2010 rating review states that the site is now flushed on a regular basis to prevent this and has been so since 2000.
- The site is also known to be affected by algal growth on the weir and weed growth within the upstream and downstream channel sections. This can potentially increase the recorded stage at the station for a given flow and is currently managed on a reactive basis by monthly clearing.
- For the last few years, the Environment Agency have collected high flow spot gauging data (above 1.4m) using an ADCP (Acoustic Doppler Current Profiler). These measurements are known to be affected by the movement of the channel bed at the site that can result in the under-recording of flow for a given stage. Measurements have therefore been internally corrected to make allowance of this. In the future, the Field Monitoring and Data Team hope that a GPS system for recording high flow spot gauging data will prevent this issue[3].

3 Information provided by Stuart Eckersley (FMD) via e-mail to Dominic Nickson dated 21/07/2011

Figure 2-2 Rating Curve and Spot Gauging at Kirkby Gauging Station (69032)

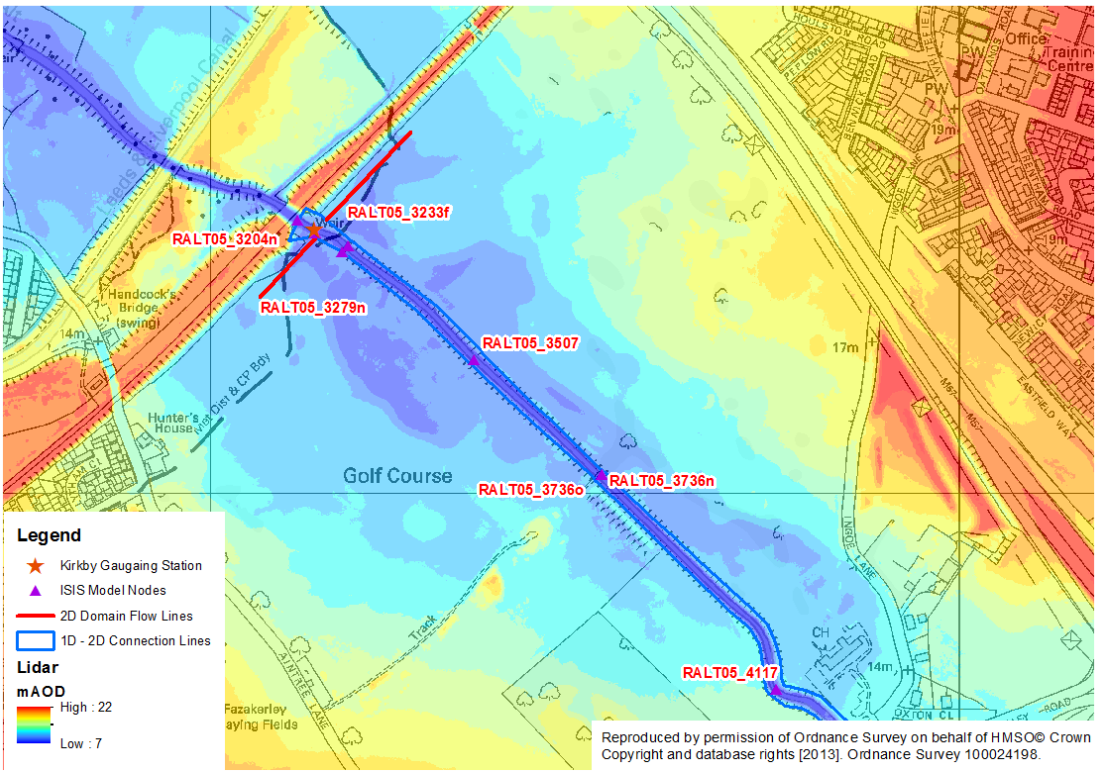


Given the uncertainties and the positive deviation away from spot gauging data during high flows, additional modelling at the station has been undertaken to help extend the rating curve to reflect the flow that may bypass the station during large events. The extension of the rating curve will also help confirm the magnitude of the larger events that have occurred at the station that will provide an important reality check on design peak flow estimates produced.

The modelling at Kirkby Gauging Station has been based on the linked ISIS-TUFLOW model of the Upper Alt developed for the study. The use of a linked 1D-2D model of the channel and floodplain will allow the total flow passing the gauging site to be accurately calculated by adding the predicted flow in the river at the weir with any bypassing flow on the floodplain. Within the 2D model, 2d flow observation lines have been included in the model to measure any bypassing flow. The general arrangement of the model at Kirkby Gauging Station is shown in Figure 2-3. Full details of the development of the hydraulic model are available in Section 4 of this report.

The model has been run for a range of flows to assess the stage discharge relationship at the station. To help address the issue of vegetation growth within the channel and the impact that this has on recorded stage values, summer and winter versions of the model, with varying channel and bank roughness values have been configured.

Figure 2-3 TUFLOW Model Schematic



The linked 1D-2D model shows that the channel capacity of the Upper Alt in the reach extending through the Golf Course is approximately 30m^3/s with floodwater predicted to overtop the left bank approximately 200m upstream of Kirkby Gauging Station. The modelling indicates that during large flood events, the flood extent within the Golf Course will be constrained by the rising topography away from the river. The raised railway embankment immediately downstream of the gauging station provides a constriction to floodplain flow and forces floodwater back into the channel. This results in the localised circulation of floodwater on the floodplain in the vicinity of the gauge.

The outputs from the simulation, shown in Figure 2-4, highlight that the rating curve produced by the model generally supports the existing rating curve used at the station up to a flow of 25m^3/s and a stage of 1.91m. Beyond this, the rating curve produced by the hydraulic model is generally flatter, resulting in an increase in flow for a given stage. The rating curve predicted by the model is also supported by a better agreement with the spot gauging data available at the station. Given this the Environment Agency may wish to consider whether to adopt the upper section of the modelled rating curve for use at the station in future.

2.5.3 Revitalised Flood Hydrograph Method

The FEH ReFH method has also been considered by the assessment. When considering the potential use of the ReFH method, it should be borne in mind that the heavily urbanised nature of the catchment means that the method is less well suited for flood estimation within the catchment.

Peak flow estimates from the ReFH method have been based on a 7 hour recommended storm duration. The estimates produced have been based on a winter storm profile despite the degree of urbanisation within the catchment. This is justified on the basis of the outcome of the critical storm duration assessment completed (described in Section 3.5 of this report) that found that flood risk within the catchment is driven by longer duration events more typically associated with a winter storm profile.

Initial testing found that the peak flow estimates from the ReFH method were very sensitive to the storm profile used.

2.5.4 FEH Based Design Flow Estimates

The peak flow estimates produced from the FEH Statistical and ReFH methods are shown in Table 2-5 below. These are compared to the previous flow estimates produced by the S105 study and the Lower Alt study.

Table 2-5 Indicative Peak Flow Estimates (m^3/s) at Kirkby Gauging Station

Return Period	2	10	25	30	50	100	1000
Upper Alt Study - single site analysis	17.5	24.4	28.3	29.2	31.6	35.1	49.9
Upper Alt Study - pooled, Kjeldsen UAF	17.5	24.3	27.8	28.5	30.5	33.3	43.8
Upper Alt Study -pooled, No Urban Adjustment	17.5	25.2	28.8	29.5	31.6	34.4	44.1
Upper Alt S105 Study		29.0	35.7		41.5	48.1	
Lower Alt Study - pooled	16.9	21.9	24.5		26.5	28.7	36.6
ReFH (winter storm profile)	29.7	45.9	55.1	57.1	63.5	73.6	127.7

The peak flow estimates show;

- There is an increase in FEH Pooled Statistical peak flow estimates produced by the present study compared to the flow estimates produced by the 2010 for the Lower Alt study. This will be affected by the change in QMED between studies but will be more significantly influenced by the use of the Kjeldsen (2010) method of urban adjustment, not published or recommended for use when the original work was completed.
- Flow estimates from the pooled statistical analysis (based on Kjeldsen) are comparable to the flow estimates produced assuming a rural catchment.
- Single and Pooled statistical peak flow estimates are generally comparable for the lower magnitude events up to the 50 year return period. For higher magnitude events the steeper growth curve from the single site assessment produces larger flow estimates compared to the statistical analysis because of the limited availability of flow data and the extrapolation as a result.
- ReFH flow estimates are significantly higher than statistical peak flow estimates, but given the urbanised nature of the catchment and the presence of a flow gauge within the catchment these are provided for comparative purposes only.

Flood events that occurred in 2004 and 2010 both had a recorded peak flow of ~30m^3/s at Kirkby Gauging Station. According to the FEH Statistical assessment completed, these events are estimated to have an Annual Exceedance Probability between the 3.33% and 2% AEP events. A rainfall frequency analysis completed using the recorded rainfall depths for these events at Liverpool North, suggests that both events have an estimated exceedance probability between the 10% and 5% AEP events.

2.6 UU Sewer Models

United Utilities have provided InfoWorks CS sewer models of the surface water and combined sewer networks across the Upper Alt catchment for use within the study. These have been used to understand the impact of the urban drainage system on inflows into the Upper Alt, Fazakerley, Deys and Tue Brook. Access to the models has helped to develop the hydrological assessment beyond that typically associated with a flood risk mapping study (based on the FEH) and the black box approach used by the S105 study. The coverage of the available models draining to Fazakerley and Huyton Treatment Works and the Tue Brook surface water system are shown in Figure 2-12.

Approximately 38km^2 of the 96km^2 catchment area draining to Kirkby Gauging Station is included in the sewer models. The sewer models typically represent inflows from hard surfaces (including roofs, roads) and permeable areas within the urban area. It is not possible to directly use the available sewer models for flood estimation as they only cover and reflect part, roughly 40%, of the total catchment. To use the models within the hydrological analysis it has been necessary to adopt a hybrid approach, whereby a different method of flood estimation is used to represent the larger permeable parts of the catchment not included within the available sewer models.

A brief summary of the sewer models available is given below.

2.6.1 Fazakerley Treatment Works Model

The Fazakerley sewer model is the largest model covering ~30% of the catchment and includes the foul, storm water and combined system. Inflows are provided into the sewer system using predefined sub-catchments based on various surface types, (i.e. roofs, gardens, roads) with runoff from each surface calculated using a fixed percentage runoff or the New UK routing model outlined below.

- Fixed percentage runoff – The percentage runoff is supplied by the user. As a fixed percentage runoff is used this method is only suitable for surface types where a good estimate of the percentage runoff can be made. This routing method has been generally used to represent runoff from impermeable areas where a high fixed percentage runoff can be applied with some degree of confidence. Depending on the land use type a fixed percentage ranging from 5% to 90% has been applied to the different sub-catchments.
- New UK - The New UK model represents the varying catchment wetness throughout an event. This method is typically used to define the runoff from pervious surfaces where it is not appropriate to assume a fixed percentage runoff. This method is particularly appropriate for longer duration storms, where there is a greater potential for the change in catchment wetness to impact resultant runoff volumes.

The Wallingford method has also been used for one small sub-catchment within the Fazakerley model.

2.6.2 Tue Brook Surface Water Model

The Tue Brook Model is the smallest of the InfoWorks models and covers an area of 1.3km^2, less that 2% of the overall catchment. The model represents only the surface water component that discharges into the Upper Alt catchment. The westerly part of the Upper Alt catchment is served by a combined system draining to Sandon Dock Treatment Works located outside of the catchment, although parts of the Sandon Dock Treatment Works catchment drain topographically into the Upper Alt catchment. Within the Tue Brook model, the Wallingford routing method has been used to generate runoff from the pervious and impervious surfaces present in this part of the catchment.

Initially, there was concern about the apparent limited area shown to drain into the system and as a result of this a comparison has been made against the Hydroworks model of the Tue Brook system developed for the S105 study. The total contributing area used within both models is the same (at 1.3km^2) although a reduced area of 0.78km^2 is shown to discharge directly into Tue Brook within the UU model, with the remaining 0.52km^2 discharging into the upper Main River extent of Fazakerley Brook. For the 1% AEP event, the predicted peak

Figure 2-12 Coverage of UU Sewer Models

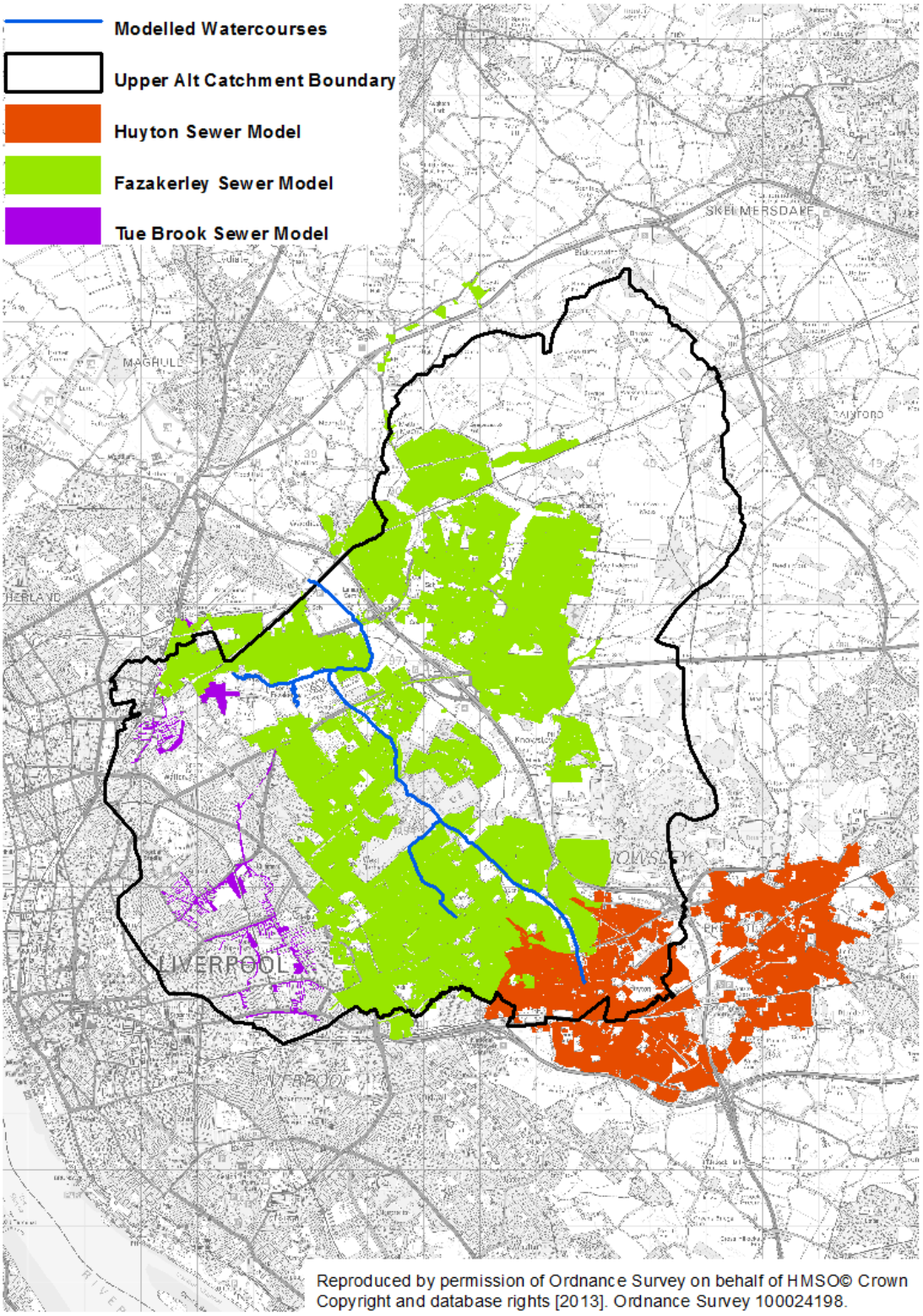


Figure 2-13 Flood Frequency Comparison at Kirkby Gauging Station

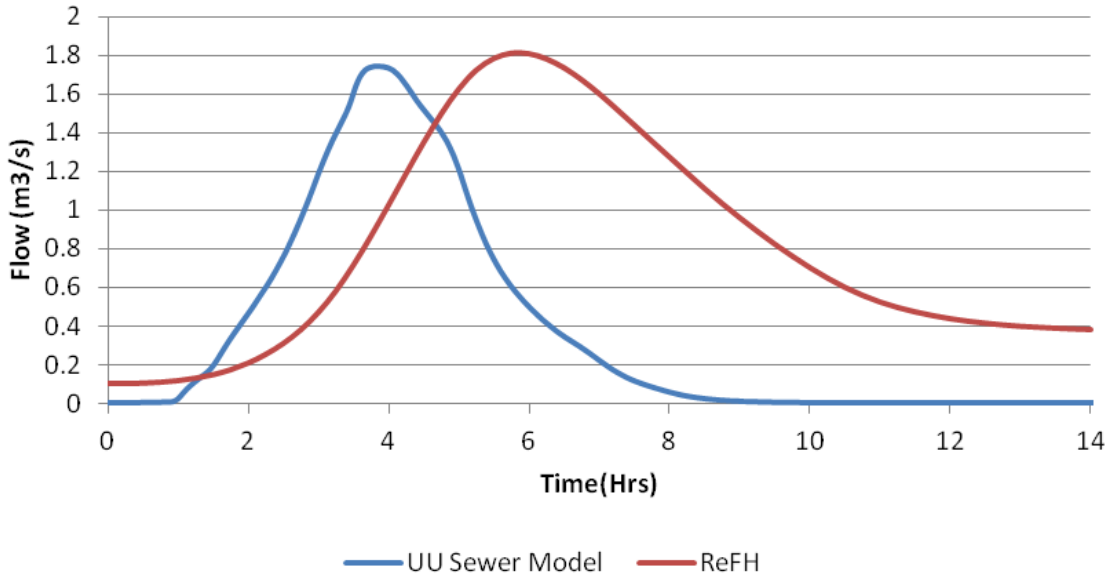


Figure 3-2 Schematisation of Model Inflows

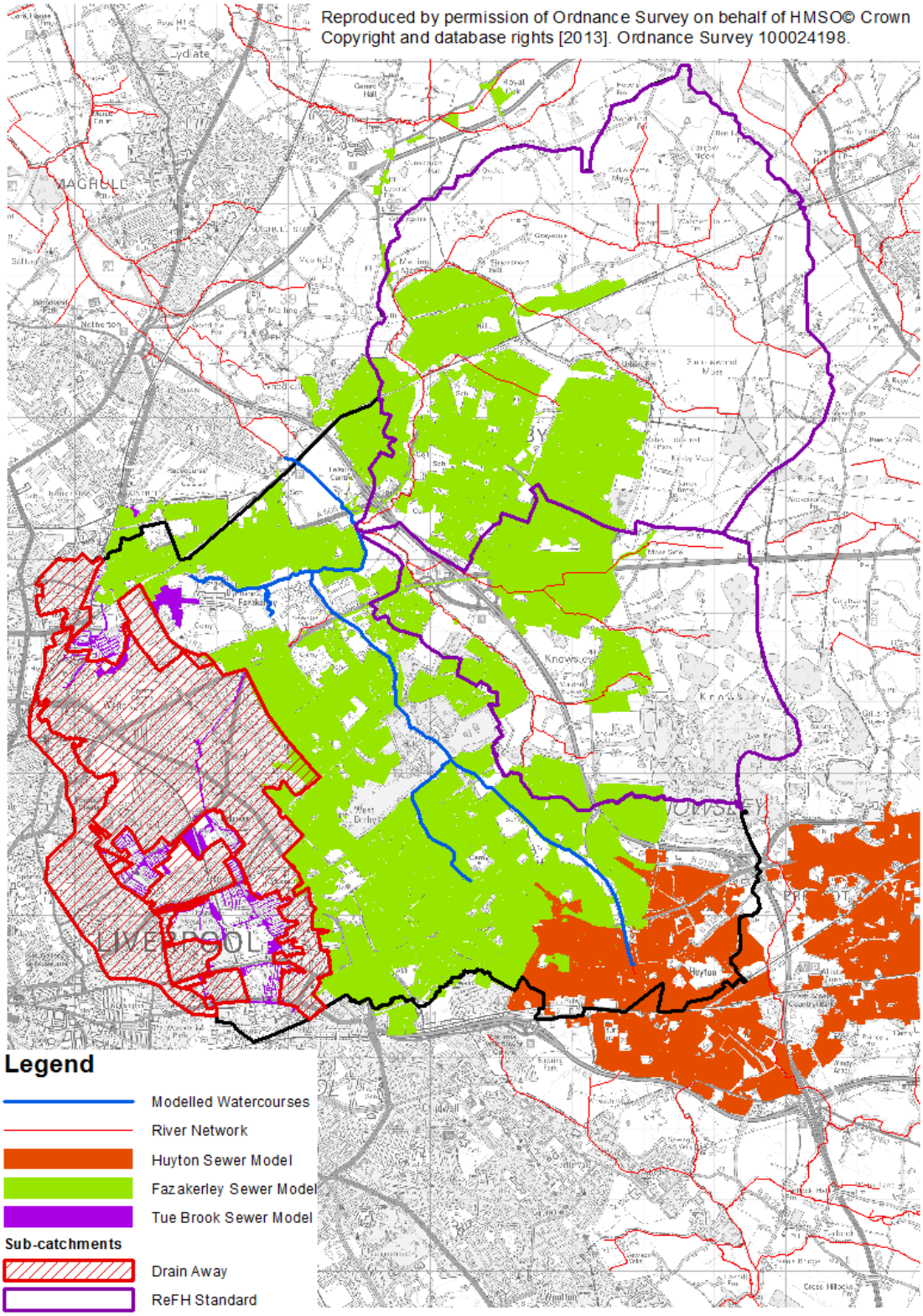
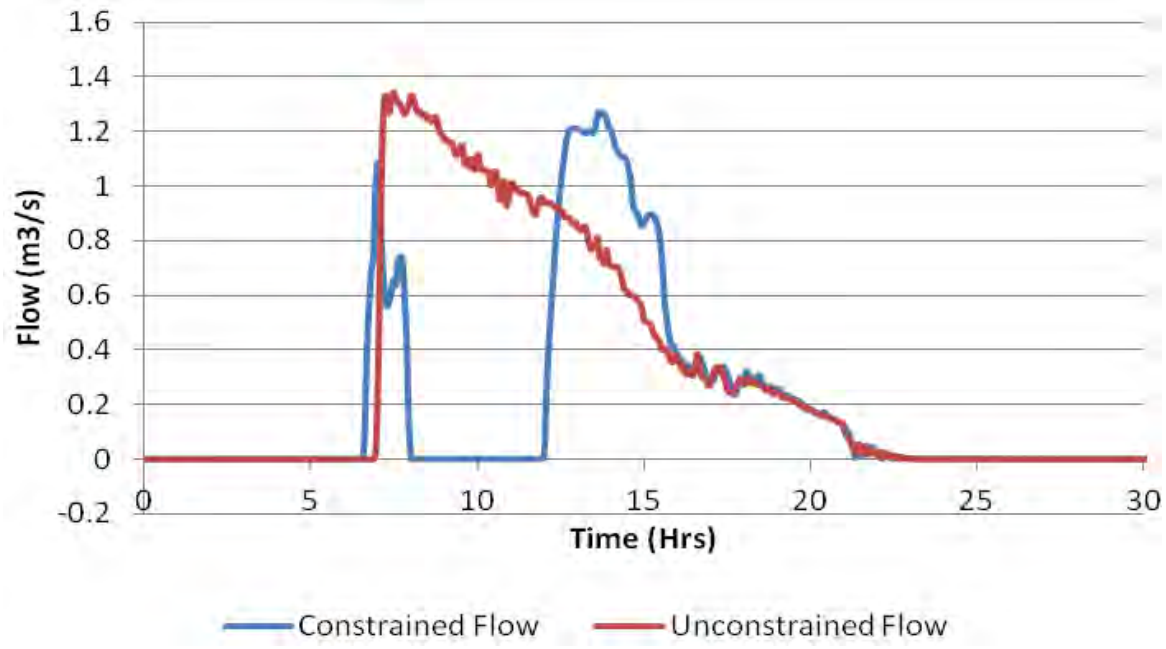


Figure 3-3 Comparison of flows at the outfall at Fazakerley Treatment Works with and without the downstream constraint



Given the remote location of the surface water outfalls on un-modelled sections of Kirkby Brook and Knowsley Brook, outfalls from the sewer models have not been included within the modelling, as doing so directly would not make any allowance of the time of travel of floodwater between the outfall locations and the confluence of these watercourses with the Upper Alt. This decision was taken after initial model runs, that included these urban outfalls directly into the Upper Alt, indicated an initial early peak not observed in the flow record at Kirkby Gauging Station. These catchments have instead been represented by ReFH boundary units that will make some in-direct allowance of travel time.

3.3 Model Calibration

Given the availability of flow data within the catchment at Kirkby Gauging Station, and the adoption of a non-standard hydrological approach, model calibration has been a very important part of the hydrological assessment. The calibration process has utilised the hydraulic model developed to route calculated inflows through the study reach down to Kirkby Gauging Station. The calibration therefore includes both the hydrological and hydraulic components of the modelling, although it is accepted that there is likely to be more uncertainty associated with the hydrology and therefore this has been the focus of the calibration process.

The flood events that have been used to calibrate the model occurred in October 2000, August 2004 and July 2010. These events represent a range of flow conditions in both summer and winter months. Recorded rainfall from the Liverpool North gauge has been used to provide rainfall inputs into both the sewer and ReFH models. The consistent use of the recorded rainfall data at Liverpool North is supported by the similar altitude and rainfall depths recorded at the neighbouring raingauges.

Initial conditions describing the antecedent rainfall and soil moisture were calculated and set for the sewer and ReFH models.

The antecedent precipitation index (API30), required for the New UK routing model in sewer models has been calculated using a 30-day rainfall record prior to each event.

4 Hydraulic Modelling

4.1 General Overview

A linked 1D-2D ISIS-TuFLOW model has been developed as part of the study. The model extends approximately 15.3km along the main watercourses draining through the study area and includes the designated Main River sections of the Upper Alt, Fazakerley Brook, Tue Brook and Deys Brook. Defended and Undefended versions of the model have been developed. The defended model includes the defences present within the study area (outlined in Section 1.2.2) and assumes they remain in place and do not breach during the design events. The undefended model has these defences removed; this is described in more detail in Section 4-6.

The 1D ISIS model represents the river channel and its capacity. It has approximately 662 nodes, with a large number of these units associated with the 65 modelled structures within the study area. The floodplain has been represented using a 2D TuFLOW model that has a total area of approximately 4km^2. The sections below describe the development of both the ISIS and TuFLOW models in more detail.

4.2 ISIS Model Schematisation and Development

A 1D hydraulic model extending along the Main River sections of the Upper Alt, Fazakerley Brook, Tue Brook and Deys Brook has been developed using ISIS software (v3.6). River channel sections were taken from surveyed cross sections collected by Survey Operations Ltd and Maltby Land Surveys Ltd between 2009 and 2011 as outlined in Table 4-1 below. The nomenclature used to label river sections is a combination of watercourse name, reach number and chainage (m from the downstream extent of the reach). In addition to these labels, several suffixes have been used in the form of u....d etc at the upstream and downstream faces of structures. This is similar to the labelling convention adopted by the surveyors, but due to the different times of survey collection, especially along the Upper Alt, node label names differ from the original survey names. To avoid confusion, the original survey labels have been included in the comment fields of river sections to allow cross referencing back to the survey drawings.

Figure 4-1 Upper Alt ISIS Model Schematic (located at the back of the report)

Table 4-1 Watercourse Labelling System

Watercourse Name	Reach (NGR)	ISIS Node Label	Channel Survey
Upper Alt (Huyton to Downstream of A506)	343860, 391328 - 339860, 397666	RALT07_3589 - RALT05_4249	Survey Operations Ltd - March/April 2011
Lower Alt (A506 - Downstream of Kirkby Gauging Station)	339754, 397738 - 339115, 398364	RALT05_4117 - RALT05_3204	Maltby Land Surveys - 2009
Fazakerley Brook	337622, 396770 - 338685, 396581	FAZA01_1932 - FAZA01_0000	Survey Operations Ltd - March 2011
Tue Brook	338745, 396212 - 338704, 396642	TUEB01_0497 - TUEB01_0000	Survey Operations Ltd - March 2011
Deys Brook	341570, 392484 - 341285, 394194	DEYS01_2140 - DEYS01_0000	Survey Operations Ltd - Feb 2010

4.2.1 1D Hydraulic Resistance

Hydraulic resistance within the 1D model has been defined using Manning's n roughness values estimated using photographs provided with the channel survey. Manning's n values have been set on a reach by reach basis and using experienced judgement. The values adopted are summarised in Table 4-2. In the upstream reaches of the Upper Alt, channel

roughness values have been set to 0.035 and represent the silted channel with debris and gravel that characterises the upper section of the River Alt. Further downstream (downstream of the Fazakerley Brook confluence) Manning's n values are increased to 0.040 to represent the additional debris, boulders and submerged vegetation present in the channel. For Fazakerley, Tue and Deys Brook, Manning's n values within the river channel have been set to 0.035.

Table 4-2 Channel and Bank Winter Manning's 'n' Values

Watercourse	Watercourse Labelling	Channel Manning's Values	Bank Manning's Values
Upper Alt	RALT07_3589 - RALT06_0770	0.035	0.040
Upper Alt	RALT06_0760 - RALT06_0000	0.035	0.045
Upper Alt	RALT05_5722 - RALT05_3204	0.04	0.045
Fazakerley	FAZA01_1932 - FAZA01_0000	0.035	0.040
Tue Brook	TUEB01_0497 - TUEB01_0000	0.035	0.040
Deys Brook	DEYS01_2140 - DEYS01_0000	0.035	0.040

4.3 Representation of 1D Structures

Given the urban nature of the Upper Alt system, there are many structures present on the modelled watercourses. These have the potential to affect the predicted flood risk by producing flow constrictions and elevating upstream water levels and therefore it is important that the hydraulic impact these create is reflected within the model.

A total of 65 structures have been included within the model. These comprise a mixture of bridge crossings, culverts and weirs. Full details of how each structure has been modelled are given in the ISIS-TuFLOW Check File included in Appendix C of this report.

The hydraulic modelling completed has identified the following structures as important hydraulic controls:

- Tue Brook Culvert (at TUEB01_0095n). The 10m long, 1.1m diameter culvert is located within the designated wetland area. It has been modelled using an ORIFICE unit, 3 circular CONDUITS and an OUTLET unit. During the 1% AEP event, a head loss of ~600mm is predicted at the structure. Given its location, the culvert does not increase the flood risk to properties.
- West Derby Golf Course Culvert (DEYS01_1184). The culvert is located at the downstream extent of the West Derby Golf Course and flows under a pedestrian walkway. The culvert is 16m long and has an upstream opening area of 2.4m^2. The upstream and downstream surveyed sections show that there is a shape change through the culvert. Without any further information regarding the location of the shape change, it has been assumed to occur halfway through the culvert. The structure has been represented in ISIS using rectangular CONDUIT units as both sections of the culvert retain this shape. Water levels at this culvert are affected by the backwater effect created at the Deysbrook Lane culvert downstream. Significant flooding is predicted upstream of the culvert inundating parts of the golf course.
- Deysbrook Lane Culvert (DEYS01_0931n). The culvert under Deysbrook Lane is 682m long. The culvert inspection report details 7 shape changes within the barrel of the culvert and these have been represented in ISIS using rectangular CONDUIT units. The opening area at the culvert inlet is 3.82m^2. In the 1%AEP event the limited flow capacity of this structure is predicted to create a backwater effect and impacts water levels along a 250m section of Deys Brook upstream.

- Copple House Lane Road Bridge (RALT06_0000n) is located on the Upper Alt approximately 100m downstream of the confluence with Fazakerley Brook. The bridge has been modelled as a culvert because of its length relative to its width. The barrel of the structure varies in shape between the upstream (rectangular) and downstream (sprung arch) surveyed faces of the structure. This has been directly represented within the model using two rectangular units and two sprung arch conduits with the shape change assumed to take place in the middle of the culvert. There is a pipe crossing both upstream and downstream of the bridge. The upstream pipe crossing has been modelled using the USBPR unit and the downstream pipe has been accounted for by setting the soffit level of the ORIFICE unit representing the bridge to the invert level of the pipe. During the 1% AEP event these structures are predicted to generate a 550mm head loss through the structure.

4.4 Boundary Conditions

4.4.1 Model Inflows

Inflows into the model are provided by a mixture of ReFH and Flow-Time (QT) boundaries within ISIS. Twenty one Flow-Time boundaries provide inflow into the model from the sewer and storm drainage systems defined using the UU sewer models. There are a total of 108 outfalls within the study area that have been grouped together based on their geographical proximity to produce the 21 inflow boundaries. Figure 4-3 shows the location of the outfalls along the modelled watercourses relative to the location of the assumed ISIS model inflows. Further details about how the inflows have been grouped and relate back to the UU sewer models are given in the supporting spreadsheet (InfoWorks CS Inputs.xls) that accompanies this report.

The complete length of Deys Brook has been represented as a storm sewer within the UU InfoWorks CS model and hence the predicted flow from the conduits connecting into Deys Brook has been used to provide inflows within the model in this area.

Inflow from the remaining catchment area is represented by ReFH boundary units that either represent the permeable areas within urban catchments (covered by a UU model) or predominantly rural sub-catchments.

Eleven ReFH boundaries have been used to estimate the runoff from the sub catchments that reach the watercourse naturally. Within these boundaries the catchment characteristics of each sub catchment have been modified to remove the areas that drain to the storm or combined sewer system and the URBEXT value has been set to 0 to ensure that resulting area represented by the boundary is rural. Seven of these boundaries represent lateral areas along the modelled watercourses. Lateral inflows are connected to several LATERAL INFLOW units that distribute inflows along each reach. Within the lateral units flows are distributed based on area.

Two ReFH boundaries have been used to represent the inflows from sub-catchments representing the catchment area draining into Kirkby Brook and Knowsley Brook. The representation of these areas is described in Section 3.2 of the report. The ReFH units are summarised in Table 4-3 and are schematised in Figure 4-2 below.

Table 4-3 Upper Alt ReFH Units

Catchment Inflow	ReFH Boundary
Inflows from permeable areas into the Upper Alt at the upstream modelled extent	RALT_US
Lateral inflow into the Alt from permeable areas upstream of the confluence with Deys Brook	LAT_2
Lateral inflow into the Alt from permeable areas downstream of the confluence with Deys Brook	LAT_3
Lateral inflow into the Alt from permeable areas at the downstream modelled extent	LAT7
Lateral inflow into the Alt from permeable areas upstream of Sugar Brook	LAT8
Inflow from permeable areas at the upstream modelled extent of Fazakerley Brook	Fazak_US
Lateral inflow into the Alt from permeable areas between the RALT_US to LAT_2	LAT9
Lateral inflow into the Alt from permeable areas adjacent Tue Brook	Fazak_LAT
Inflow from permeable areas at the upstream modelled extent of Tue Brook	UppTue_Bk
Inflow from permeable areas both at upstream modelled extent of Deys Brook and laterally	Deys_Bk
Represents inflow from the permeable areas flowing into Sugar Brook	Sugar_Bk
Represents inflow from Kirkby Brook	Kirkby_Bk
Represents inflow from Knowsley Brook and Croxteth Brook	Knowsley_Bk

4.4.2 Downstream Boundary

The downstream model boundary is located at the railway crossing immediately downstream of Kirkby Gauging Station. This was considered to be a suitable location to locate the downstream boundary of the model as flow will be constrained within the river channel because of the elevated railway embankment that cuts across the floodplain at this location. The downstream boundary within the model has been configured using a Flow - Head (QHBDY) boundary unit, with the flow-head relationship set using the predicted output from the Lower Alt hydraulic model at the equivalent model node (RALT05_3024).

Figure 4-2 Schematic of ReFH Sub-catchments with Respective Permeable Areas (km^2)

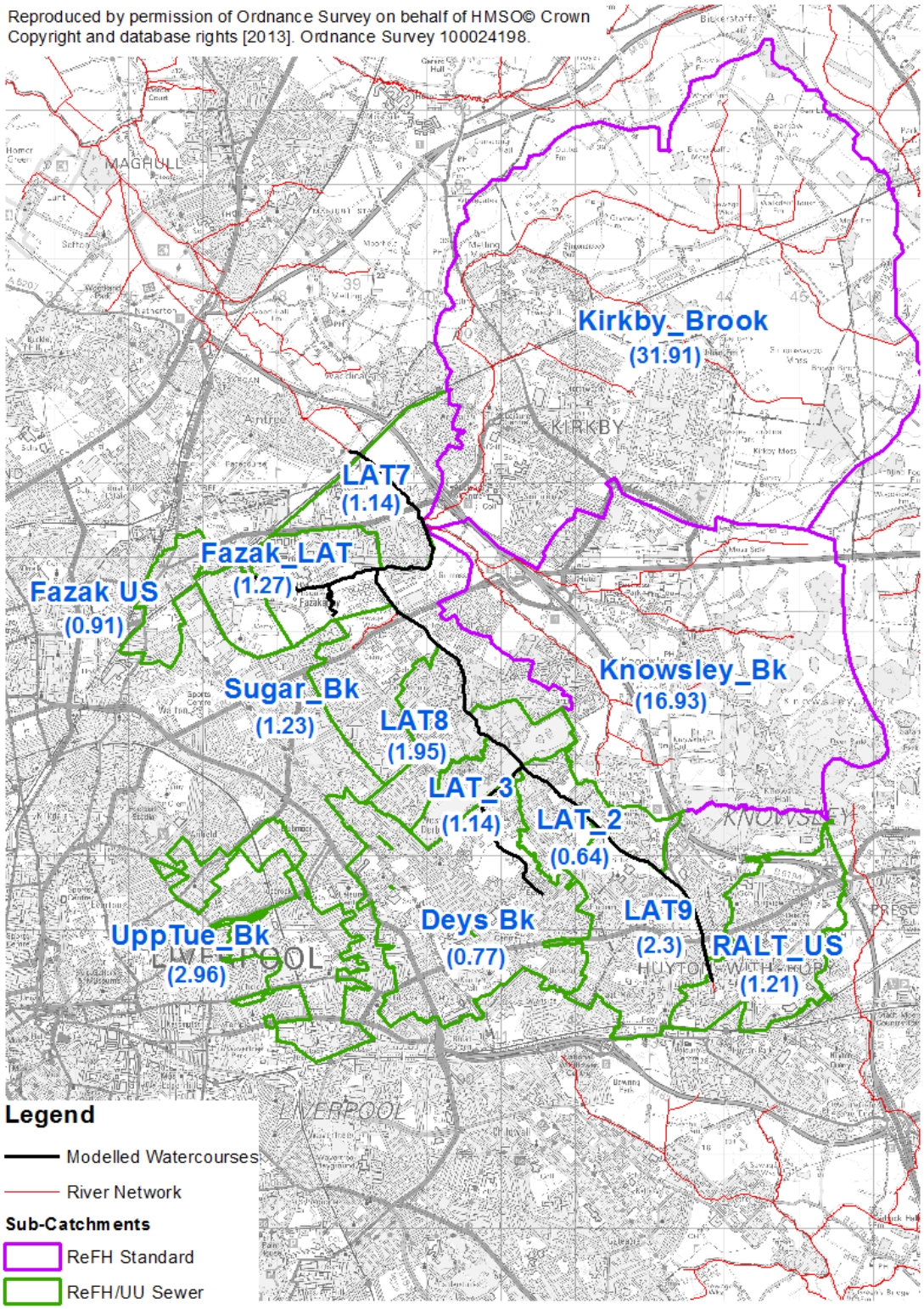
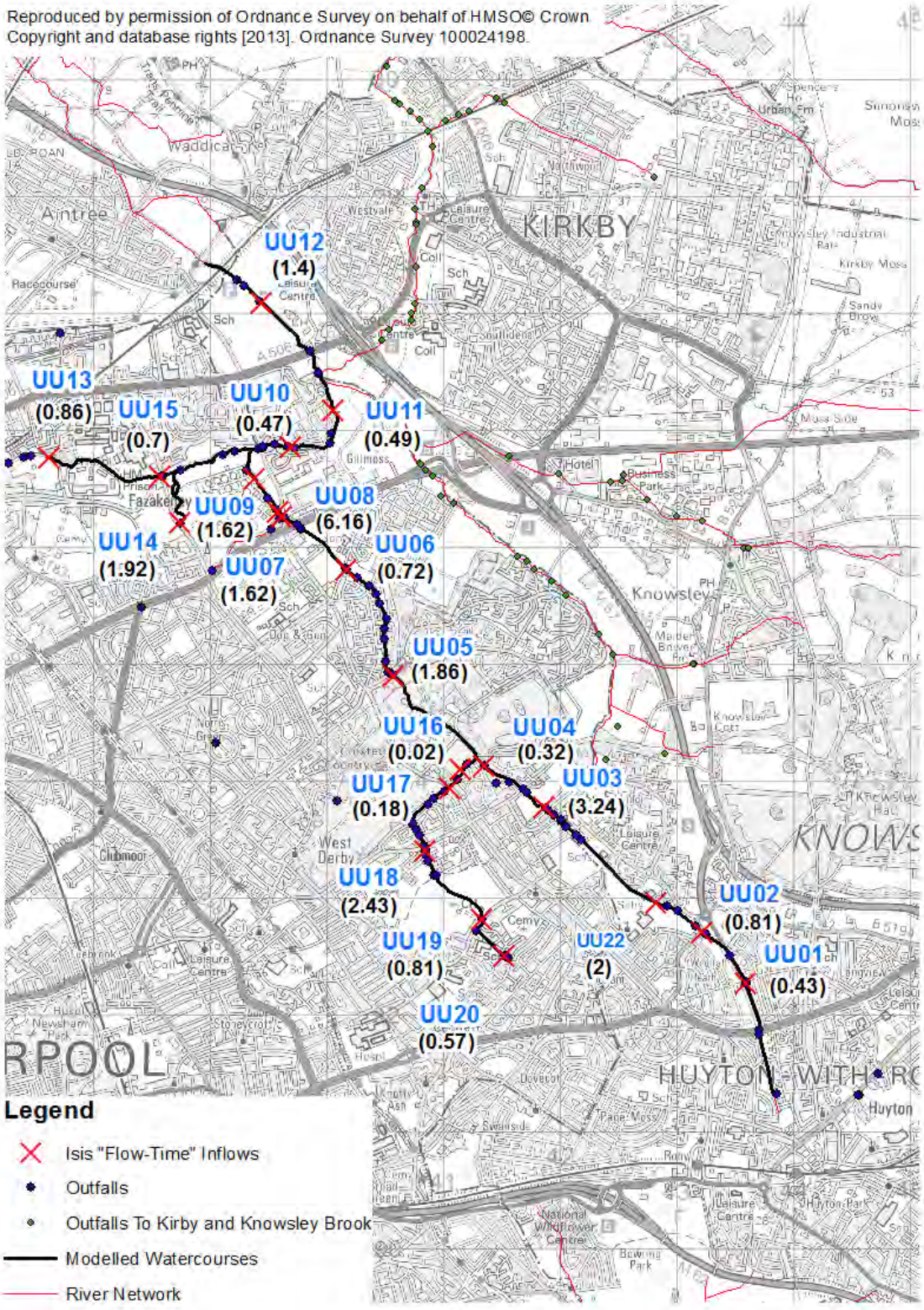


Figure 4-3 Schematic of UU InfoWorks CS model outfalls and ISIS model inflows with their respective 1% AEP Event Peak Flows (m^3/s)



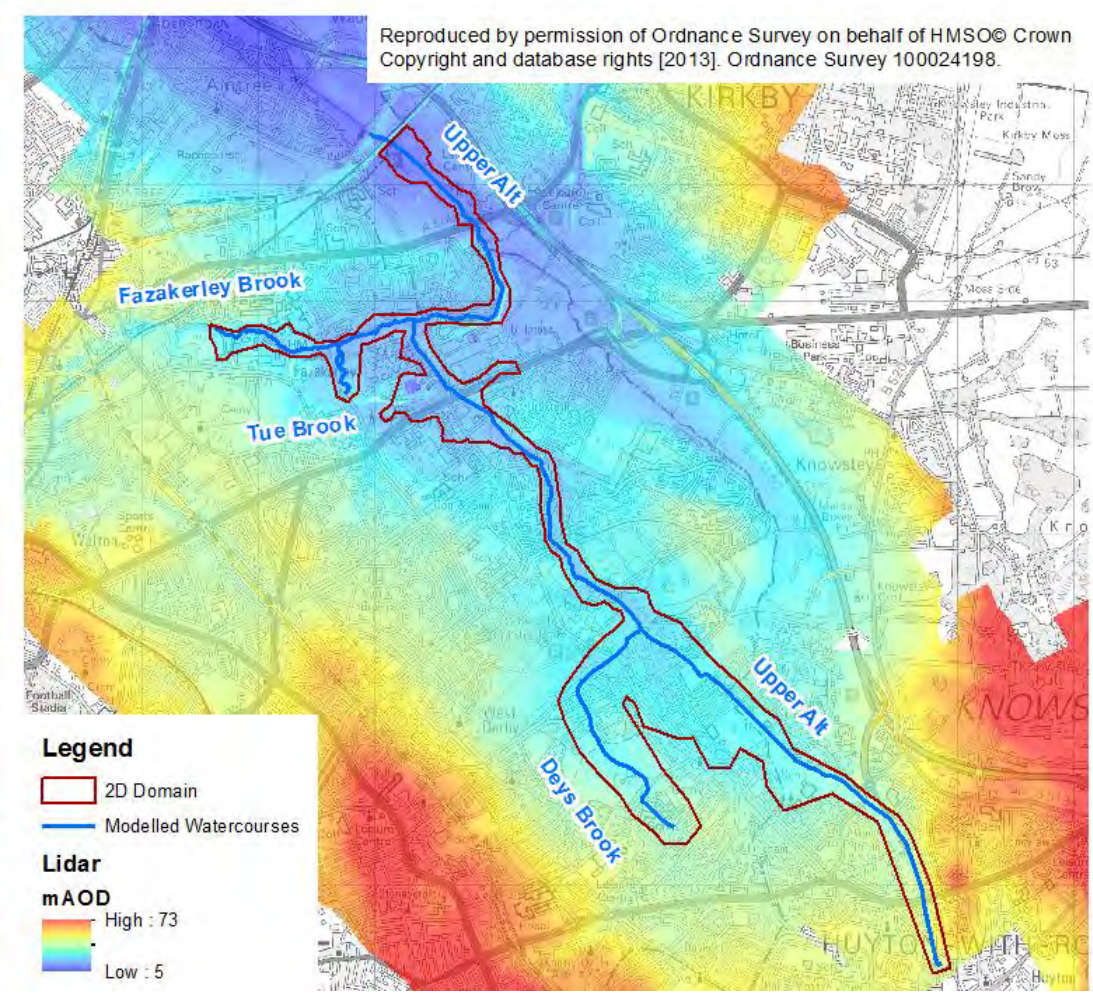
4.5 The 2D Floodplain

A 2D TuFLOW model of the floodplain has been developed for the study using TuFLOW version 2012_05_AB-w64 after the 1D ISIS model indicated that there were several sections where water levels were observed to pass out of bank during high flow events. The use of a 2D floodplain model will more accurately represent the movement of floodwater within the urban area which may be complicated by the presence of buildings and preferential flow routes along key roads. The 2D model developed has been coupled with the 1D model to produce a linked ISIS-TuFLOW model. The development of the 2D model is described in the sections below.

4.5.1 Model Domain

Figure 4-4 below illustrates the 2D model domain within the study area that extends along the watercourses included in the study. The active 2D model domain was initially set using the extreme flood outline (Flood Zone 2) and has been refined as the modelling has progressed on the basis of the underlying topography and the predicted flood extents.

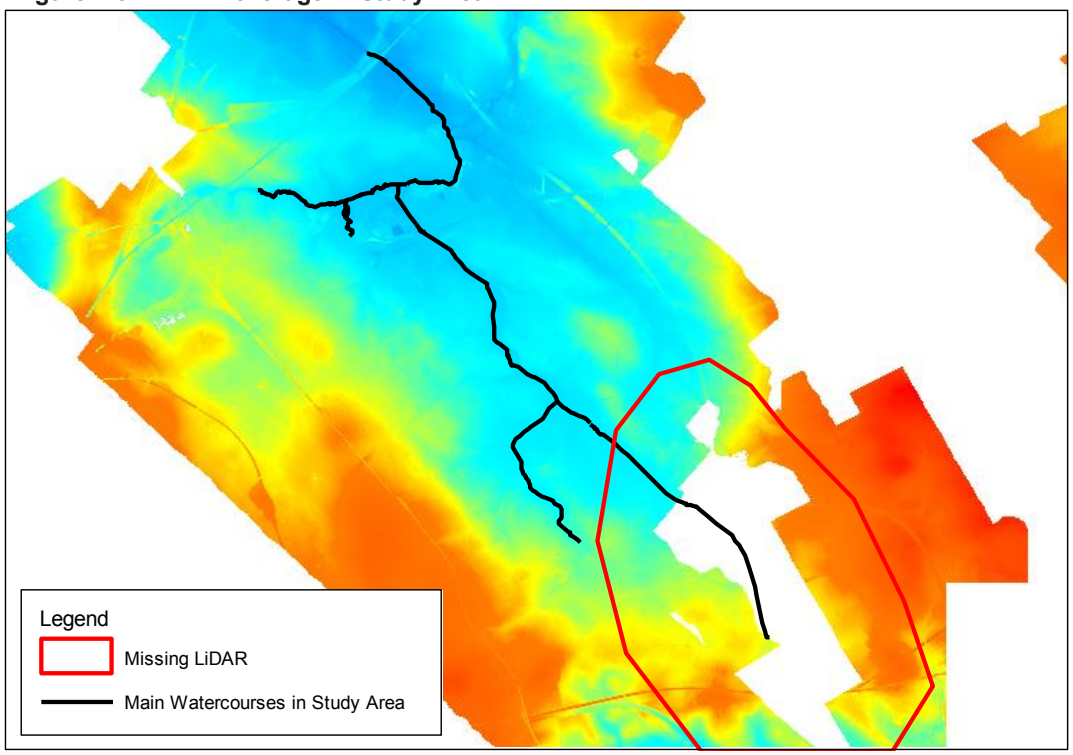
Figure 4-4 Upper Alt 2D Model Schematic



A 4m cell size has been used within the TuFLOW model to represent the underlying floodplain topography. This is considered to be an appropriate cell size to model the flood conveyance along expected flow routes. The impact of adopting a smaller 2m cell size on predicted flow routes within the urban area has been considered as a sensitivity test. This is documented in Section 4.8 of the report.

The 2D model grid has been constructed using 1m resolution filtered LiDAR flown in October 2010 and provided by the Environment Agency for use in the study. LiDAR is available across much of the catchment, although an area of missing data was identified towards the upstream modelled extent on the Upper Alt as shown in Figure 4-5. For the study, this gap has been in-filled using 1m resolution data obtained by the Environment Agency from a third party.

Figure 4-5 LiDAR Coverage in Study Area



4.5.2 ISIS-TuFLOW Linkage

The ISIS-TuFLOW link has been used to link the 1D (ISIS) and 2D (TuFLOW) models. The spill elevation between ISIS and TuFLOW has been constructed by linearly interpolating a bank level (2d_bc_HX_LW_008_pts.MIF) between the surveyed cross sections. Where defences were present the level of the surveyed crest was replaced with an approximate floodplain level at the foot of the defence. The bank heights have been extracted from ISIS using the Tabular CSV tool and imported into MapInfo. The spacing of surveyed cross sections was found to range from ~5m to ~250m and is largely determined by the presence of hydraulic structures.

For the defended model, NFCDD data was used to identify the presence of raised defences within the study area (as outlined in Section 1.2.2). There are three sections of defence included in the model. Crest level information from NFCDD was compared to survey data and LiDAR data at these locations with some deviation identified between the datasets. Following discussion with the Environment Agency the survey data is considered to be the most accurate dataset and has been used to define crest levels within the model. This information has been incorporated into the model using a 2d_zln layer (2d_zln_LWdefence_003) to overwrite the levels representing the natural bank.

The first two sections of defence are approximately 520m long and are located on the left and right banks of the Upper Alt in the vicinity of the Deys Brook confluence. The third defence is 360m long and extends along the right bank of Deys Brook upstream from the confluence with the Upper Alt to the downstream face of the Deysbrook Lane culvert.

The 1D and 2D models are linked via a linear system of HX boundaries within TuFLOW that enables the water levels within the ISIS (1D) and TuFLOW (2D) models to determine the flow across the 1D-2D boundary. These HX lines (2d_bc_HX_LW_008.MIF) have been snapped onto the crest line of the bank (defined above).

For each watercourse an inactive layer (2d_bc_HX_LW_008.MIF) has been used to remove the 1D channel from the 2D domain and avoid double accounting for this within the modelling. During the model review, a check was made to ensure the inactive polygon width matched the active channel width in ISIS.

4.5.3 2D Hydraulic Resistance

Within the 2D model, spatially varying hydraulic roughness values have been defined using OS MasterMap data to distinguish between roads, buildings and open areas via the use of a 2d_mat layer. Buildings were set with an elevated roughness value to slow the movement of water through them as would be the case in reality. Roads, tracks and paths have been set with a lower roughness value to reflect the smoother surfaces that would act as preferential flow routes during an event. Table 4-4 below illustrates the roughness values set for each land use category.

Table 4-4 Upper Alt Floodplain Roughness Values

Landcover Category	Land use Type	Manning's n Roughness Values
1	General natural surfaces	0.050
2	Buildings	1.000
3	Inland water	0.025
4	General mixed (manmade/natural) surfaces	0.050
5	Roads, tracks, paths & pavements	0.025
6	Railway	0.100
7	Non-coniferous woodland & scrubland	0.100
8	Rough grassland	0.075
9	Coniferous trees	0.150
10	General manmade surfaces	0.040
11	Marsh reeds or saltmarsh	0.065
12	Glasseshouses	0.075
13	Rock	0.035
14	Mix of coniferous trees & nonconiferous trees	0.125

4.6 Undefended Model

An undefended version of the model has been configured by removing the 2d_zln layer representing the defence crest level (2d_zln_LWdefence_003) and patching the LiDAR to remove the defences within the dataset.

The inflows and downstream boundary condition used within the model remain unchanged between the defended and undefended versions of the model.

4.7 Model Run Times and Convergence Issues

4.7.1 Run Time Information

The model has been developed using ISIS v3.6 and TuFLOW version 2012-05-AB-w64. The model runs unsteady state with a fixed 1D model timestep of 1s and 2D model timestep of 2s (for linked 1D-2D simulations).

The design event models were run for a 30 hour simulation period. This time period was found to be sufficient to ensure that peak flows within the 1D model and peak water levels within the 2D model were reached and exceeded, although it is not until after 72 hours that the falling limb of the hydrograph returns to the approximate baseflow condition. Given the model

APPENDIX E: EXISTING SCENARIO RESULTS

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DO NOT SCALE

Legend

- Site Boundary

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

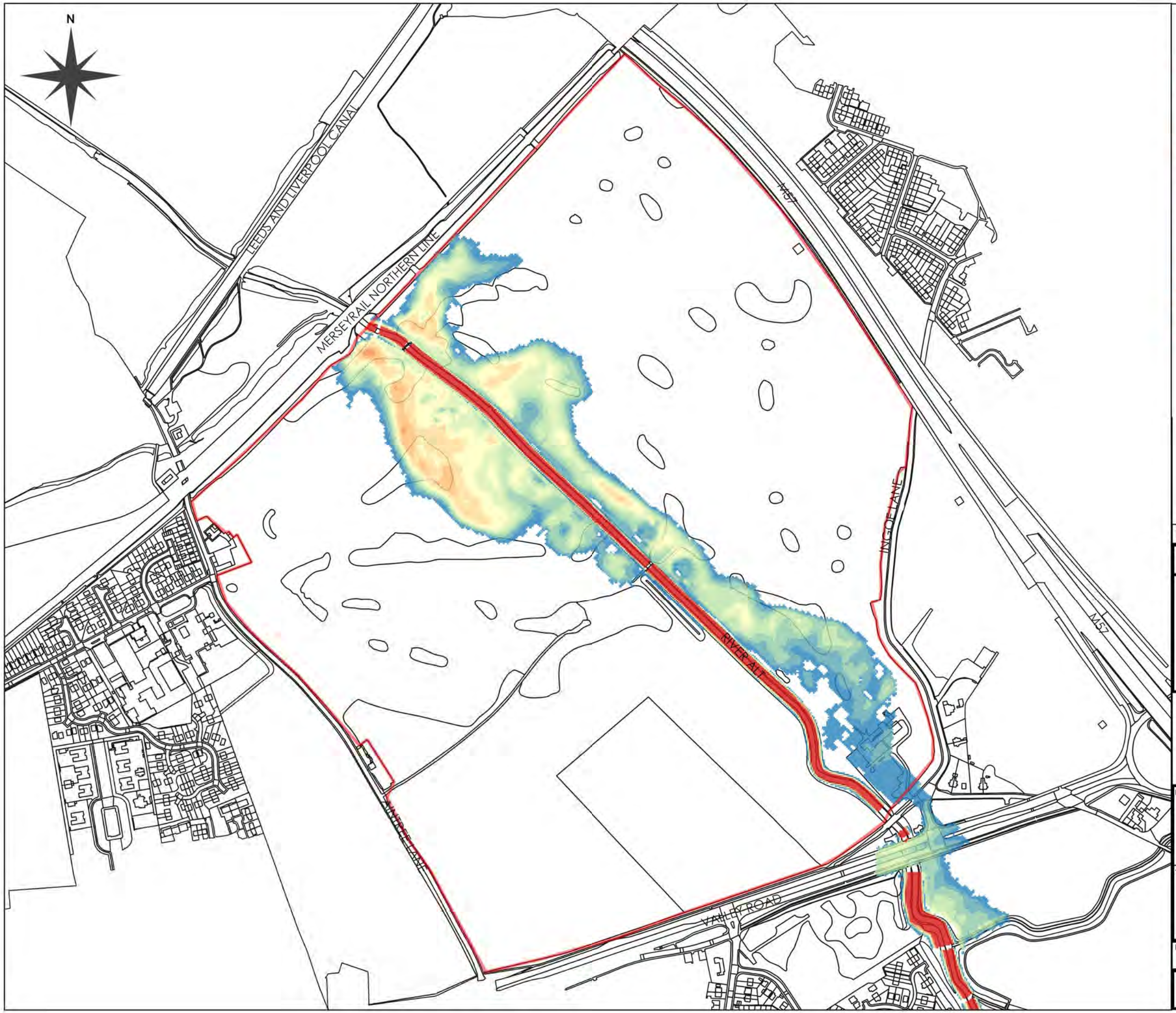
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) EXISTING SCENARIO FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	101	A



DO NOT SCALE

Legend

- Site Boundary

Flood Level (mAOD)

- <11.0
- 11.00 - 11.25
- 11.26 - 11.50
- 11.51 - 11.75
- 11.76 - 12.00
- 12.01 - 12.25
- 12.26 - 12.50
- 12.51 - 12.75
- 12.76 - 13.00
- 13.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

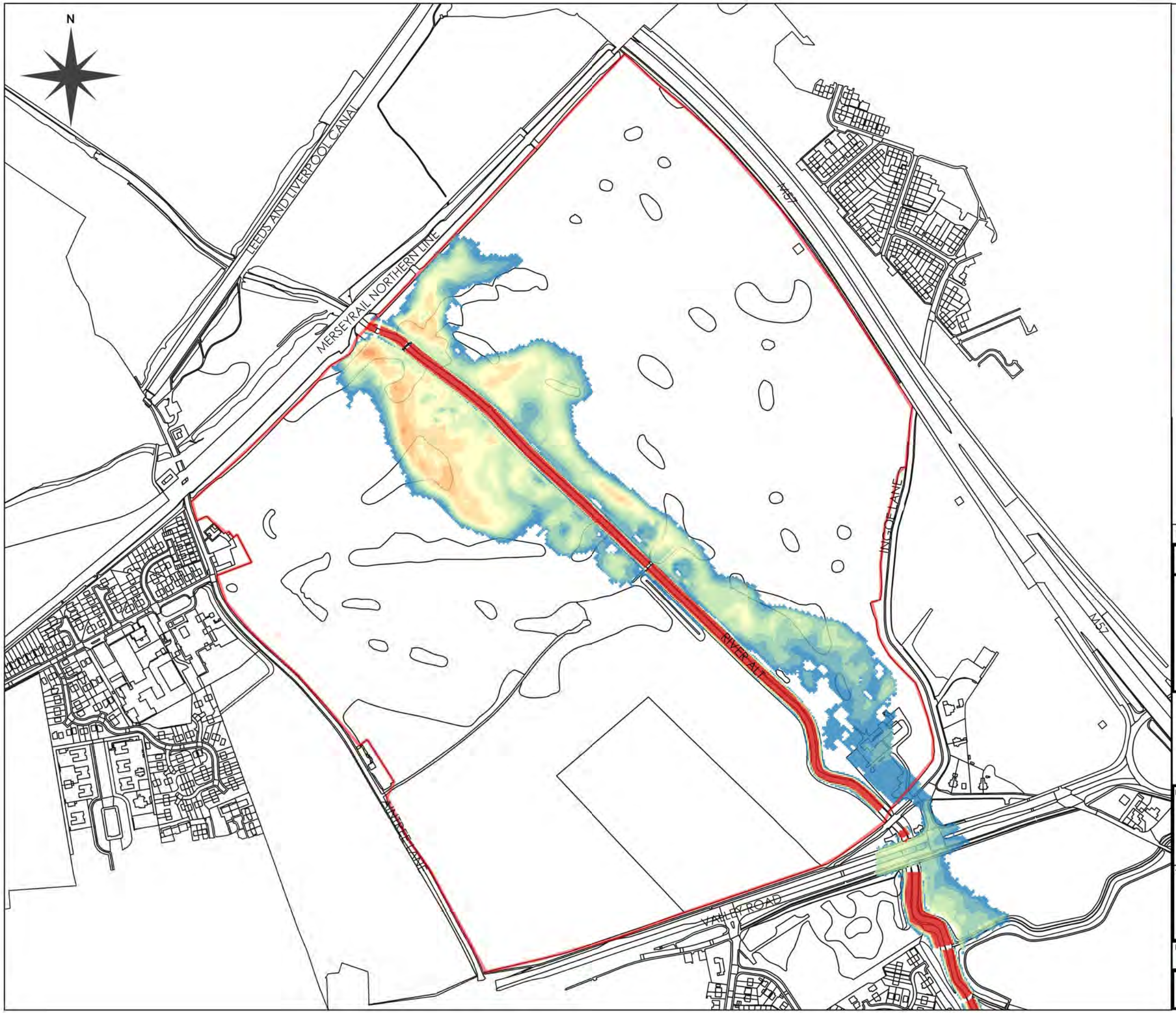
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 0.1% AEP (1 in 1000 YEAR RETURN PERIOD) EXISTING SCENARIO FLOOD LEVEL PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	106	A



DO NOT SCALE

Legend

- Site Boundary

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

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CONSULTING ENGINEERS
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PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 0.1% AEP (1 in 1000 YEAR RETURN PERIOD) EXISTING SCENARIO FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	105	A



DO NOT SCALE

Legend

- Site Boundary

Flood Level (mAOD)

- <11.0
- 11.00 - 11.25
- 11.26 - 11.50
- 11.51 - 11.75
- 11.76 - 12.00
- 12.01 - 12.25
- 12.26 - 12.50
- 12.51 - 12.75
- 12.76 - 13.00
- 13.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

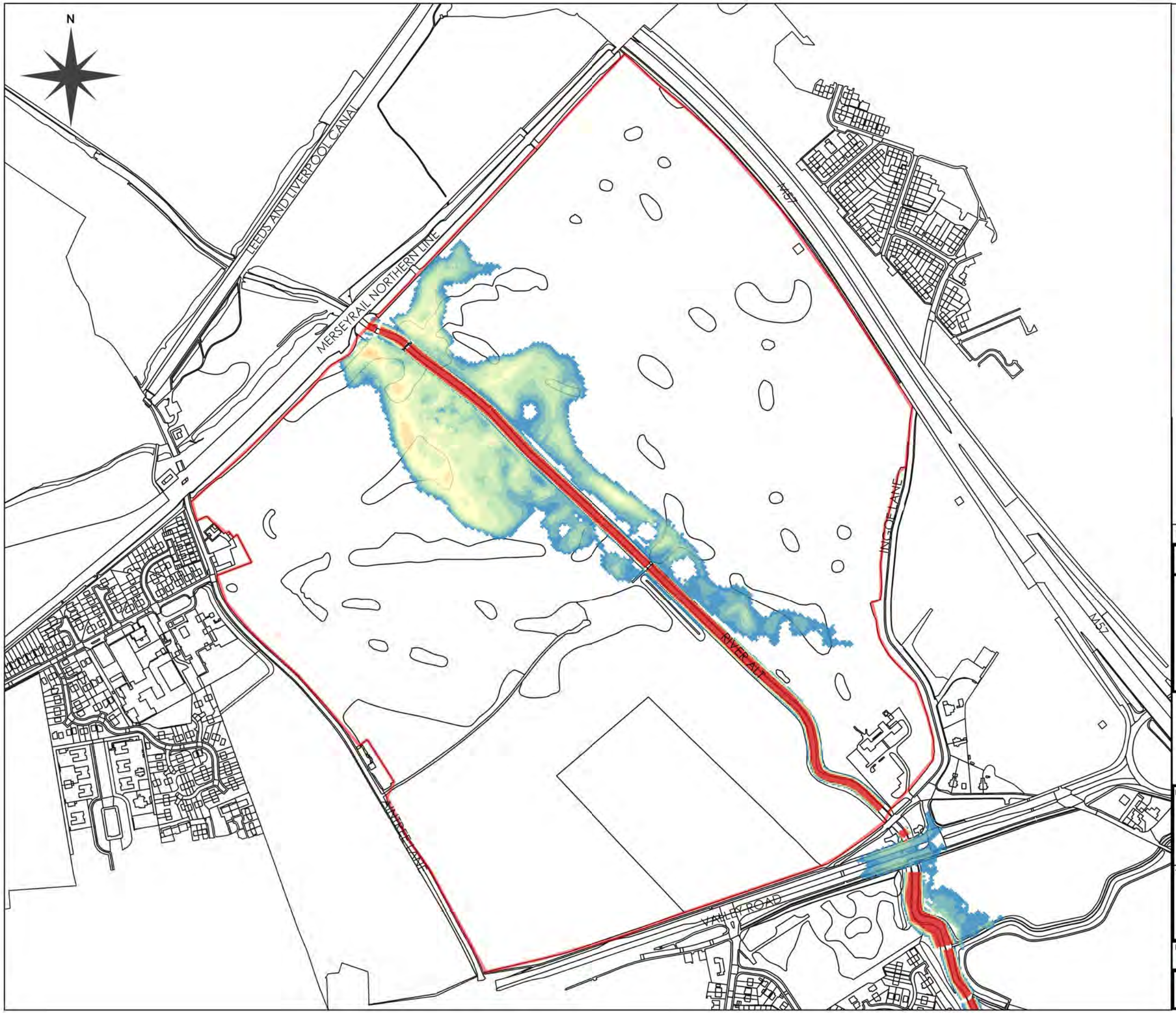
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP + CC (1 in 100 YEAR RETURN PERIOD PLUS 35% CLIMATE CHANGE) EXISTING SCENARIO FLOOD LEVEL PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	104	A



DO NOT SCALE

Legend

- Site Boundary

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

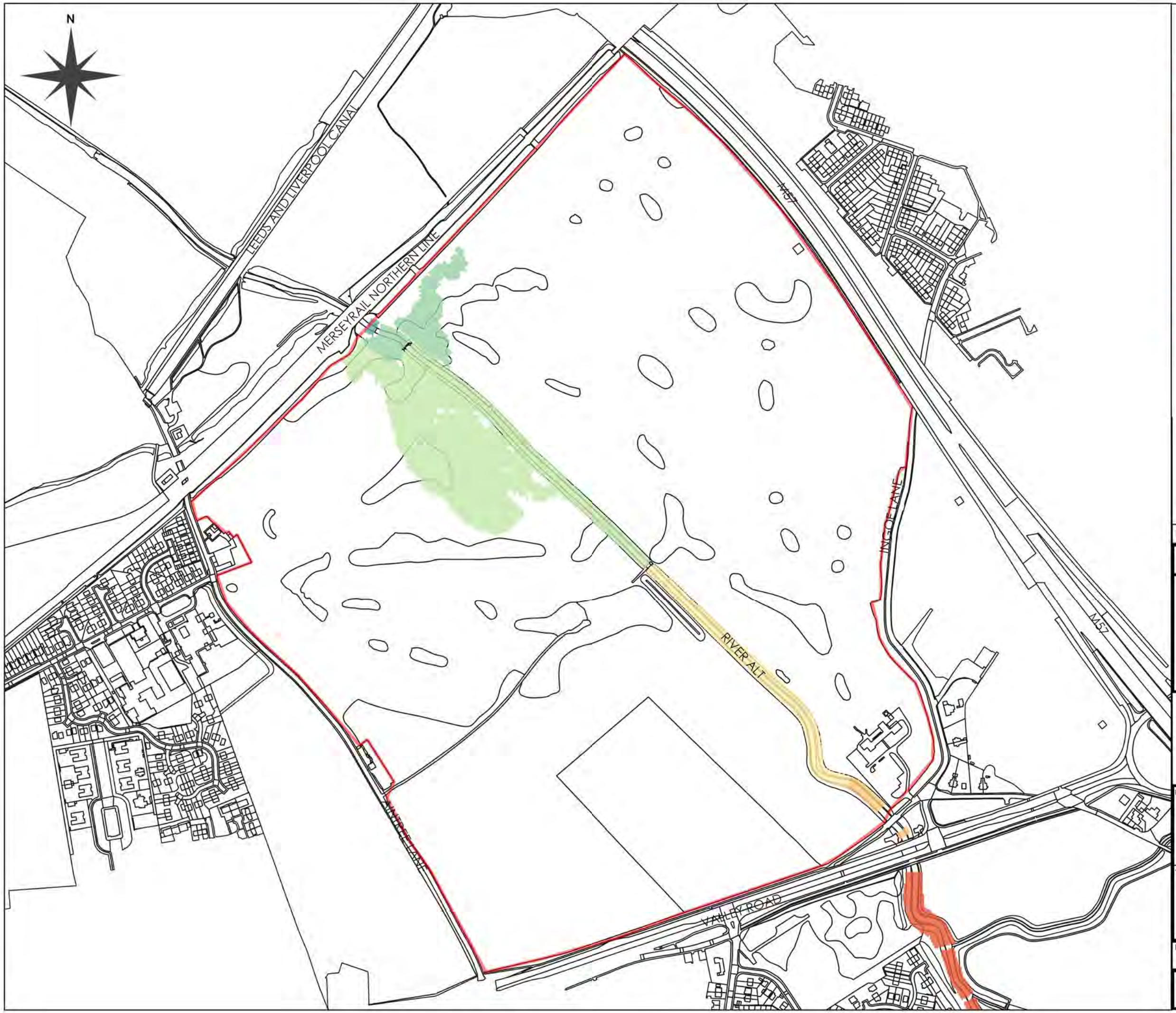
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP + CC (1 in 100 YEAR RETURN PERIOD PLUS 35% CLIMATE CHANGE) EXISTING SCENARIO FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	103	A



DO NOT SCALE

Legend

- Site Boundary

Flood Level (mAOD)

- <11.0
- 11.00 - 11.25
- 11.26 - 11.50
- 11.51 - 11.75
- 11.76 - 12.00
- 12.01 - 12.25
- 12.26 - 12.50
- 12.51 - 12.75
- 12.76 - 13.00
- 13.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

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CONSULTING ENGINEERS
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PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) EXISTING SCENARIO FLOOD LEVEL PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	102	A

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APPENDIX F: PROPOSED BRIDGE SCENARIO RESULTS

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DO NOT SCALE

Legend

- Site Boundary
- Proposed Bridge

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

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CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

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PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) WITH PROPOSED BRIDGE FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	107	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Bridge

Flood Level (mAOD)

- <11.0
- 11.00 - 11.25
- 11.26 - 11.50
- 11.51 - 11.75
- 11.76 - 12.00
- 12.01 - 12.25
- 12.26 - 12.50
- 12.51 - 12.75
- 12.76 - 13.00
- 13.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

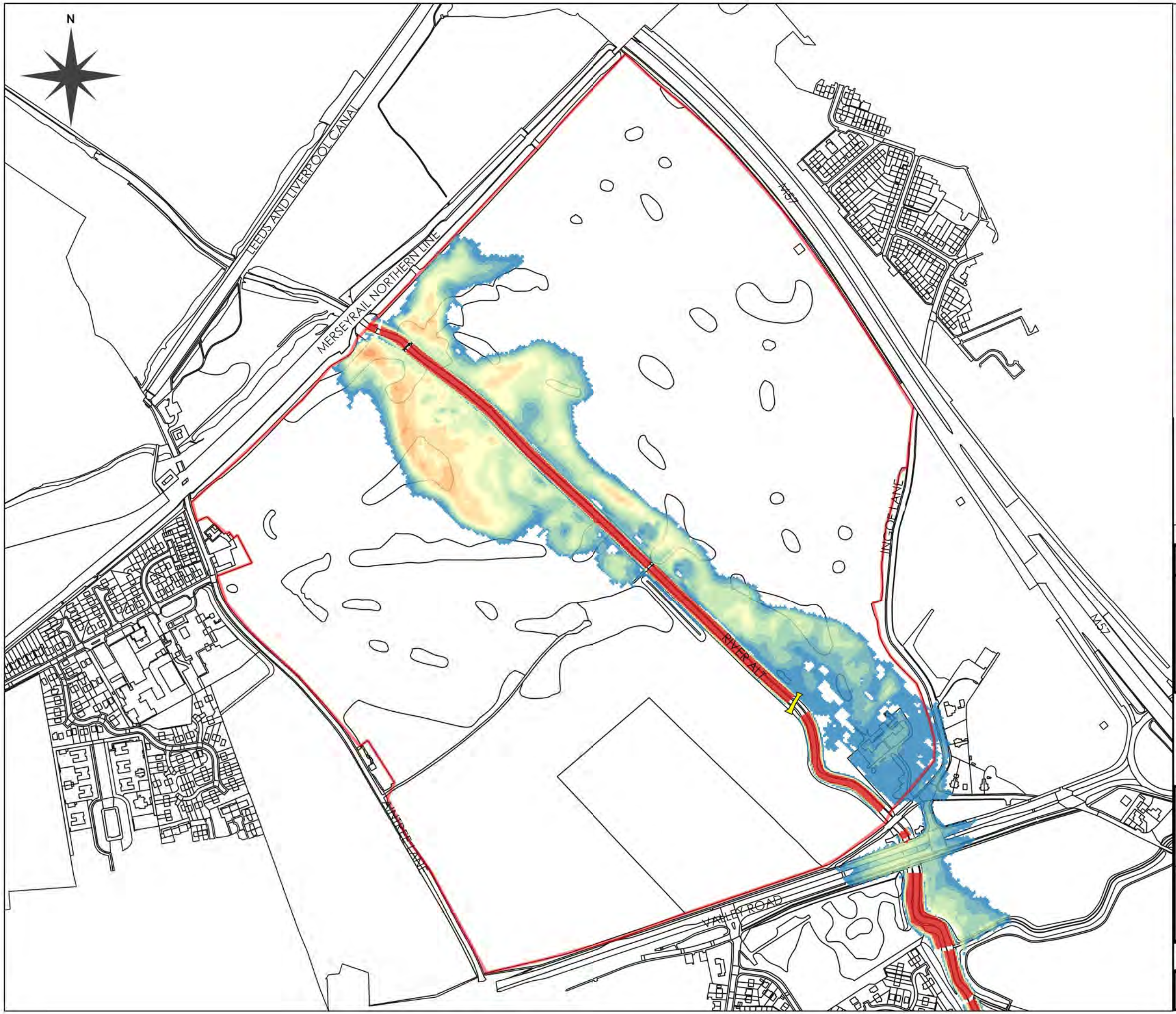
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 0.1% AEP (1 in 1000 YEAR RETURN PERIOD) WITH PROPOSED BRIDGE FLOOD LEVEL PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	112	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Bridge

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

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PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 0.1% AEP (1 in 1000 YEAR RETURN PERIOD) WITH PROPOSED BRIDGE FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	111	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Bridge

Flood Level (mAOD)

- <11.0
- 11.00 - 11.25
- 11.26 - 11.50
- 11.51 - 11.75
- 11.76 - 12.00
- 12.01 - 12.25
- 12.26 - 12.50
- 12.51 - 12.75
- 12.76 - 13.00
- 13.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

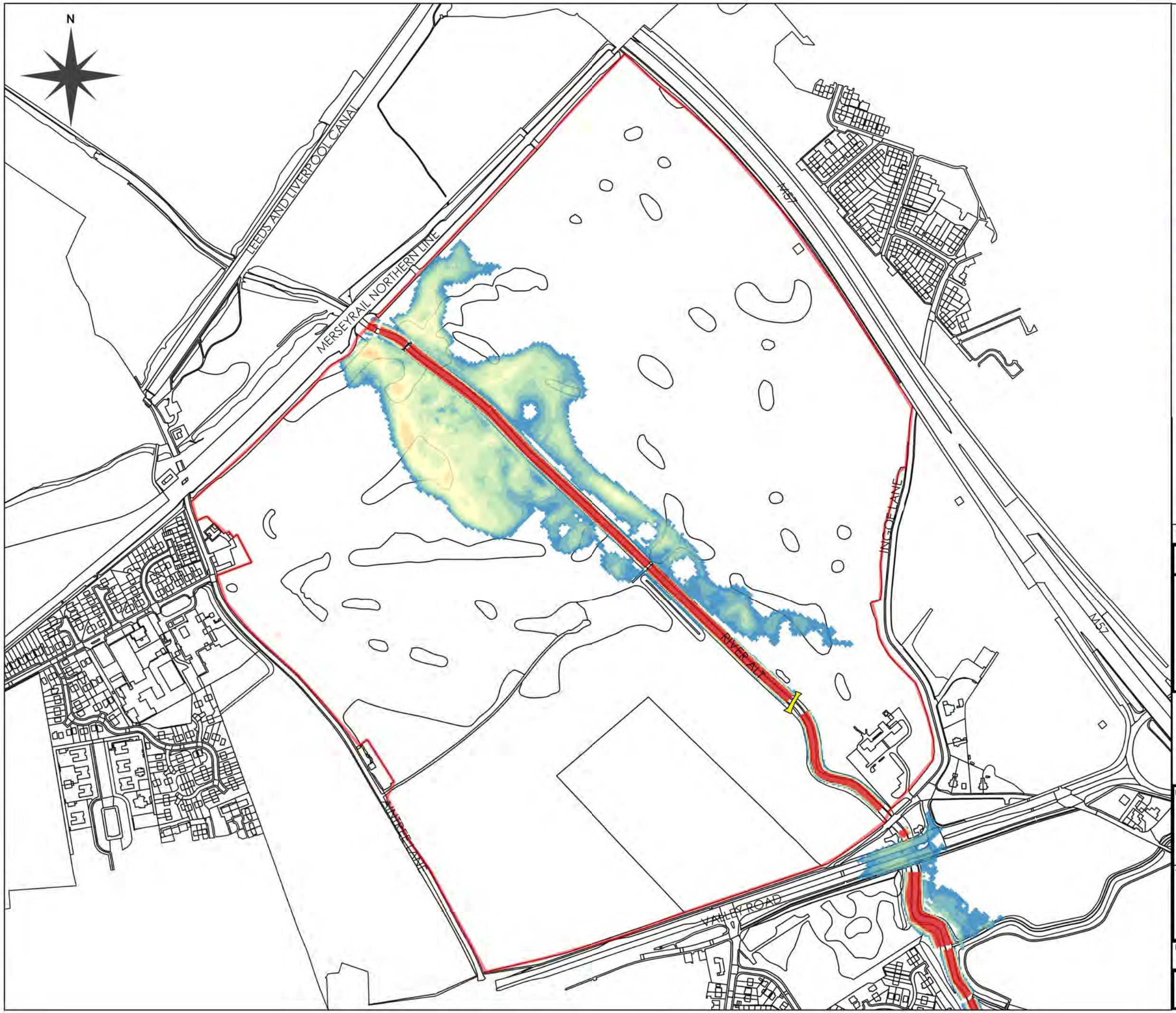
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP + CC (1 in 100 YEAR RETURN PERIOD PLUS 35% CLIMATE CHANGE) WITH PROPOSED BRIDGE FLOOD LEVEL PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	110	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Bridge

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

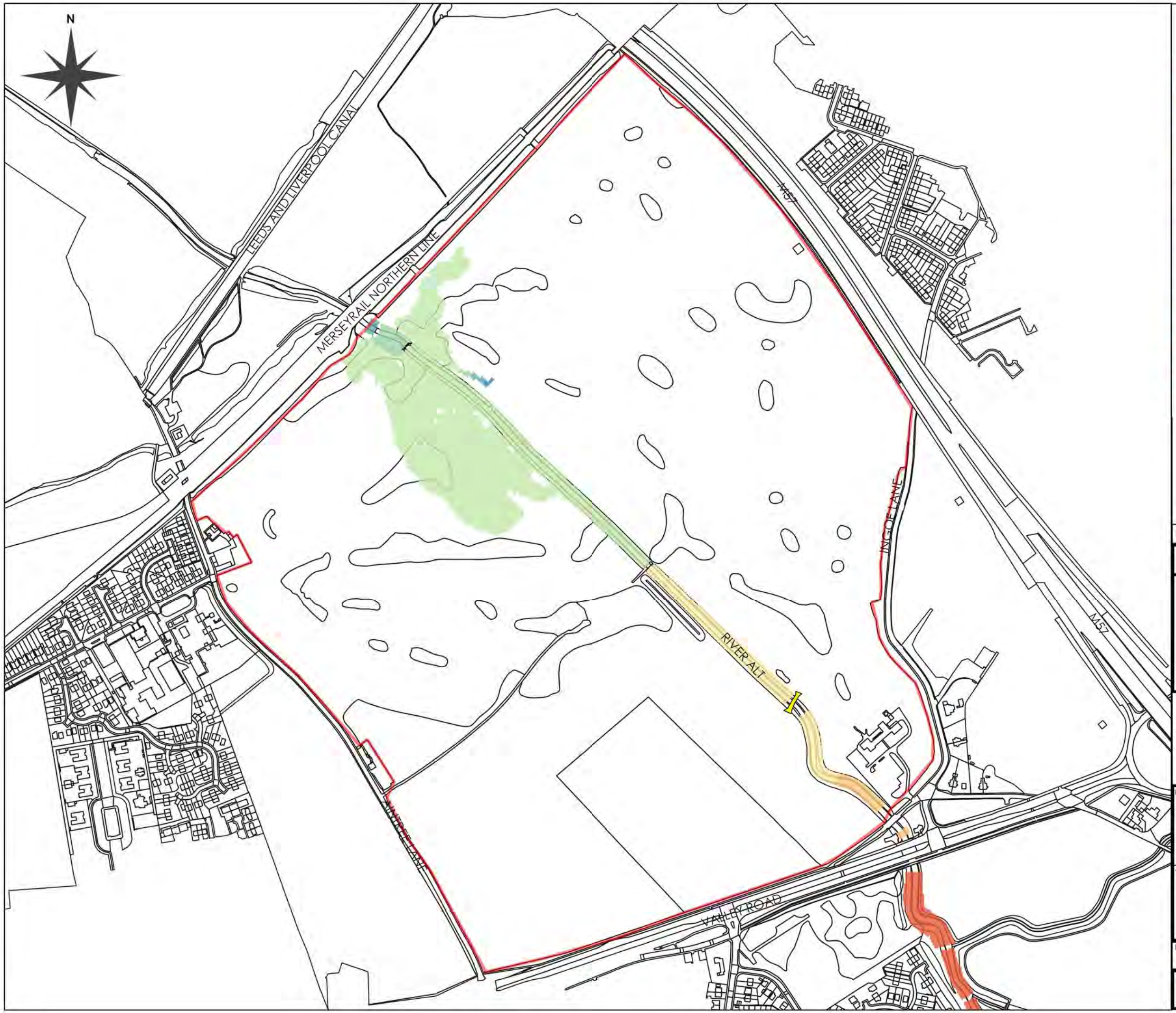
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP + CC (1 in 100 YEAR RETURN PERIOD PLUS 35% CLIMATE CHANGE) WITH PROPOSED BRIDGE FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	109	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Bridge

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	11/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) WITH PROPOSED BRIDGE FLOOD LEVEL PLAN

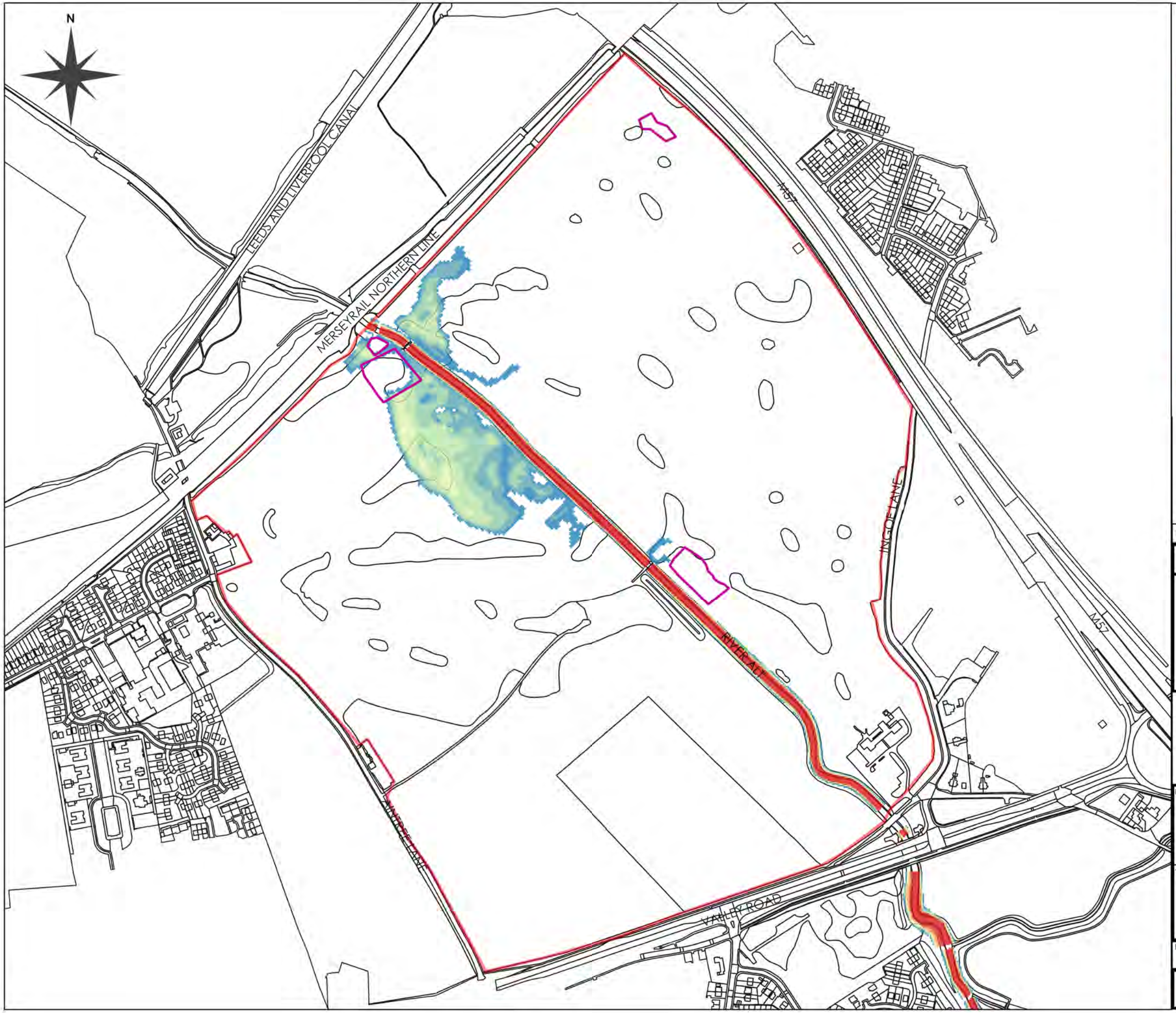
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	108	A

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APPENDIX G: PROPOSED COURSE ALTERATIONS SCENARIO RESULTS

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DO NOT SCALE

Legend

- Site Boundary
- Porposed Course Alterations (levels changing)

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	20/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

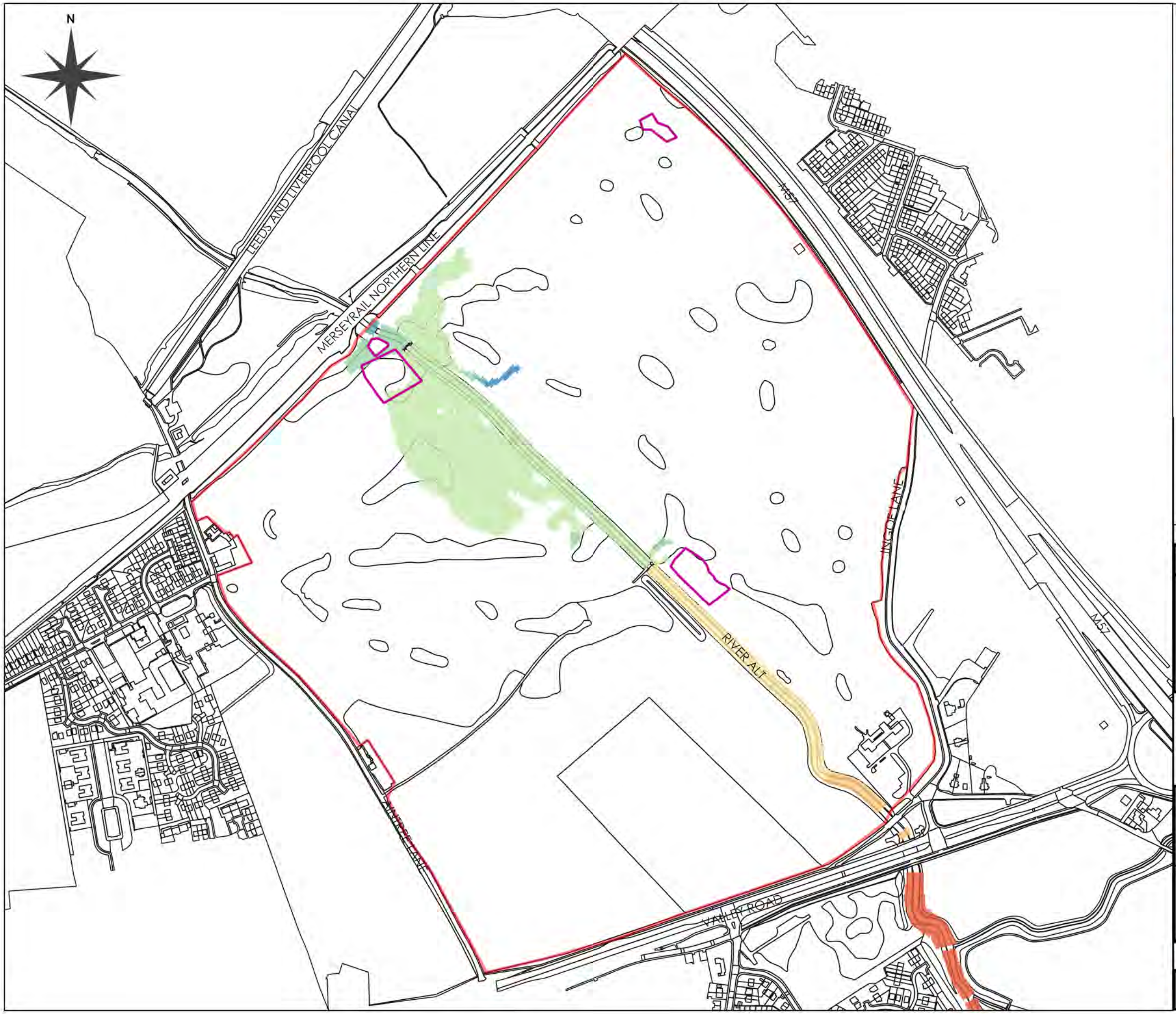
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) WITH COURSE ALERATIONS FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	113	A



DO NOT SCALE

Legend

- Site Boundary
- Porposed Course Alterations (levels changing)

Flood Level (mAOD)

- <11.0
- 11.00 - 11.25
- 11.26 - 11.50
- 11.51 - 11.75
- 11.76 - 12.00
- 12.01 - 12.25
- 12.26 - 12.50
- 12.51 - 12.75
- 12.76 - 13.00
- 13.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	20/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

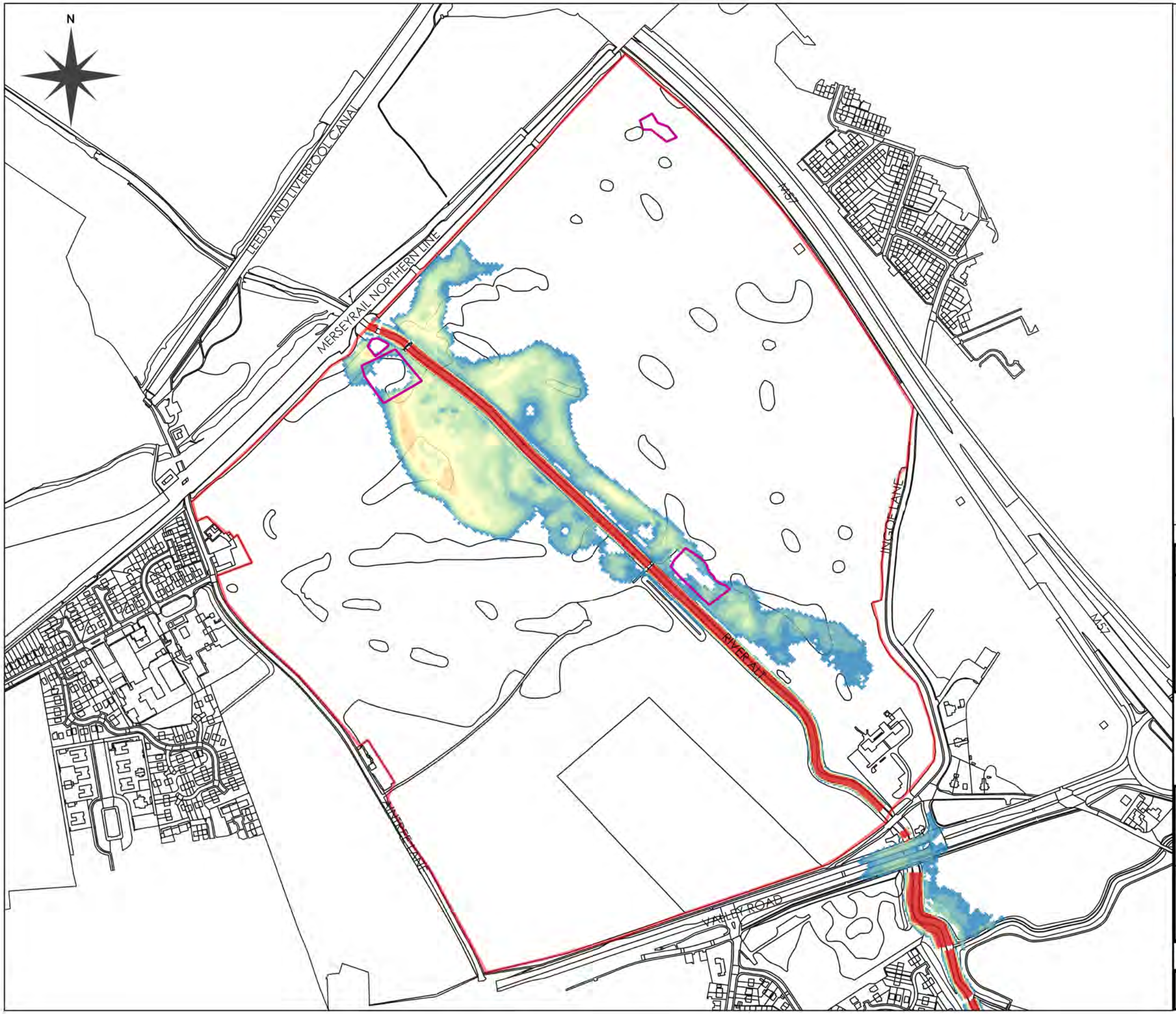
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) WITH COURSE ALERATIONS FLOOD LEVEL PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	114	A



DO NOT SCALE

Legend

- Site Boundary
- Porposed Course Alterations (levels changing)

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	22/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

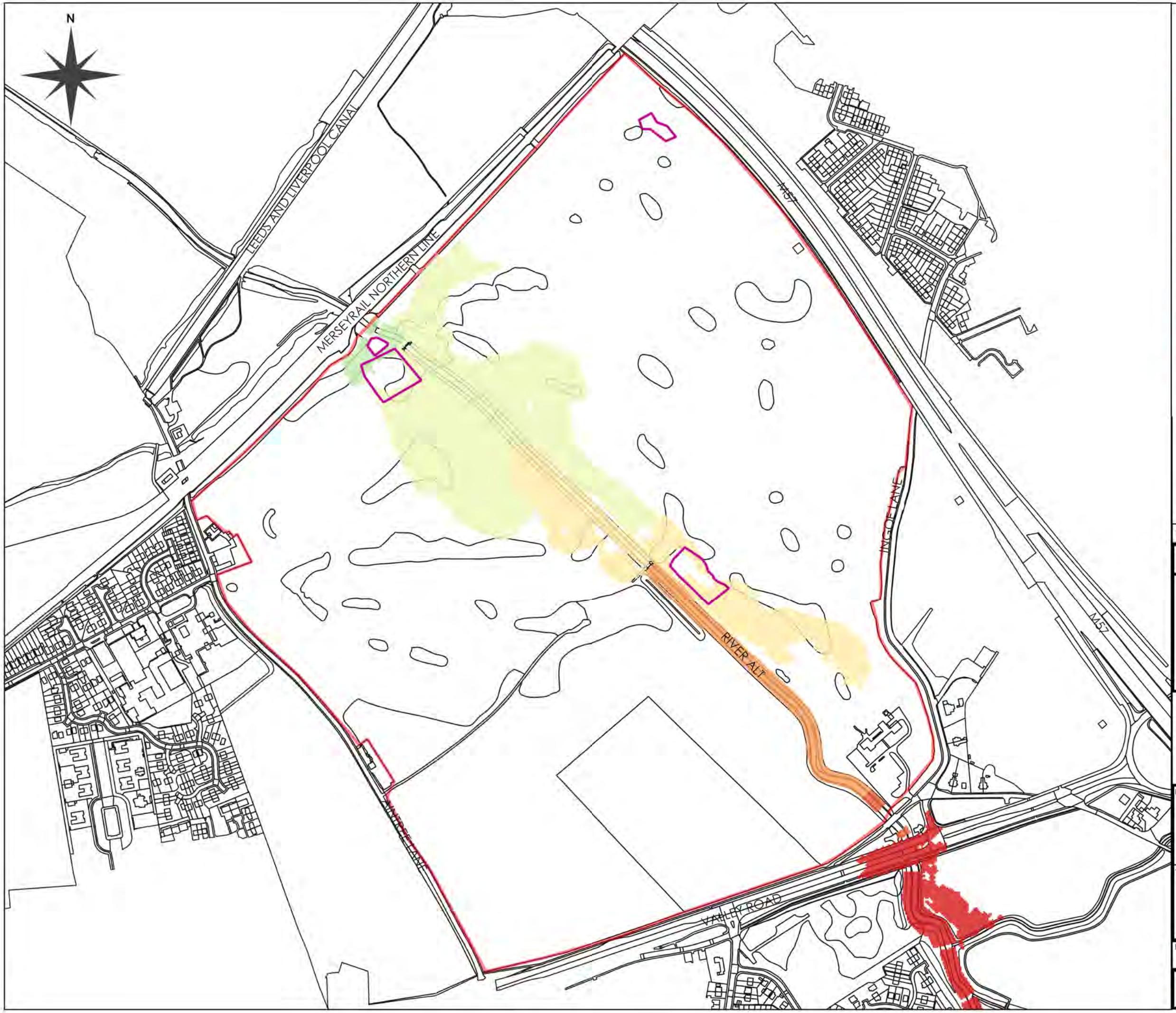
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP + CC (1 in 100 YEAR RETURN PERIOD PLUS 35% CLIMATE CHANGE) WITH COURSE ALTERATIONS FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	115	A



DO NOT SCALE

Legend

- Site Boundary
- Porposed Course Alterations (levels changing)

Flood Level (mAOD)

- <11.0
- 11.00 - 11.25
- 11.26 - 11.50
- 11.51 - 11.75
- 11.76 - 12.00
- 12.01 - 12.25
- 12.26 - 12.50
- 12.51 - 12.75
- 12.76 - 13.00
- 13.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	22/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

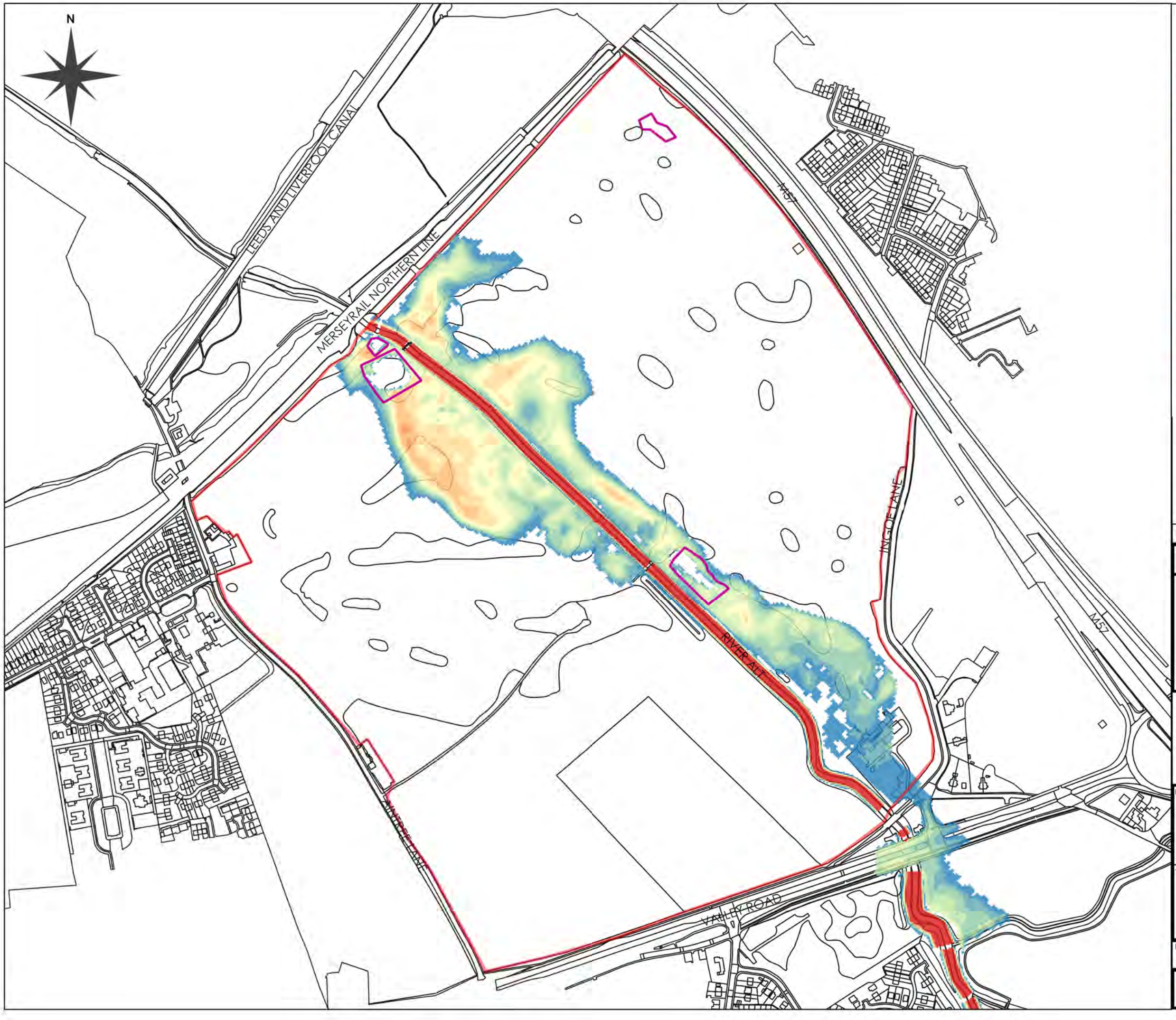
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP + CC (1 in 100 YEAR RETURN PERIOD PLUS 35% CLIMATE CHANGE) WITH COURSE ALTERATIONS FLOOD LEVEL PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	116	A



DO NOT SCALE

Legend

- Site Boundary
- Porposed Course Alterations (levels changing)

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	20/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 0.1% AEP (1 in 1000 YEAR RETURN PERIOD) WITH COURSE ALERATIONS FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	117	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Course Alterations (levels changing)

Flood Level (mAOD)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	20/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

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CONSULTING ENGINEERS
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PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 0.1% AEP (1 in 1000 YEAR RETURN PERIOD) WITH COURSE ALERATIONS FLOOD LEVEL PLAN

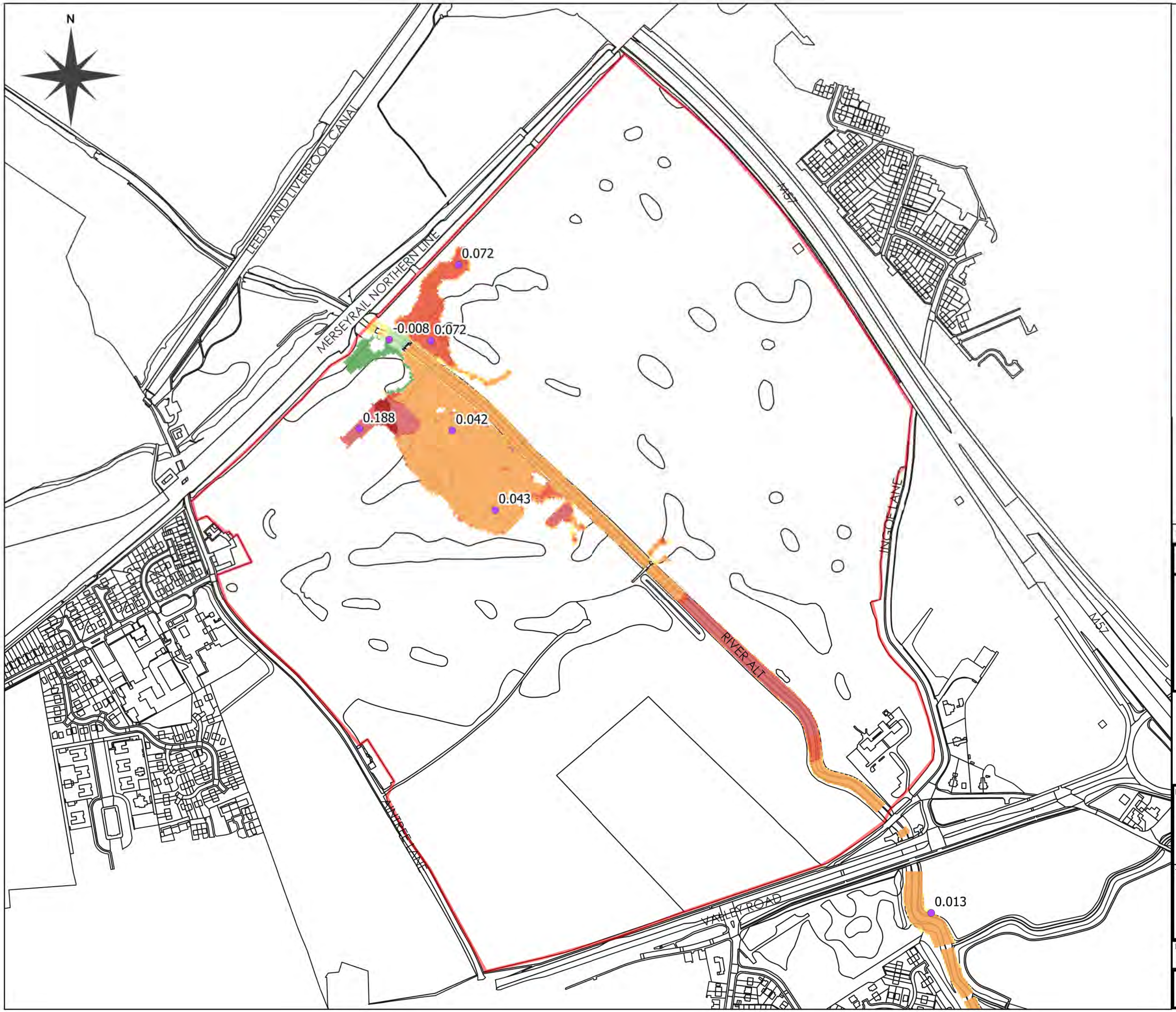
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	118	A

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APPENDIX H: DEPTH DIFFERENCE PLANS

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DO NOT SCALE

Legend

- Site Boundary

Depth Difference (m)

- -4.0 to -1.0
- -0.99 to -0.05
- -0.049 to -0.02
- -0.019 to -0.005
- -0.0049 to 0
- 0
- 0 to 0.0049
- 0.005 to 0.009
- 0.010 to 0.050
- 0.050 to 0.100
- 0.100 to 0.500
- 0.500 - 1.500
- Spot Depths (m)

REV	DATE	BY	DESCRIPTION	CHK
A	27/11/19	PT	PRELIMINARY	DK

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PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) PROPOSED MITIGATION RELATIVE TO EXISTING SCENARIO DEPTH DIFFERENCE PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	205	A

APPENDIX I: MITIGATION PLANS

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DO NOT SCALE

Legend

🟥 Site Boundary

● Proposed Levels

REV	DATE	BY	DESCRIPTION	CHK
A	28/11/19	PT	PRELIMINARY	DK

DRAWING STATUS:

PRELIMINARY

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PROJECT:

KIRKBY VALLEY GOLF COURSE

TITLE:

PROPOSED COMPENSATORY STORAGE LEVELS

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:1000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	198	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Course Alterations (levels changing)
- Compensatory Flood Storage

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	28/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

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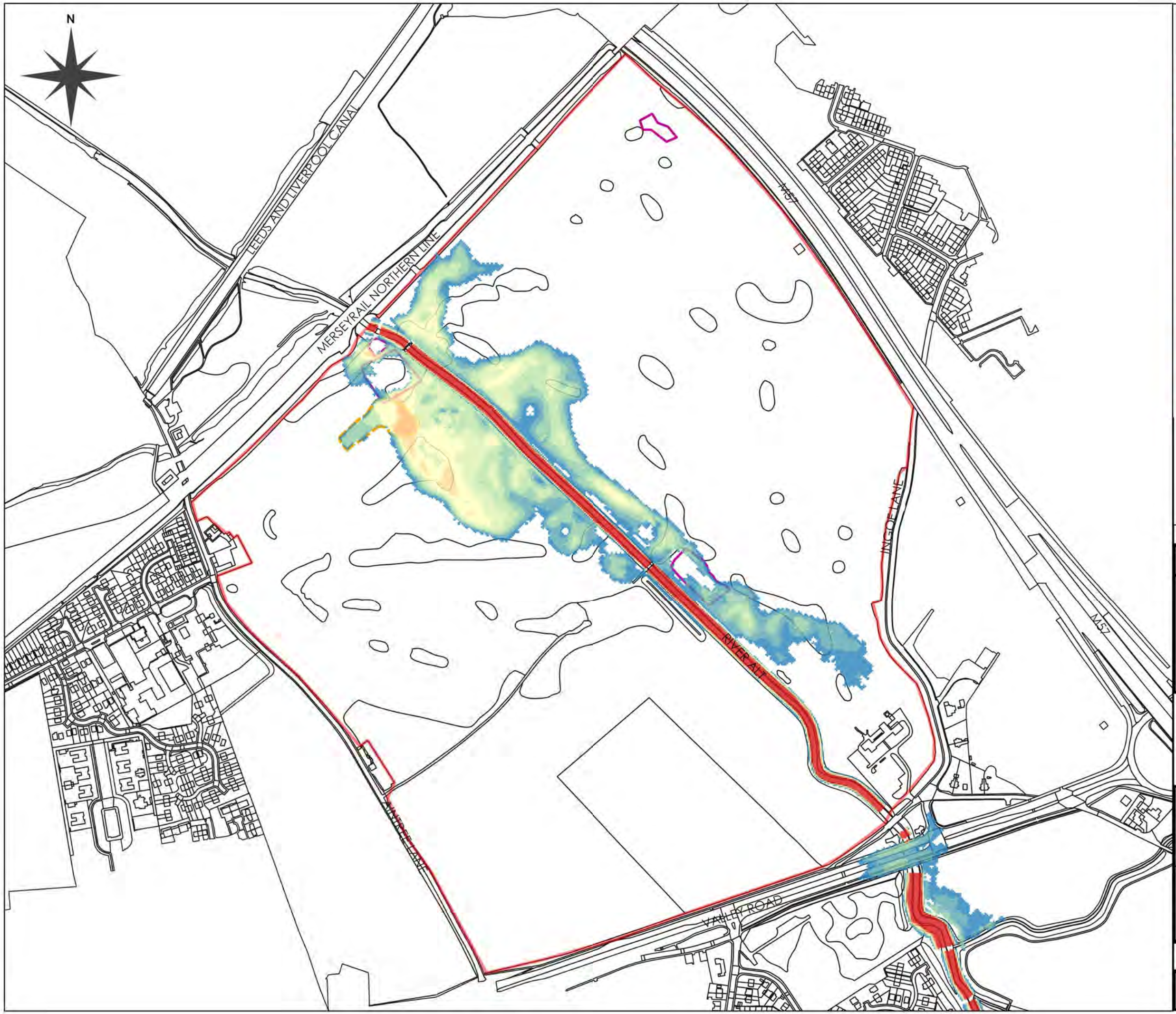
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 1% AEP (1 in 100 YEAR RETURN PERIOD) COURSE ALTERATIONS AND COMPENSATORY STORAGE FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	206	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Course Alterations (levels changing)
- Compensatory Flood Storage

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	28/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

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CONSULTING ENGINEERS
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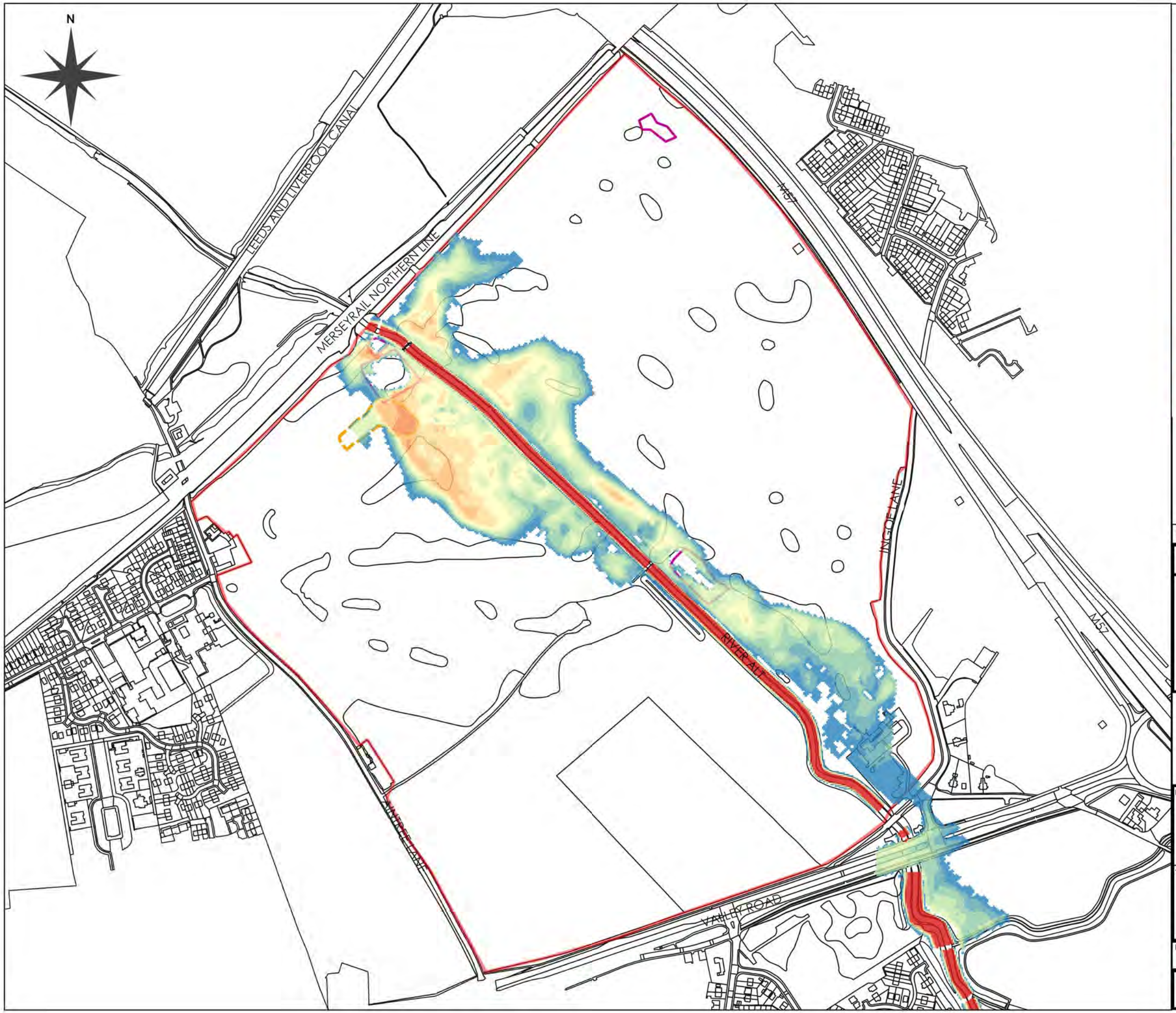
green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE:
1% AEP + CC
(1 in 100 YEAR RETURN PERIOD PLUS 35% CLIMATE CHANGE)
COURSE ALTERATIONS AND COMPENSATORY STORAGE
FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	207	A



DO NOT SCALE

Legend

- Site Boundary
- Proposed Course Alterations (levels changing)
- Compensatory Flood Storage

Flood Depth (m)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.20
- 1.21 - 1.40
- 1.41 - 1.60
- 1.61 - 1.80
- 1.81 - 2.00
- 2.00 +

REV	DATE	BY	DESCRIPTION	CHK
A	28/11/19	PT	PRELIMINARY	DK

DRAWING STATUS: PRELIMINARY

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green circle estates

PROJECT: KIRKBY VALLEY GOLF COURSE

TITLE: 0.1% AEP (1 in 1000 YEAR RETURN PERIOD) COURSE ALTERATIONS AND COMPENSATORY STORAGE FLOOD DEPTH PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
NOV 19	1:5000	P.T.	D.K.

PROJECT No:	DRAWING No:	REV:
HYD444	208	A

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APPENDIX J: NOTES OF LIMITATIONS

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

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

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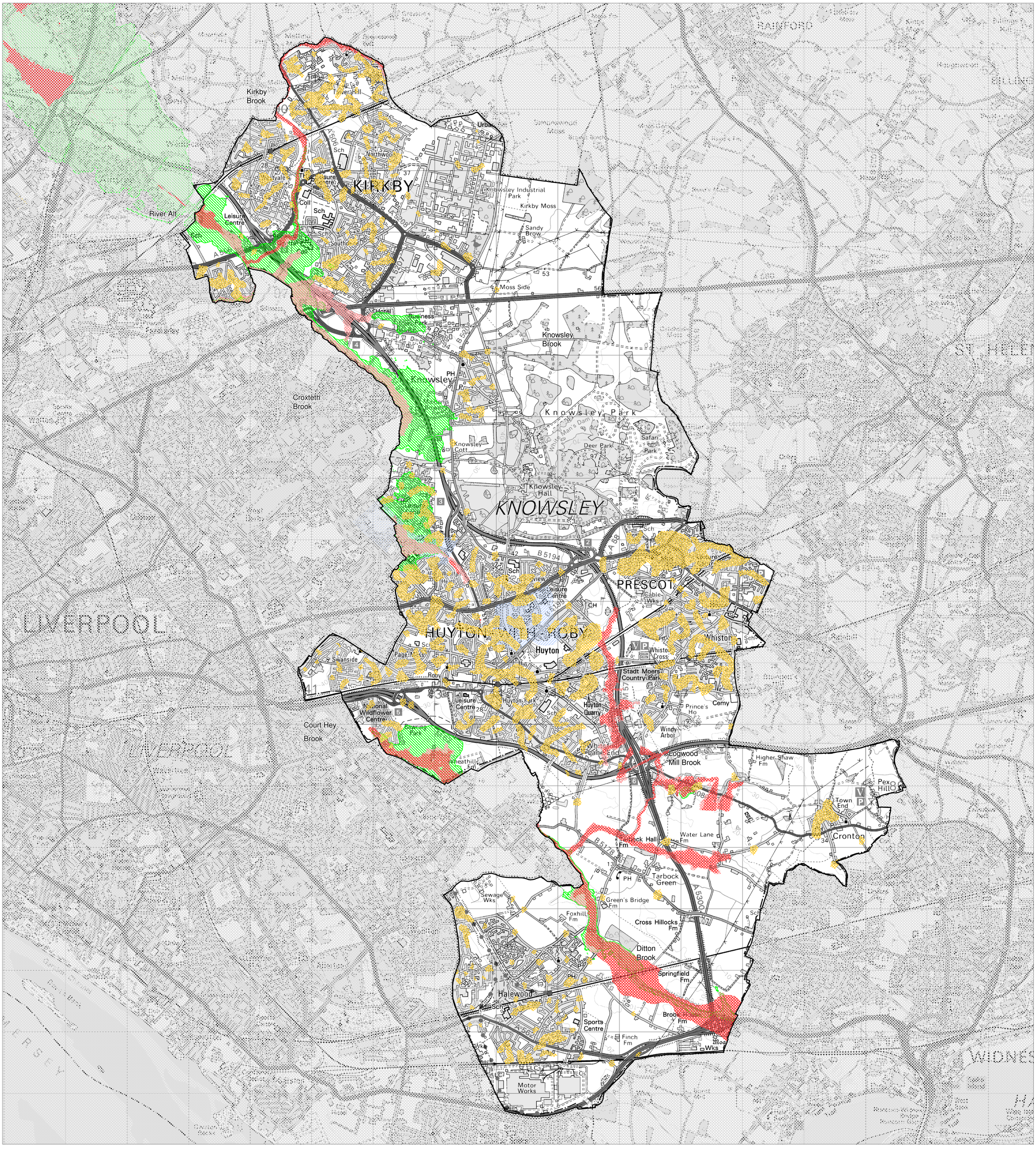
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APPENDIX J: PFRA/SFRA PLANNING EXTRACTS

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Legend:

- Knowsley Boundary
- Flood Zone 3b - High Risk
- Flood Zone 3a - High Risk
- Flood Zone 2 - High Risk
- Surface Water Flooding Indicated From Council Records - Medium Risk
- High Frequency Internal DG5 Surface Water Flooding - Medium Risk
- Potential Groundwater Flooding - Low Risk

SCALE: NTS

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Project Title:

Knowsley and Sefton Strategic Flood Risk Assessment

Figure Title:

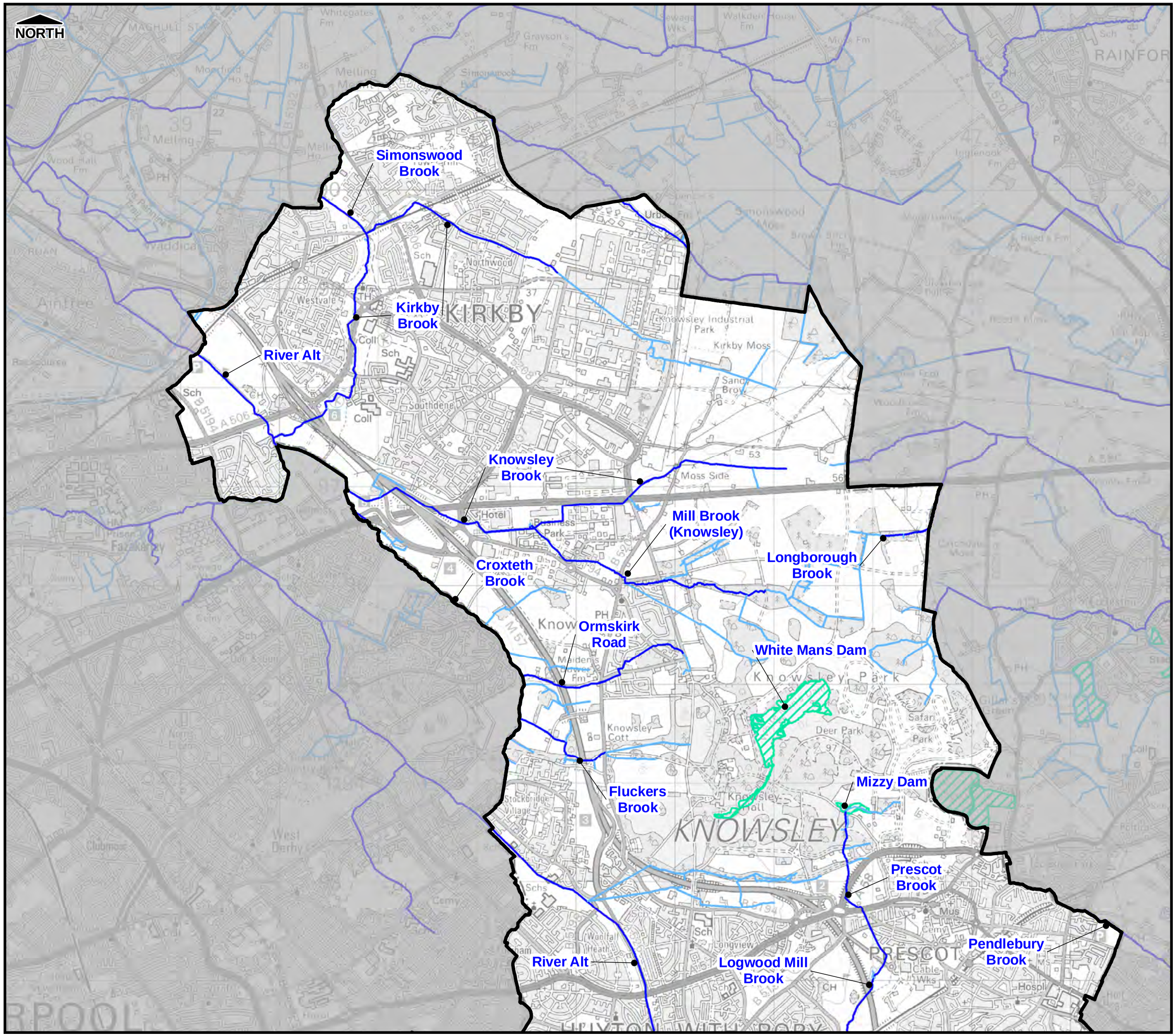
Combined Risk Matrix Map Knowsley

Document Ref: **5074164/DG/002**

Figure Ref: **J1**

Knowsley Council

ATKINS



Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Lakes/Reservoirs

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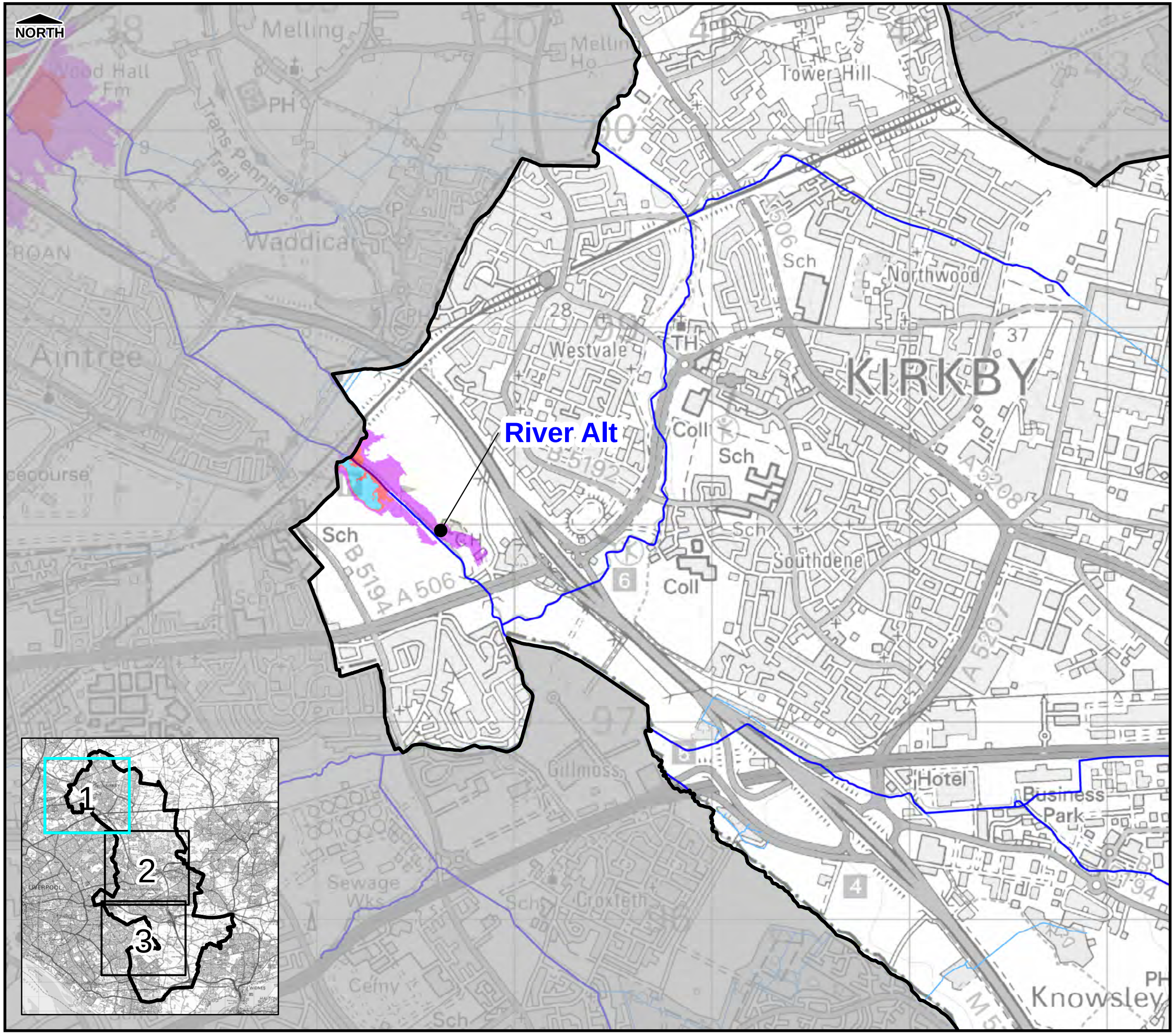
KNOWSLEY METROPOLITAN BOROUGH COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT

Figure B1-1-1
Catchment Overview

Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER	REV
CS056421/B1-1-1	-



Legend

- Borough Administrative Boundary
- 5% AEP Flood Extent
- 1% AEP Flood Extent
- 1%+CC AEP Flood Extent
- 0.1% AEP Flood Extent
- Main River
- Ordinary Watercourse

NOTES:

The flood extents are taken from the Logwood Mill Brook (2012), Netherley and Halewood (2012), Childwall Brook (2008) and Lower Alt (2010) studies and take into account the presence of existing defences

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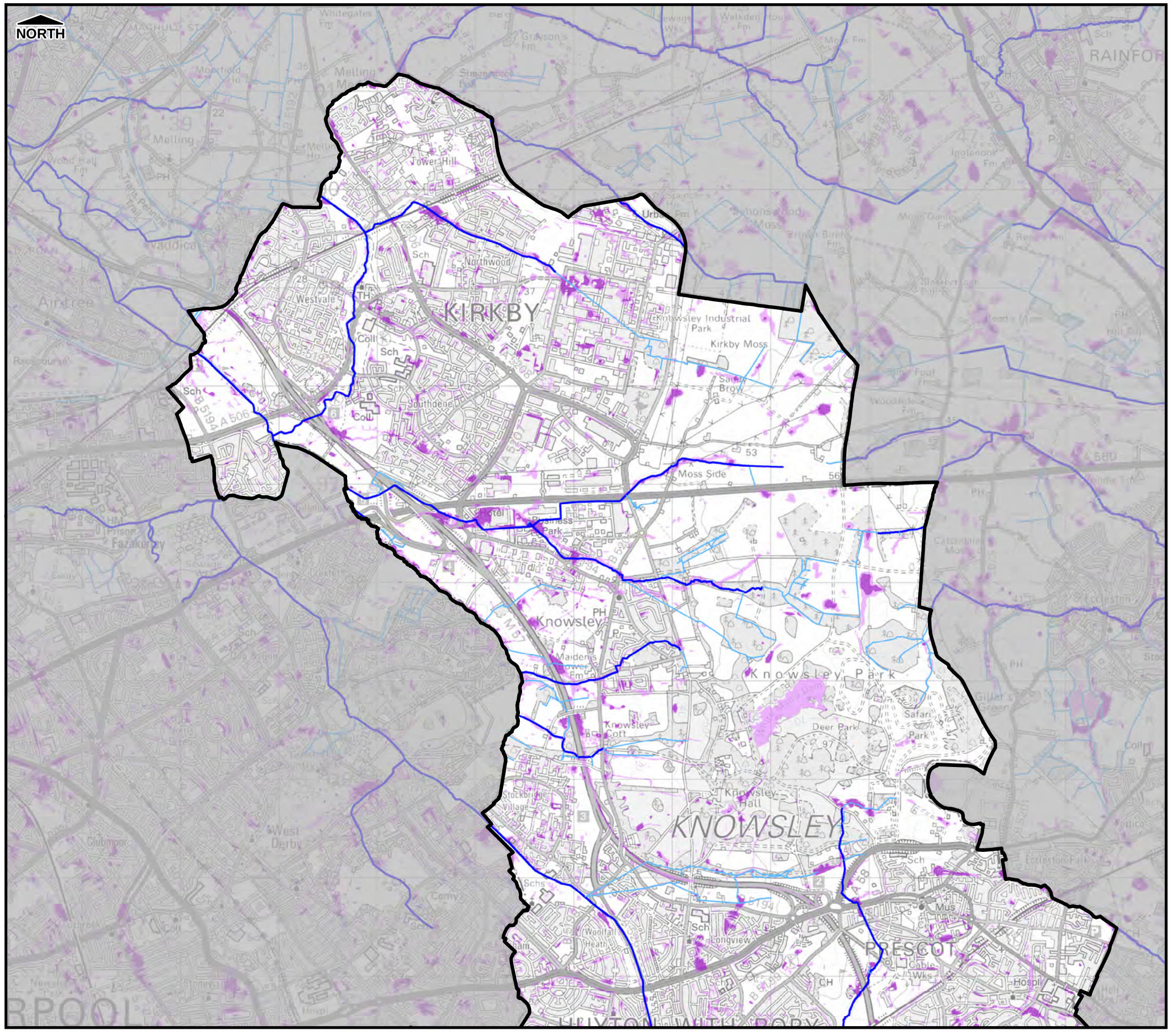
KNOWSLEY METROPOLITAN BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT

Figure B3-A-1
Actual Risk
Flood Extent

Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER	REV
CS056421/B3-A-1	-



Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- 200yr Surface Water Event (Deep)
- 200yr Surface Water Event (Shallow)

DISCLAIMER:

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

NOTES:

The outputs are from the Environment Agency Flood Map for Surface Water Data Set (2010).

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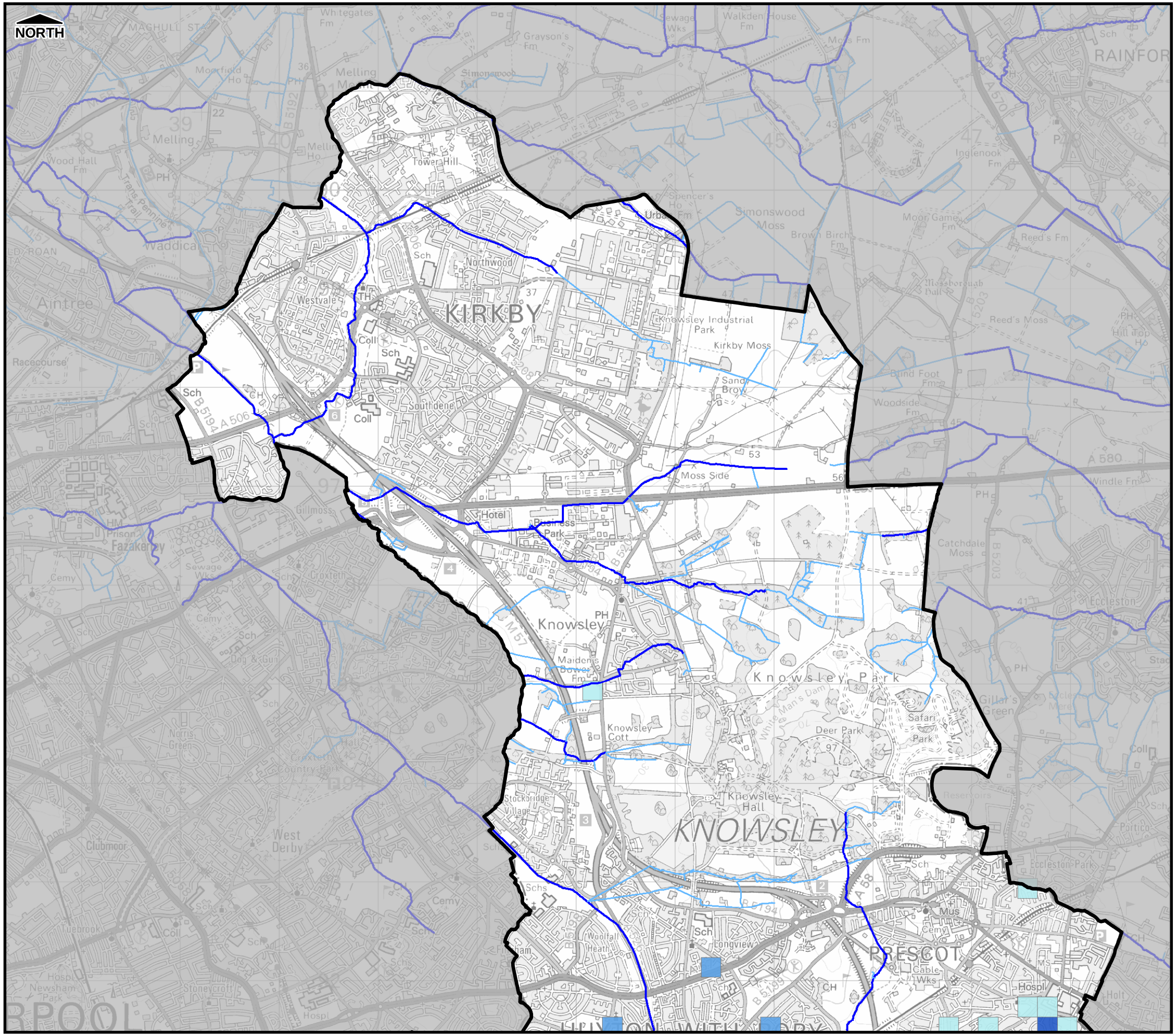
KNOWSLEY METROPOLITAN BOROUGH COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT

Figure B5-1 Environment Agency Flood Map for Surface Water

Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER	REV
CS056421/B5-1	-



Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse

Flooding incidents from 1st April 2008 - 3rd May 2012:

- 1 - 2
- 3 - 5
- 6 - 9
- > 10

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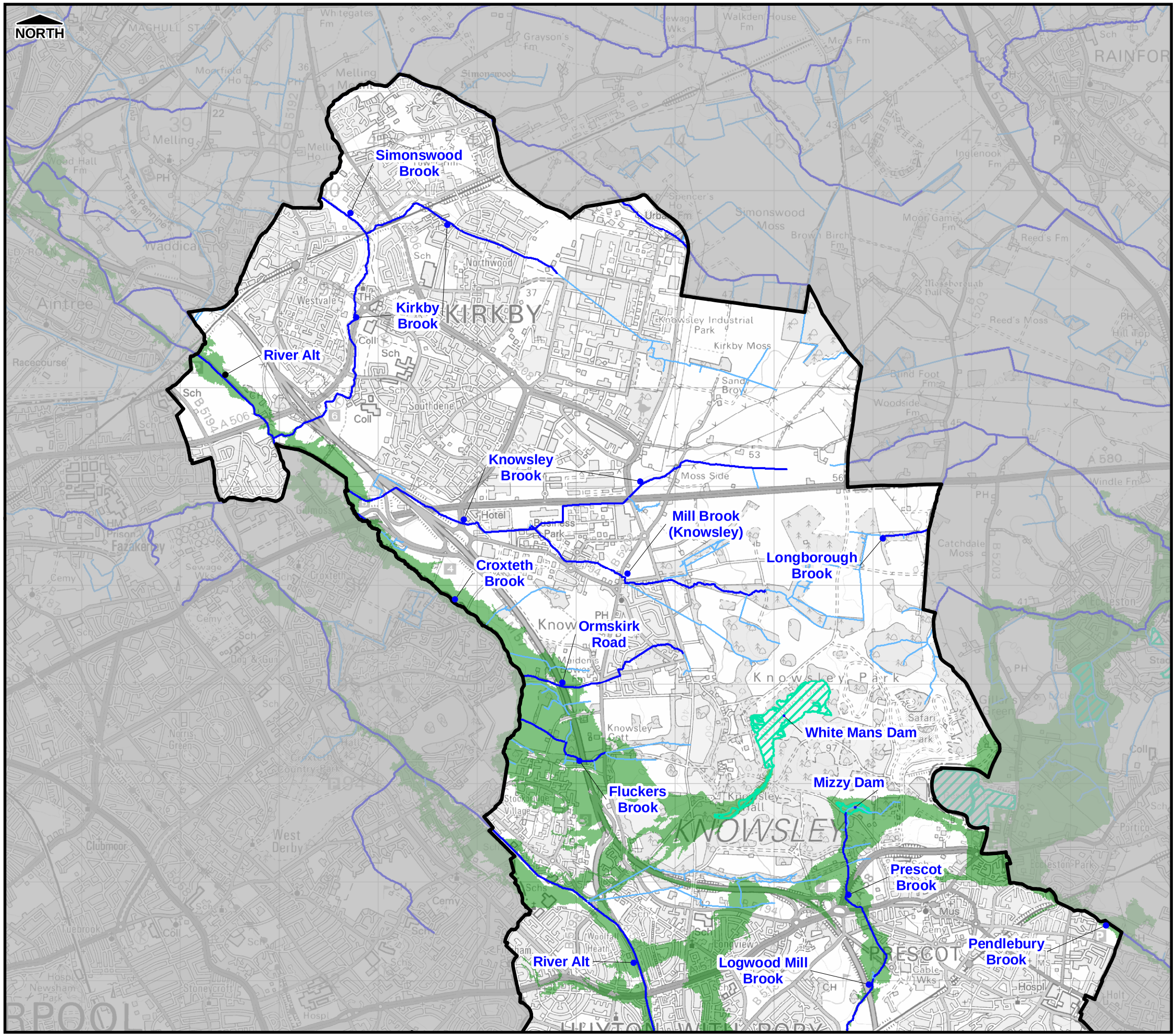
KNOWSLEY METROPOLITAN BOROUGH COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT

Figure B6-1 Number of Sewer Related Surface Water Flooding Incidents

Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER	REV
CS056421/B6-1	-



Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse
- Lakes/Reservoirs
- Maximum Extent of Resevoir Flooding

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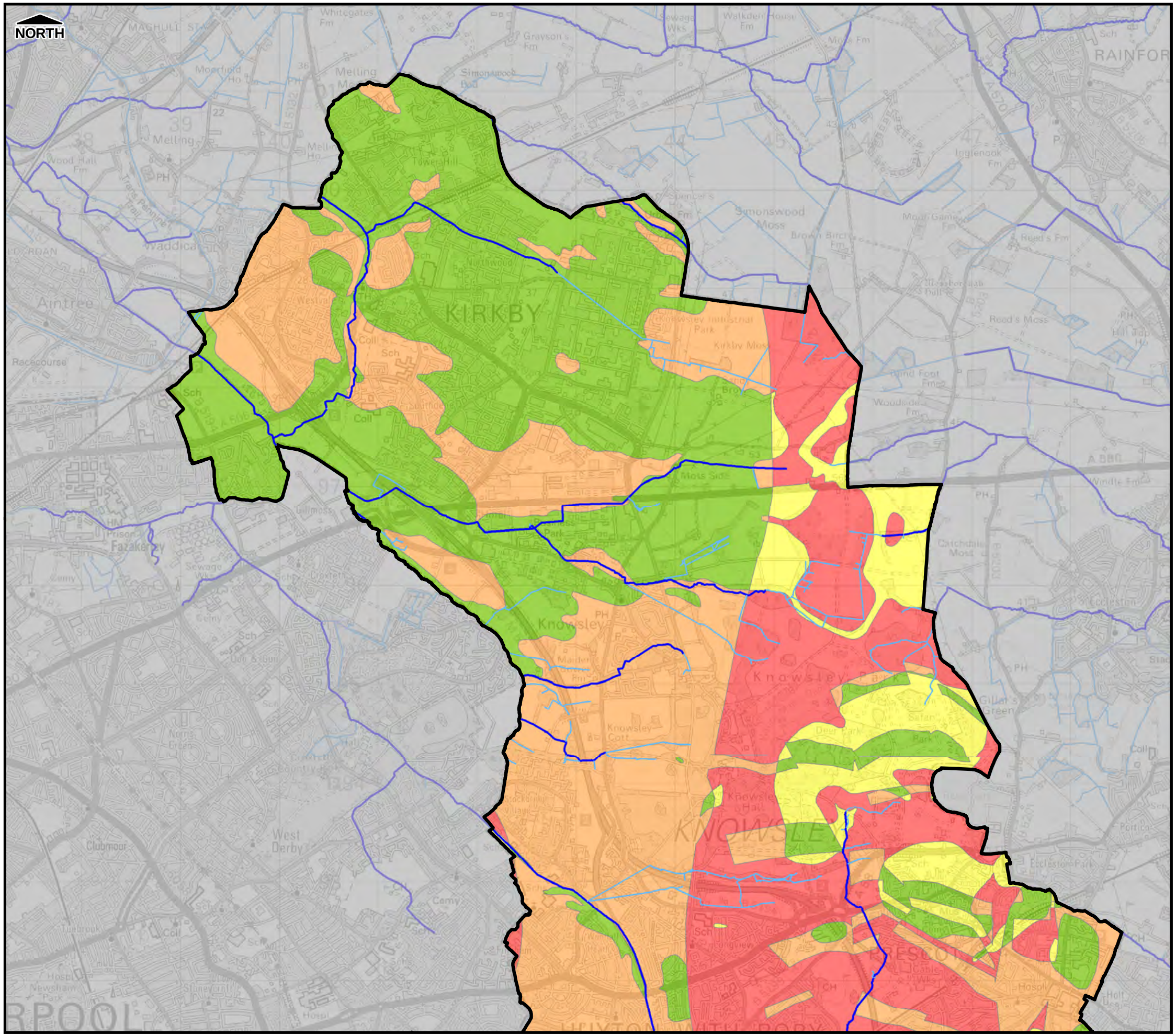
KNOWSLEY METROPOLITAN BOROUGH COUNCIL LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT

Figure B7-1
Reservoir Flooding

Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER	REV
CS056421/B7-1	-



Legend

- Borough Administrative Boundary
- Main River
- Ordinary Watercourse

Potential Suitability for SuDS

- High
- Medium 1
- Medium 2
- Low

Notes

Areas identified as High Probability are those that combine a permeable drift (or no drift) above a Sandstone solid geology. The Medium Probability (1) class consists of those that are permeable drift above Coal Measures, whilst the Medium Probability Class (2) consists of impermeable/other types of drift above Sandstone solid geology. The Low Probability Class consists of impermeable/other types of drift above Coal Measures.

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1:40,000	Sheffield

KNOWSLEY METROPOLITAN BOROUGH COUNCIL
LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT

Figure B11-1
Potential Suitability for SuDS

Knowsley Council

CAPITA SYMONDS

DRAWING NUMBER	REV
CS056421/B11-1	-

velocity of flow, the speed of onset of flooding and duration. Flood hazard can therefore vary greatly throughout catchments and even across floodplain areas. Hazardous river flows can pose a significant risk to exposed people, property and infrastructure. Lower hazard flooding can be less of a risk to life, by virtue of being shallower or with low velocity. It can, however, disrupt communities, require significant post-flood cleanup and can cause costly and possibly structural damage to property.

2.2.4 Knowsley lies at the head of the River Alt catchment, which rises in Huyton. It is in culvert along Salerno Drive and then open channel through Woolfall Heath where it is met by two unnamed drains that drain areas bordering the M57. It then leaves the Borough west of Stockbridge Village and flows through Croxteth Country Park before meeting Fazakerley Brook north of the sewage works before it re-enters the Borough in the northwest corner of Gillmoss Industrial Estate. It then flows for approximately 1.2km through Kirkby Golf Course before finally leaving the Borough at the weir slightly north of Hancocks Bridge.

2.2.5 Knowsley Brook is a significant tributary of the River Alt that drains the predominantly rural area to the west of the settlement of Knowsley Village, which includes parts of the Knowsley Hall Estate. The watercourse has two branches, the southern branch (Mill Brook) rises in Berry Hill and the northern branch rises close to Coopers Moss Farm on Cut Lane. Both branches meet at Ainsworth Lane west of Knowsley Business Park. Knowsley Brook then flows for approximately 1.9km meeting the River Alt at Willow Bed Plantation.

2.2.6 Croxteth Brook meets Knowsley Brook in Gillmoss and prior this it flows in open channel along the Knowsley boundary and Croxteth in Liverpool. A number of small watercourses drain westwards from the settlement of Knowsley Village and to the north of Stockbridge Village meeting the Croxteth Brook, including Flukers Brook.

2.2.7 Kirkby Brook is another significant tributary of the River Alt and it drains an area to the north of Kirkby. Rising in rural Kirkby Moss and flowing in culvert under Knowsley Industrial Park, it then meets the Simonswood Brook, changing direction to flow south in open channel through Millbrook Park and Valley Park before flowing under the M57 to meet the River Alt approximately 100m upstream of the confluence with the Knowsley Brook. Simonswood Brook is a much larger watercourse that drains the area to the north of the Borough. It follows the northern Knowsley boundary flowing around the Tower Hill urban area before meeting Kirkby Brook.

2.2.8 In the south of the Borough the principal catchment is that of Ditton Brook. The source of Ditton Brook is just upstream of Mizzy Dam, located in Knowsley Park

Table 2-1: Records of fluvial flooding from ordinary watercourses within Knowsley (Source: Knowsley PFRA)

Date flooding reported	Location	Sewer Type	Outfall	Chance of rainfall happening in any year	Consequence
Nov 2000	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Feb 2005	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Jan 2008	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Oct 2010	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Jan 2011	Kirkby	Culverted Watercourse	River Alt	Not Known	Highway Flooding
Feb 2011	Kirkby	Culverted Watercourse	River Alt	Not Known	Internal flooding to one property

2.2.13 Flow and level data is also available from the Environment Agency's HiFlows-UK website for the Alt at Kirkby flow and stage monitoring gauge (Gauge Ref: 69032). This is located at NGR 339180, 398340 on the boundary of Knowsley and is operated by the Environment Agency. A review of the annual maximum series, which identifies the highest flow within each water year (1st October to 30th September), indicates that the highest recorded flow at the gauge was approximately $31m^3s^{-1}$ recorded on 10th August 2004. Prior to this the highest recorded flow had been of $26m^3s^{-1}$ on 10th August 1971, followed by two events of nearly $25m^3s^{-1}$ in successive water years, on 30th October 2000 and 9th September 2002. It is not known whether these events caused flooding anywhere, however, they do not coincide with records presented in the PFRA[11] for Kirkby Brook or those within the Mersey Estuary CFMP[13] for Ditton Brook.

2.2.14 A review of the Chronology of British Hydrological Events website, managed by University of Dundee, and an internet search were also carried out for other historical fluvial flooding information but no results were found within the Borough of Knowsley.

Flood Zones

2.2.15 Current national planning policy defines three distinct flood zones, 1, 2 and 3, with further sub-classification of Flood Zone 3 into Flood Zone 3a and Flood Zone 3b.

2.2.16 Table 2-2, provides detail of how each flood zone is defined. It is important to

the Borough should have reasonable permeability and may therefore be suitable for infiltration based drainage system. The Coal and Millstone Grit deposits of the Borough generally give rise to poor permeability therefore the potential for infiltration based drainage solutions in these areas may be limited. Overlying drift deposits also influence the suitability for SuDS, as this can allow or inhibit the infiltration of runoff into the underlying solid geology. For example, less permeable till deposits are likely to reduce the opportunities for the infiltration of rainfall into underlying strata, whilst permeable sand deposits are likely to facilitate infiltration.

4.3.24 Figure B11 presents a schematic of the potential to use SuDS to manage surface water. Areas identified as High Probability are those that combine permeable drift or no drift above Sandstone solid geology. The Medium Probability (1) class consists of those that are permeable drift above Coal Measures, whilst the Medium Probability Class (2) consists of impermeable/other types of drift above Sandstone solid geology. The Low Probability Class consists of impermeable/other types of drift above Coal Measures.

4.3.25 Overall Figure B11 indicates that opportunities for infiltration-based SuDS systems are likely to be highest in those areas around Kirkby in the north of the Borough, which lie in an area with both sand drift deposits and underlying sandstone solid geology, though there are isolated pockets of land that may however be favourable elsewhere. Away from Kirkby, it is likely that there will be fewer opportunities for infiltration-based SuDS systems, with limited opportunities in a band of land extending northwards from midway between Huyton and Prescot towards the eastern edge of Kirkby.

4.3.26 Where space is available within developments then SuDS such as swales, balancing ponds and wetlands should be promoted, though it should be acknowledged that these require space to be set aside for their operation, as well as having maintenance requirements. Green roofs are a valuable technique in the urban environment to reduce existing site runoff and KMBC should consider actively promoting their use. In February 2011 the Green Roof Organisation produced the Green Roof Code[24] for the United Kingdom. The code, which was the result of technical co-operation across the UK green roof industry, is intended to be recognised as a code of best practice and guide behaviour relating to green roof design, specification, installation and maintenance.

4.3.27 The use of possible infiltration-based SuDS should be investigated at a site specific scale when individual development sites come forward for development. Infiltration tests should be carried out as there may be opportunities for some

[24] The Green Roof Code, February 2011.

covers, flood gates for doorways and windows and no-return valves for drainage pipes.

4.3.35 Guidance from CLG in *Improving the Flood Performance of New Buildings: Flood resilient construction* (2007)[26] indicates that most buildings that are impacted by flooding to a depth of greater than 100mm may benefit from resistance measures. These are likely to be effective when depths are relatively shallow and potentially up to approximately 0.6m. Above this, and inevitably in some cases below this value, flood water is more than likely to ingress through an unprotected pathway and flood resilience measures become more appropriate.

4.3.36 Assessment of the Flood Map for Surface Water (FMfSW) 200yr (deep) dataset would suggest that there are isolated areas of Kirkby, Huyton, Prescot and Halewood that might benefit from flood resilience and resistance measures. Further assessment of the FMfSW outlines against the National Receptor Database has been undertaken to count properties at risk and to identify where there may be benefits from retrofitting flood resilience and resistance measures. The definition of acceptability is based on the CLG guidance above, in which it is recommended that depths below 0.3m are potentially appropriate for flood resistance measures and depths that are less than 0.6m are potentially appropriate for flood resilience measures.

4.3.37 Using this criteria, the 30yr Flood Map for Surface Water dataset identifies at least 1,267 ground floor properties at risk from flooding whilst the 200yr dataset identifies at least 4,792 properties at risk from flooding. Of these 1,032 and 4,156 properties respectively are homes and the remainder are businesses and other uses that may benefit from flood risk management measures.

4.3.38 The 30yr (deep) Flood Map for Surface Water dataset identifies at least 179 properties at risk from flooding that is greater than 0.3m, whilst the 200yr (deep) dataset identifies at least 1,006 properties at risk from flooding that is greater than 0.3m. The potential depth of flooding at these properties implies that flood resilience measures may be suitable, whilst for the remainder flood resistance measures may also be appropriate.

Urban Creep

4.3.39 A recent study by Martin Allitt and Andrew Tewkesbury[27] investigated the problem of urban creep in five cities across the UK. Urban creep is the loss of permeable surfaces within urban areas, typically development like extensions, patios and paving of front gardens to create off-street parking, all of which were until recently forms of permitted development. The latter, paving of front gardens, has now

[26] CLG, Improving the flood performance of new buildings: flood resilient construction.
[27] Allitt, M & Tewkesbury, A (2009) Investigations into Urban Creep at 5 Cities

4. FLOOD RISK IN THE PAST

The PFRA requires significant historic flood events to be recorded and reported to Europe through this report. There has been no formal guidance on what 'significant' means in terms of historic local flooding; Defra has left it to LLFAs to determine their own definition. For the recording of past local flood risk, the "indicative flood risk" criteria of 200 people in a 1km grid square was reduced to 20 people (or approximately 8 houses) in a 1km grid. To ensure a consistent Merseyside approach, this method for establishing past local flood risk was discussed at the Merseyside Drainage Group meeting on 17th January 2011 and on 21st February 2011 adopted across the region as the accepted way forward.

Figure 4-1: Spatial Distribution of Past Surface Water Flood Locations.

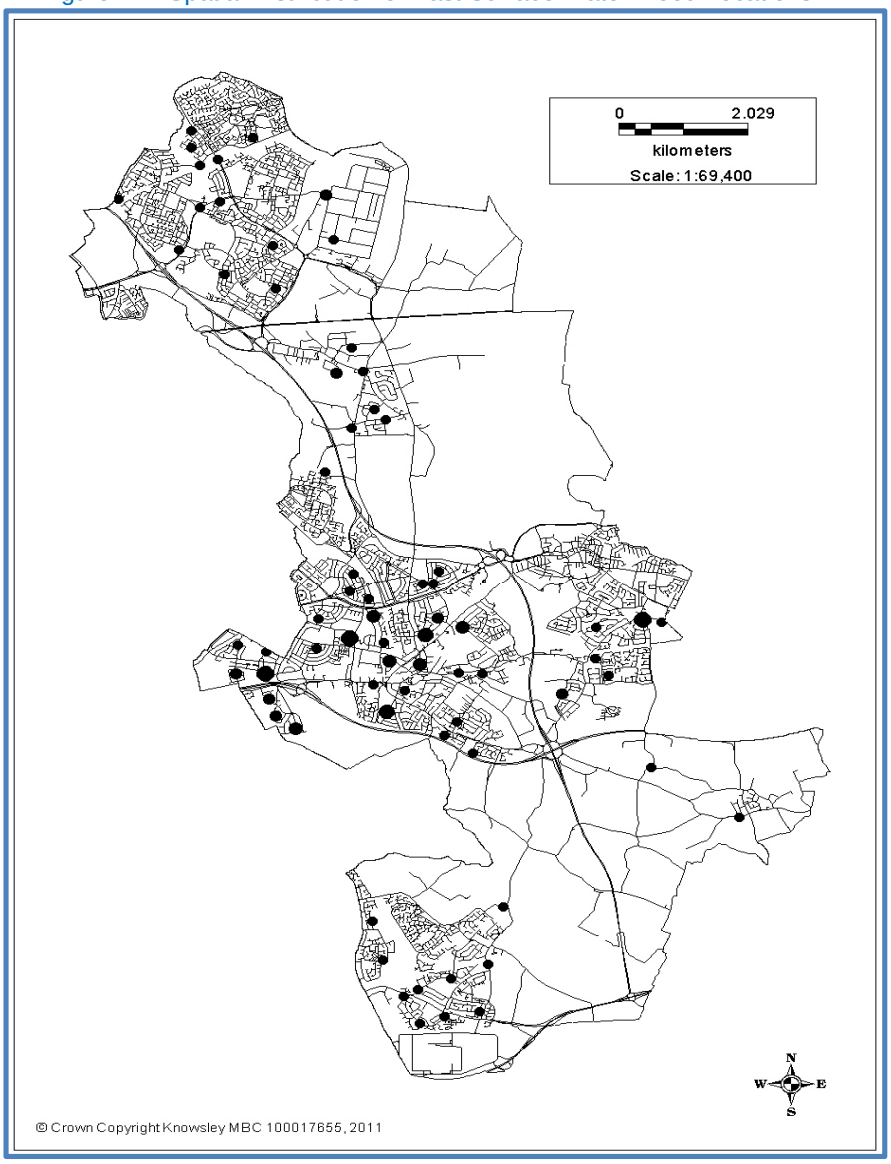
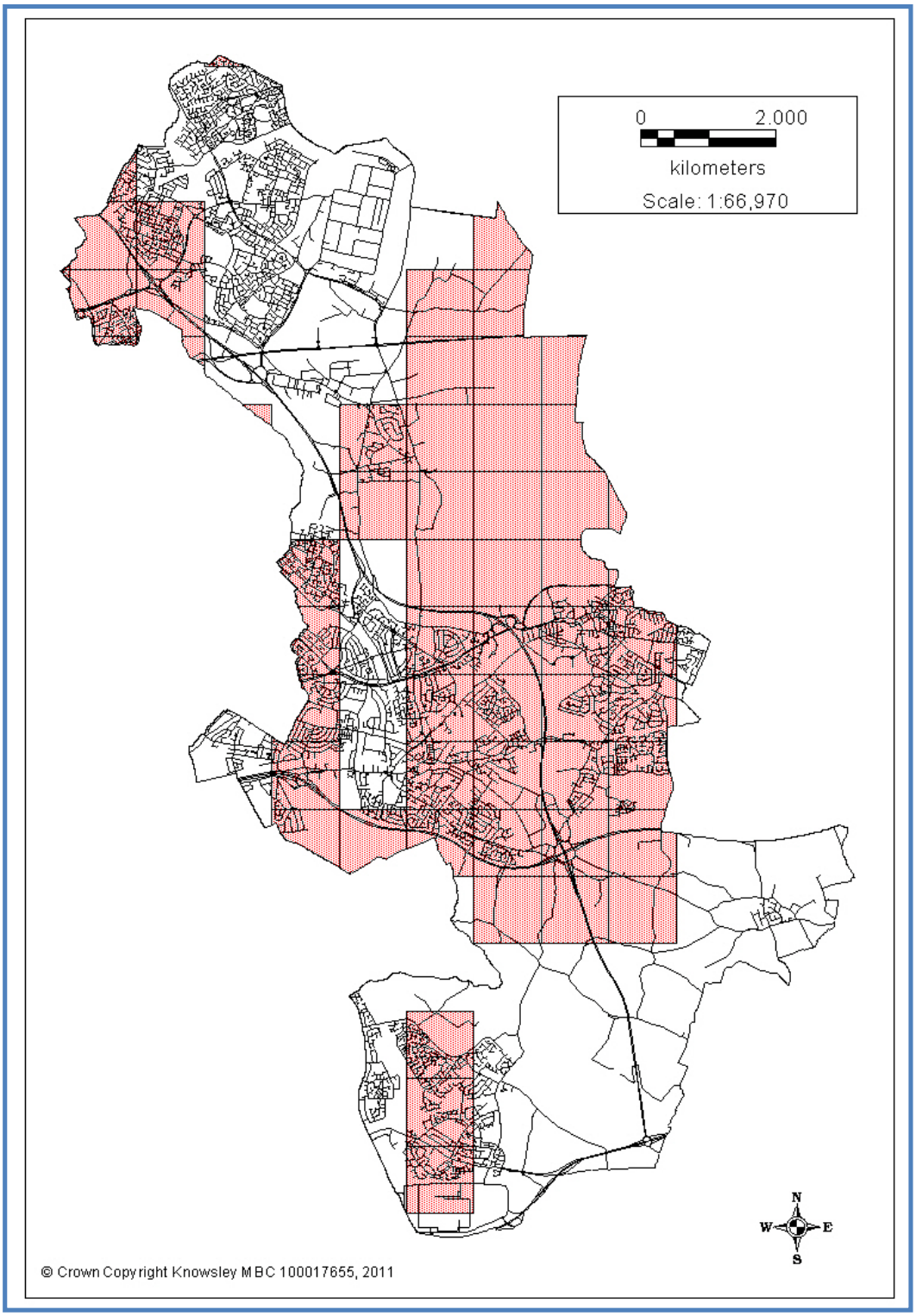


Figure 5-1 – Areas Susceptible to Ground Water Flooding



no Areas Benefiting from Defences (ABD) within Knowsley, which implies that none of the defences provides protection against flooding with a 1% chance of occurring. An ABD does exist on Netherley Brook, however, this is within the adjacent Liverpool District.

2.3.2 Figure B2 presents the Environment Agency's Flood Zones and defences. The NFCDD data indicates that none of the man-made raised defences in the Borough are in a good condition. They are all in either a fair or very poor condition. The design standard of the defences varies between a 5 year Standard of Protection (SoP) and a 100 year Standard of Protection.

2.3.3 The defences with a high SoP (100 year) are in the south of the Borough, along Ditton Brook and Dog Clog Brook. The Ditton Brook defences consist of raised earth embankments which have been assessed as being in a very poor condition. As described above, the modelling results suggest that these defences do not actually provide a 100 year SoP. The flood bank at Dog Clog Brook is classified as being in a fair condition and is supposed to provide property protection up to the 1% AEP event. This watercourse has not been modelled.

2.3.4 The defences with a lower SoP (less than 100 years) include short reaches on the Netherley Brook and Spring Brook in the south of the Borough which are in a fair condition. The low SoP is confirmed by the modelling data which shows the defences are overtopped in the 1% AEP. In the north of the Borough the embankment along Croxteth Brook is considered to be in a fair condition and had a SoP of 25-50 years.

2.3.5 Within the south of the Borough, the Netherley and Halewood Brook hydraulic model includes both defended and undefended model runs, however, the defences are on the right bank of the watercourse and therefore protect properties within Liverpool District and not Knowsley. The model results have been reviewed and the defences appear to provide a level of protection equivalent to between a 0.5% AEP and a 0.1% AEP flood event. From the 1% AEP event and above, there are small areas within Knowsley that appear to receive disbenefit from the presence of these defences, however, they are rural and there is no increase in risk to property.

2.3.6 The results of the River Alt Strategy Model show only a small floodplain in the 1% AEP within the boundary of KMBC on the Kirkby golf course in the north west of the Borough. There are no defences here and the extent of the 1% AEP floodplain is the same in the defended and undefended scenarios.

Culverted Watercourses

2.3.7 A review of the Environment agency's National Flood and Coastal Defence

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APPENDIX K: SURFACE WATER RUN-OFF CALCULATIONS

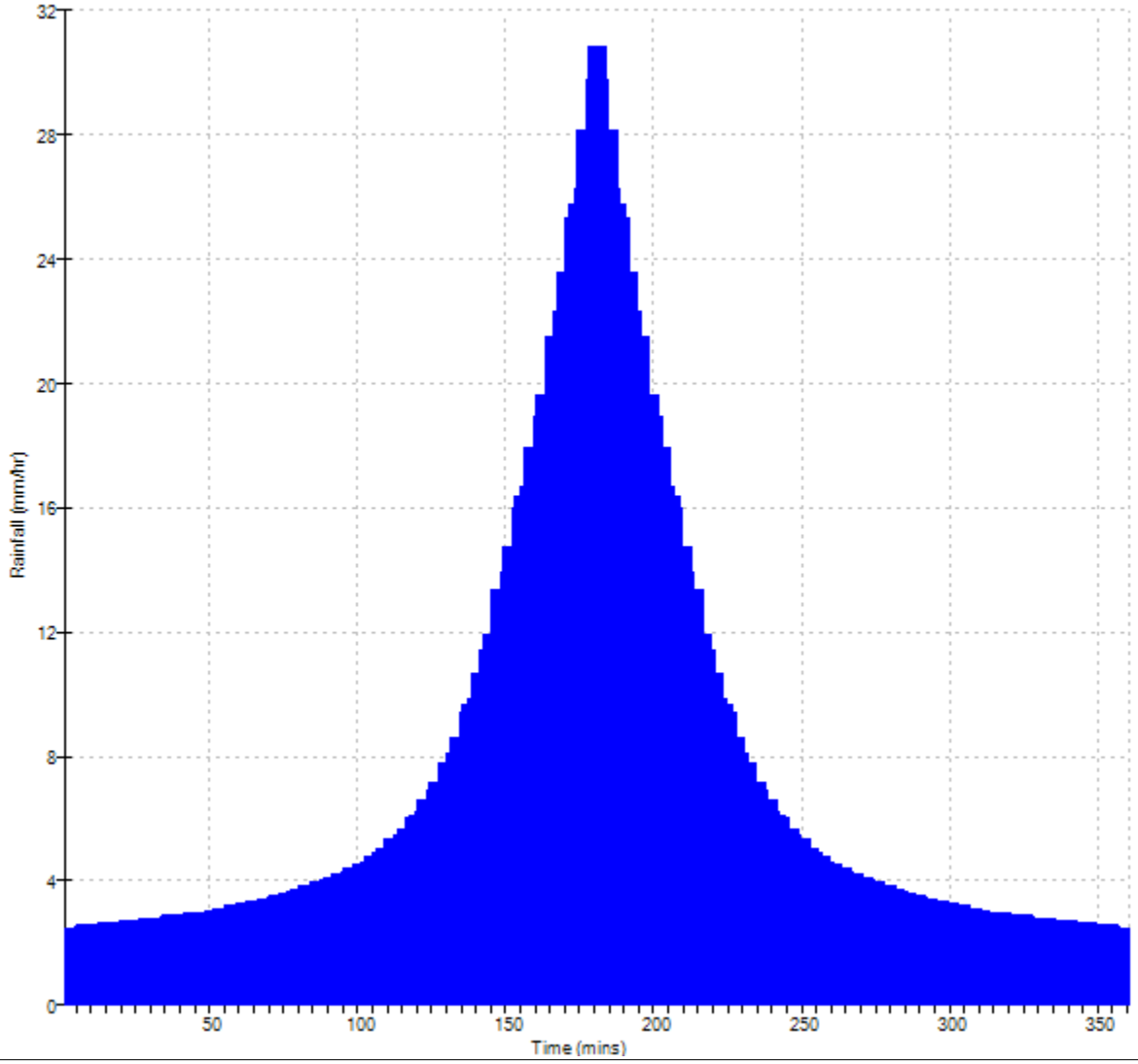
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Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY	KIRKBY VALLEY GOLF CLUB	
Date 29/08/2019 File	Designed by MB Checked by DK	
Micro Drainage	Network 2018.1	

Rainfall profile

Storm duration (mins) 360

FEH Data	
FEH Rainfall Version	2013
Site Location GB	339428 398090
Data Type	Point
Peak Intensity (mm/hr)	30.849
Ave. Intensity (mm/hr)	7.870
Return Period (years)	30.0



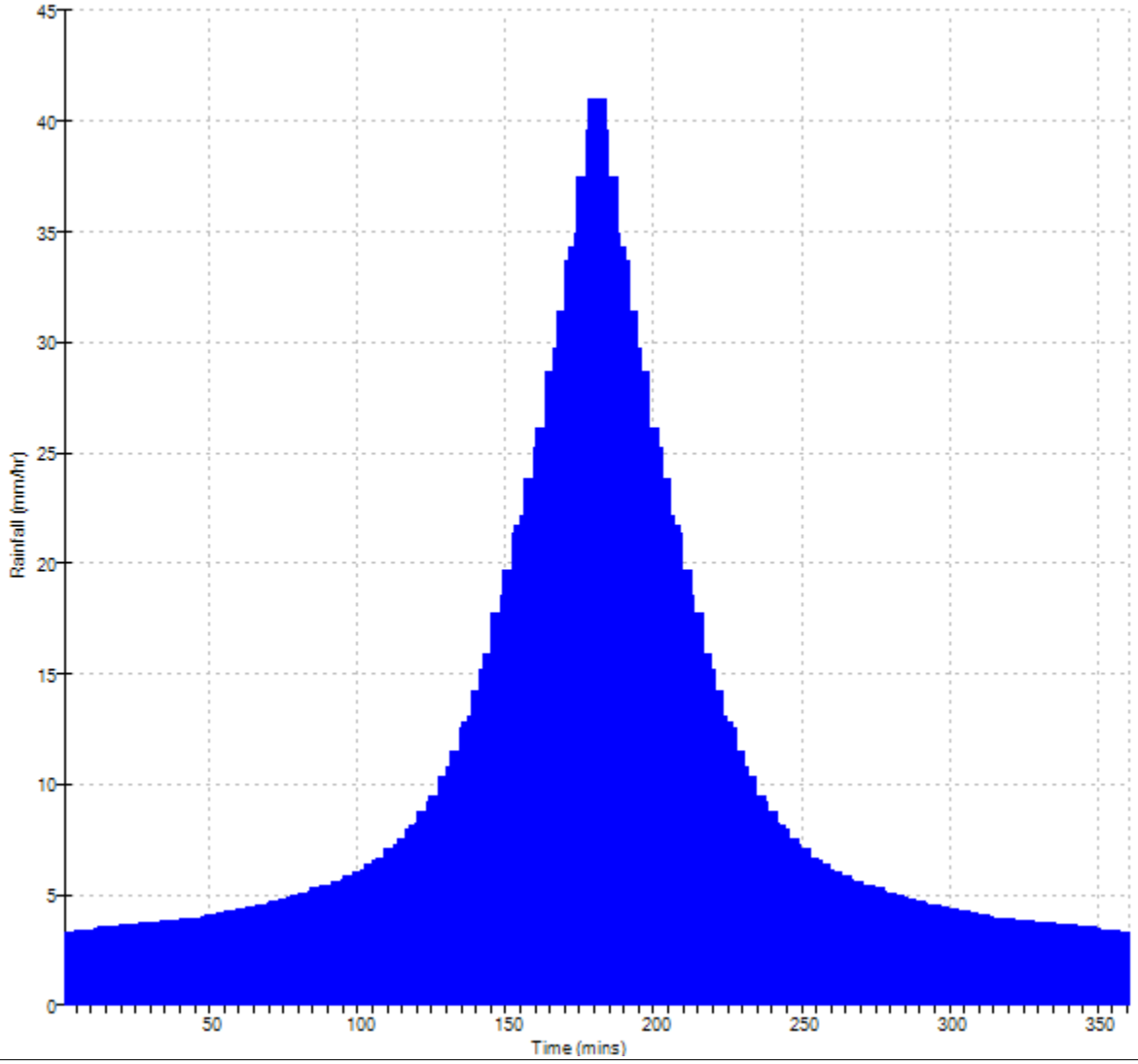
©1982-2018 Innovyze

Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY	KIRKBY VALLEY GOLF CLUB	
Date 29/08/2019 File	Designed by MB Checked by DK	
Micro Drainage	Network 2018.1	

Rainfall profile

Storm duration (mins) 360

FEH Data	
FEH Rainfall Version	2013
Site Location GB	339428 398090
Data Type	Point
Peak Intensity (mm/hr)	41.032
Ave. Intensity (mm/hr)	10.467
Return Period (years)	100.0



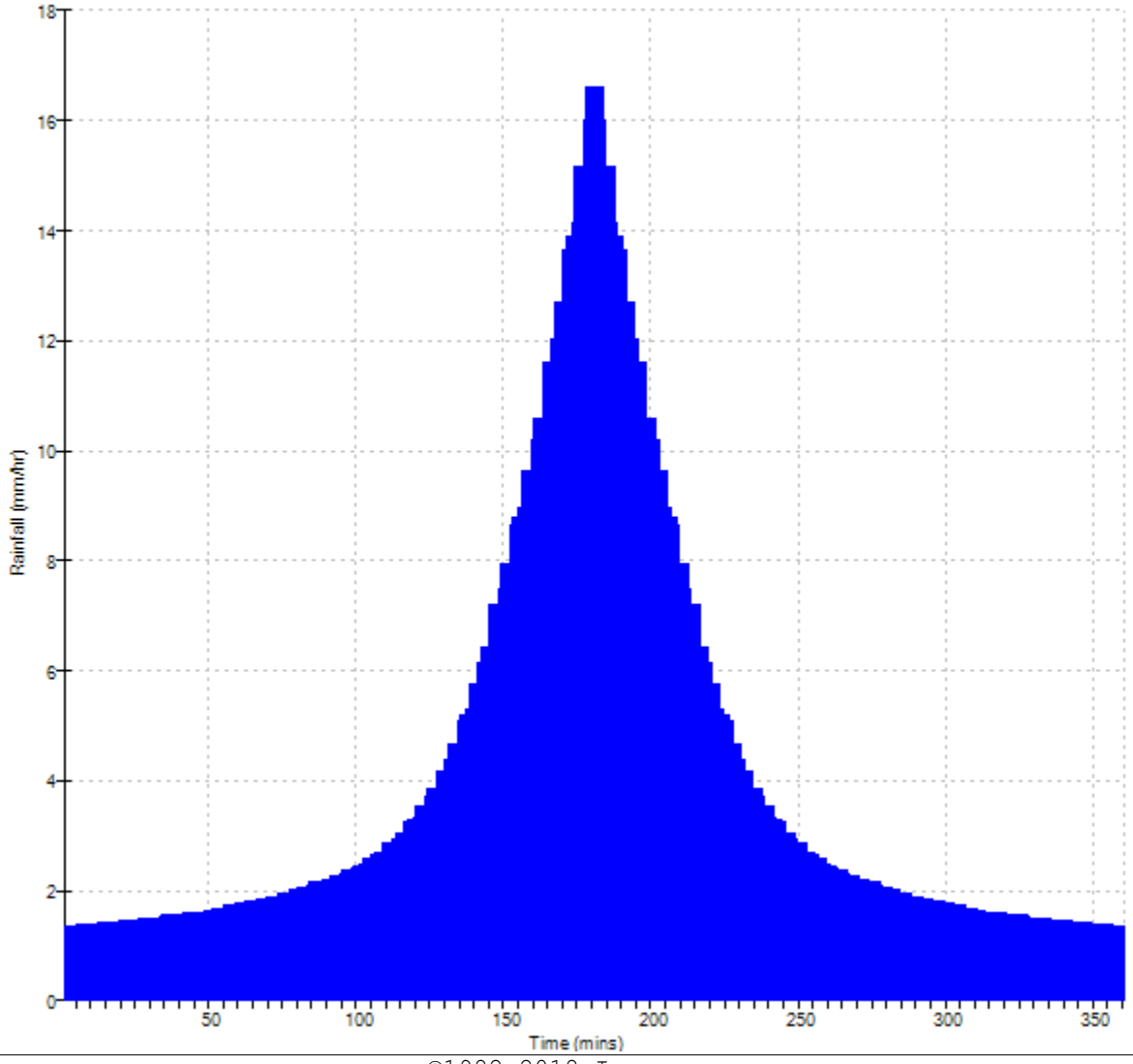
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Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY	KIRKBY VALLEY GOLF CLUB	
Date 29/08/2019 File	Designed by MB Checked by DK	
Micro Drainage	Network 2018.1	

Rainfall profile

Storm duration (mins) 360

FEH Data	
FEH Rainfall Version	2013
Site Location GB	339428 398090
Data Type	Point
Peak Intensity (mm/hr)	16.614
Ave. Intensity (mm/hr)	4.238
Return Period (years)	2.0



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Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.200
Ratio R	0.400
Areal Reduction Factor	1.00
Area (ha)	2.878
SAAR (mm)	841
CWI	119.327
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	49.29
Greenfield Runoff Volume (m^3)	856.057

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Greenfield Runoff Volume

FSR Data

Return Period (years)	30
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.200
Ratio R	0.400
Areal Reduction Factor	1.00
Area (ha)	2.878
SAAR (mm)	841
CWI	119.327
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	47.24
Greenfield Runoff Volume (m^3)	631.346

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Greenfield Runoff Volume

FSR Data

Return Period (years)	1
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.200
Ratio R	0.400
Areal Reduction Factor	1.00
Area (ha)	2.878
SAAR (mm)	841
CWI	119.327
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	45.58
Greenfield Runoff Volume (m^3)	274.475

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Megan Berry
Site name:	Kirkby Valley Golf Club.
Site location:	Liverpool

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

Site Details

Latitude:	53.47298° N
Longitude:	2.9105° W
Reference:	2002038594
Date:	Feb 18 2021 14:51

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 2.878

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.587
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.08

Hydrological characteristics

	Default	Edited
SAAR (mm):	846	846
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):		10.77
1 in 1 year (l/s):		9.37
1 in 30 years (l/s):		18.31
1 in 100 year (l/s):		22.4
1 in 200 years (l/s):		25.53

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

SURFACE WATER RUN-OFF CALCULATION SHEET

BETTS HYDRO
CONSULTING ENGINEERS

Development	KIRKBY VALLEY GOLF CLUB
Project No.	HYD444

Revision	C	**Completed by**	MB
Date	18.02.21	**Checked by**	KW

Areas

Total Site	79.781	ha	
Drainage Area[1]	2.878	ha	
Existing Impermeable	0.000	ha	
Existing Impermeable[2]	0.000	ha	
Existing Pervious	79.781	ha	
Existing Pervious[2]	0.000	ha	
Proposed total impermeable	2.878	ha	100%

Catchment Characteristics

SAAR	841	mm			
SPR	0.47				
BFI	0.587				
i_1	16.6	mm/hr	d_1	21.0	mm
i_{30}	30.8	mm/hr	d_{30}	50.2	mm
i_{100}	41.0	mm/hr	d_{100}	62.8	mm

Run-off Rates

Pre-development

Impermeable ------	1yr	0.0	l/s
	30yr	0.0	l/s
	100yr	0.0	l/s
	40mm/hr[3]	0.0	l/s
Pervious[4] ------	1yr	9.4	l/s
	30yr	18.3	l/s
	100yr	22.4	l/s
	QBar[5]	10.8	l/s
Total ------	1yr	9.4	l/s
	30yr	18.3	l/s
	100yr	22.4	l/s

Post-development (without control)

Impermeable[6] ------	1yr	132.8	l/s
	30yr	246.6	l/s
	100yr+40%CC	459.2	l/s

Volumes

Pre-development

Impermeable ------	1yr	0.0	cu.m
	30yr	0.0	cu.m
	100yr	0.0	cu.m
Pervious[4] ------	1yr	274.5	cu.m
	30yr	631.3	cu.m
	100yr	856.1	cu.m
Total ------	1yr	274.5	cu.m
	30yr	631.3	cu.m
	100yr	856.1	cu.m

Post-development

Impermeable[6] ------	1yr	60.5	cu.m
	30yr	144.4	cu.m
	100yr+40%CC	180.7	cu.m

Stormwater Storage Estimates

Based on Greenfield run-off QBar

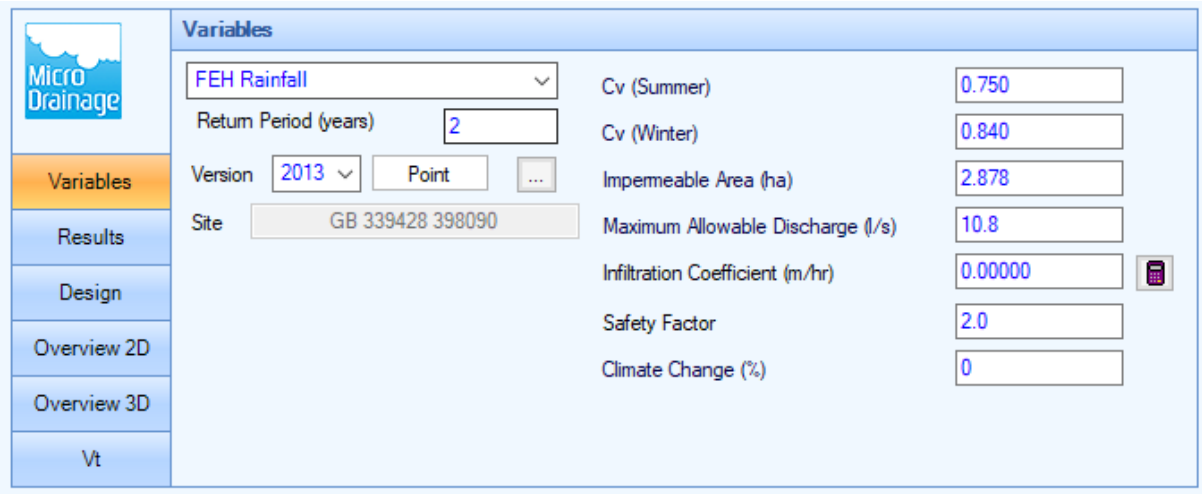
Microdrainage Quick Storage Estimates (using FEH catchment data)

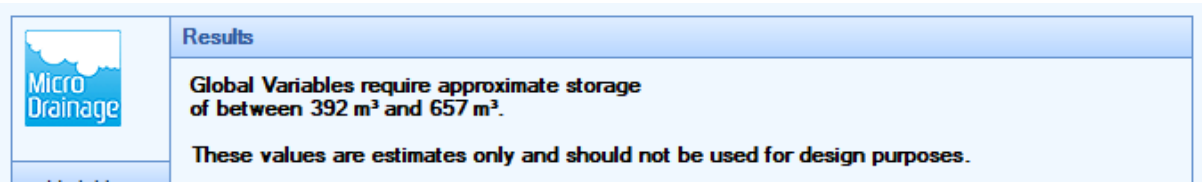
Return Period	Rate		lower	upper	mean	
1yr	10.8	l/s	392	657	524.5	cu.m
30yr	10.8	l/s	911	1262	1086.5	cu.m
100yr+10%CC	10.8	l/s	1464	1894	**1679**	**cu.m**
100yr+20%CC	10.8	l/s	1632	2103	**1867.5**	**cu.m**

1/ The 'development area' removes areas of POS and/or landscaped areas of the wider site that are to remain as existing.
2/ On occasion the existing impermeable area cannot be evidenced to connect and a reduction is applied.
3/ 50mm/hr is used for BRegs calculations and often used by Water Companies when considering allowable post-development rates of discharge. (Rational Method)
4/ The Greenfield rates and of run-off have been calculated using the UK SUDS Calculator
5/ QBar is the estimated flood flow for the 2.33yr return period event and is often used as a post-development rate restriction.
6/ Post-development run-off is only considered from the impermeable area when the proposed post-development impermeable area >50% in accordance with the EA Guidance Preliminary rainfall runoff management for developments (W5-074/A/TR1/1 rev E (2012).

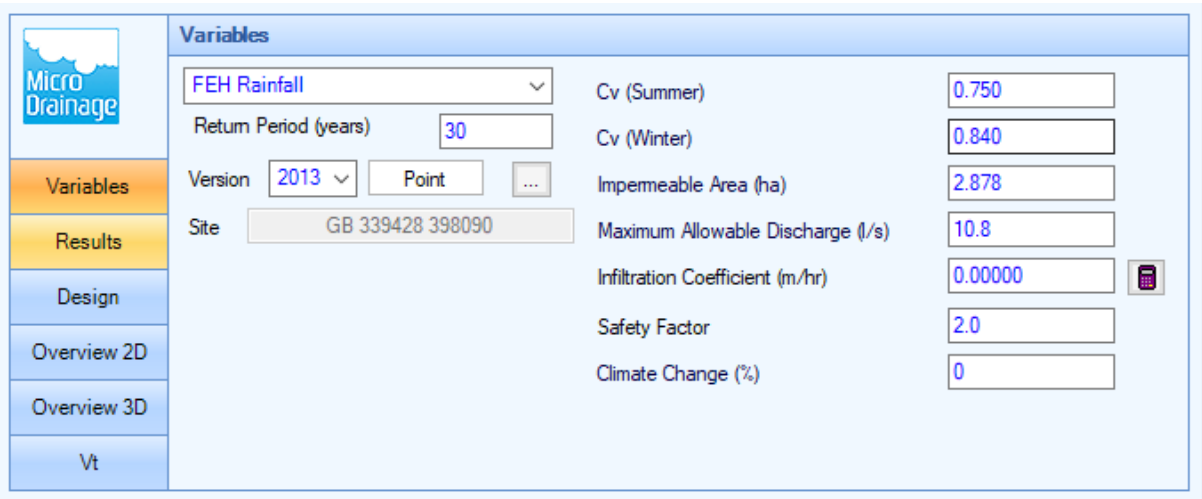
NB. The catchment characteristics are from the FEH catchment, the UK SUDS Calculator and Microdrainage.
NB. The rainfall intensities and depths are calculated for the 6hr duration rainfall event (peak summer intensity)

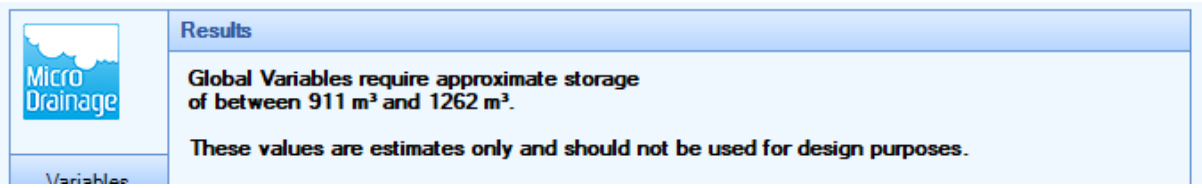
1 YEAR RETURN PERIOD STORM EVENT



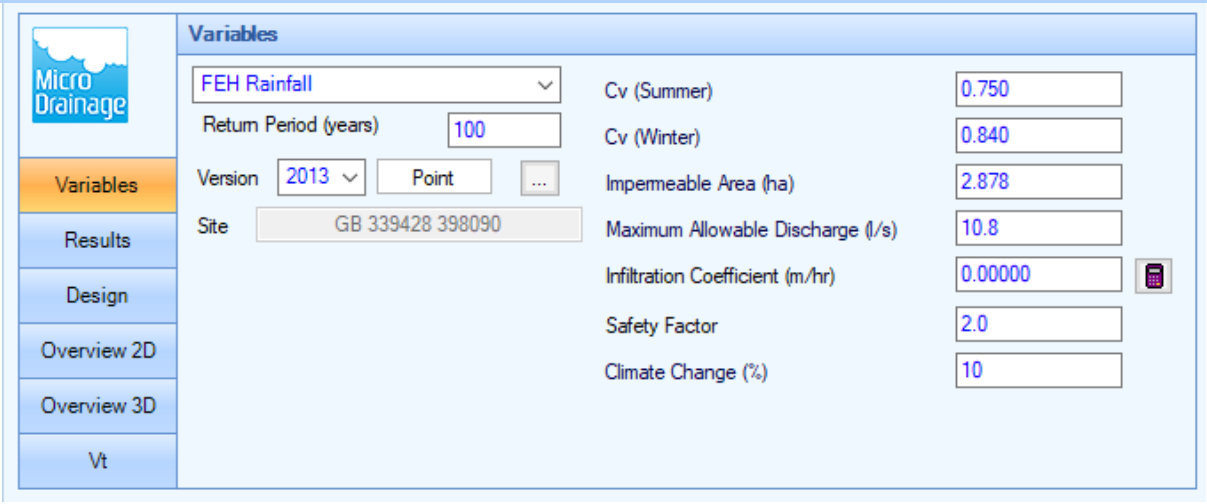


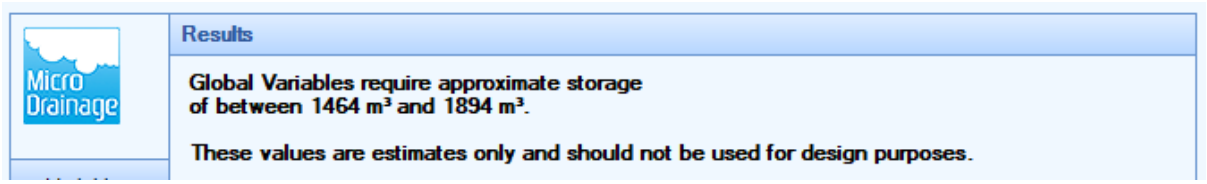
30 YEAR RETURN PERIOD STORM EVENT



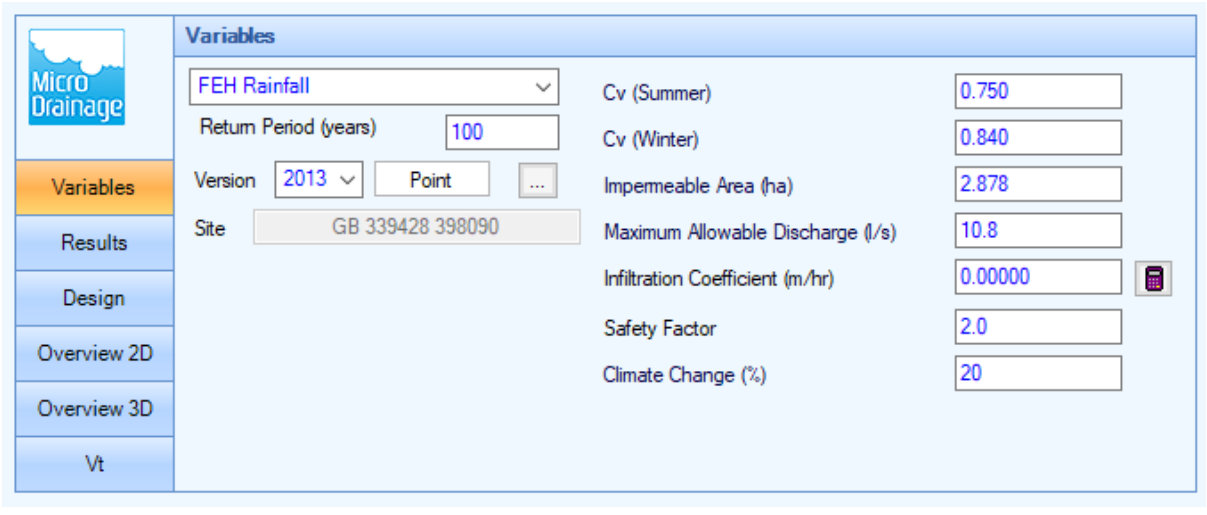


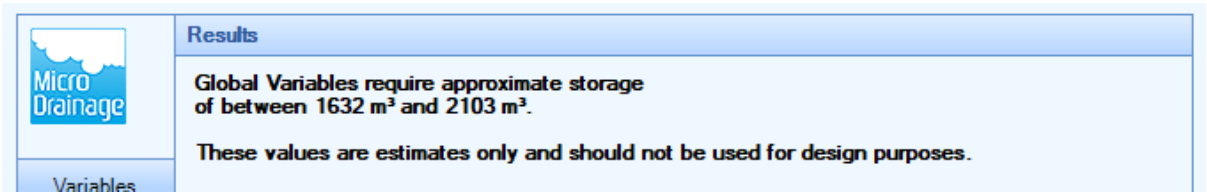
100 YEAR RETURN PERIOD STORM EVENT + 10% CLIMATE CHANGE





100 YEAR RETURN PERIOD STORM EVENT + 20% CLIMATE CHANGE

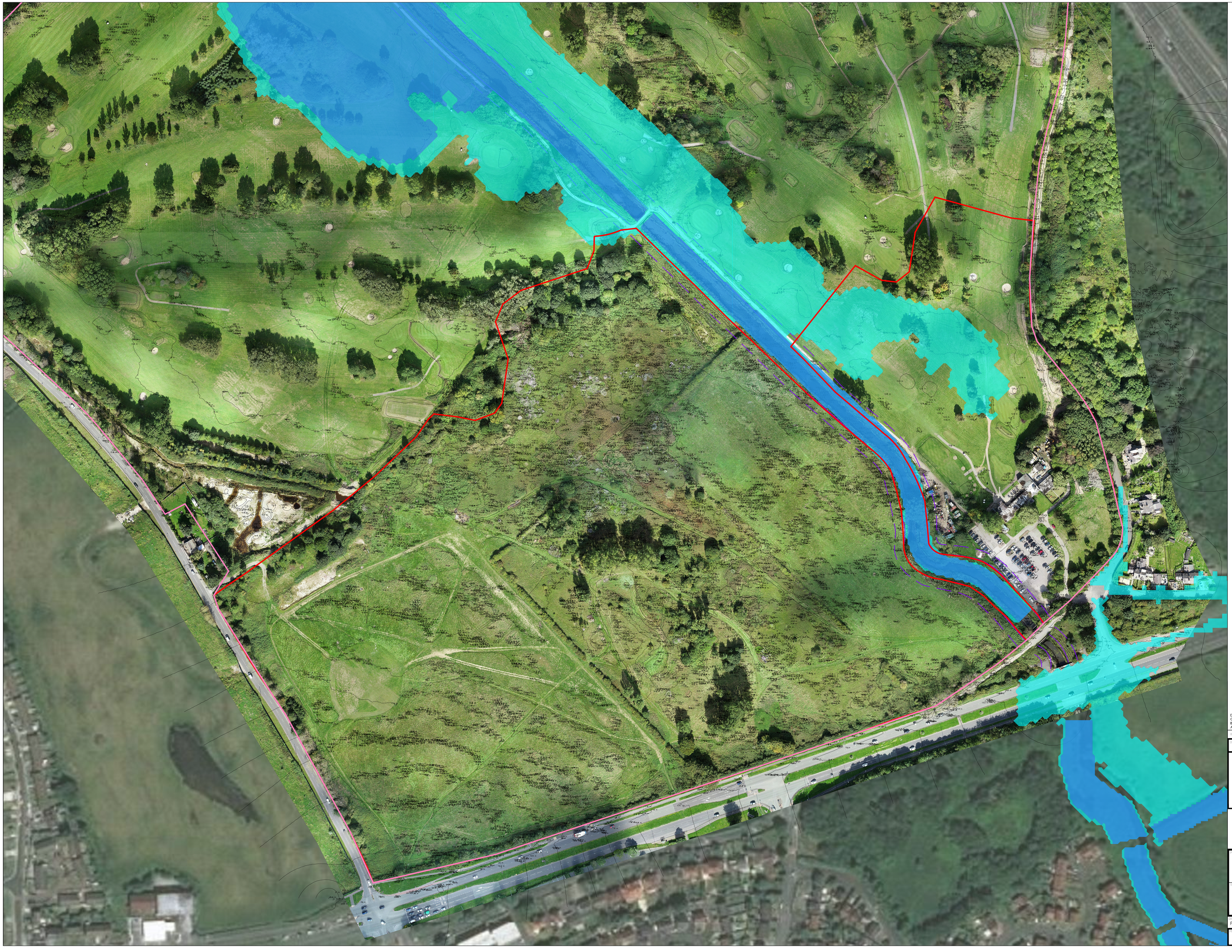




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APPENDIX L: FLOOD RISK PLAN OVERLAYS

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DO NOT SCALE

LEGEND:

WIDER SITE OWNERSHIP

DEVELOPMENT SITE AREA

EXISTING FEATURES

CONTOURS

17.5m LEVELS

TOP OF BANK
(ESTIMATED BASED ON AERIAL IMAGERY & SITE OBSERVATIONS)

8m EASEMENT FROM TOP OF BANK

FLOOD ZONES
(BASED ON THE ENVIRONMENT AGENCY SHAPEFILES FROM GOV.UK, PUBLISHED APRIL 2019)

FLOOD ZONE 3

FLOOD ZONE 2

REV	DATE	BY	DESCRIPTION	CHK
D	18.02.21	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
C	10.02.20	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
B	07.08.19	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
A	05.08.19	KW	PRELIMINARY FOR REVIEW	RDN

DRAWING STATUS:
PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Manse Farm Barns, Manse Road, Scotland, Flintshire CH5 2LY
Tel: 07734 785041 enquiries@betts-consulting.co.uk

CLIENT:
L32 TRADING LTD

PROJECT:
KIRKBY VALLEY GOLF CLUB
LIVERPOOL

TITLE:
FLOOD ZONE PLAN
(Based on EA 2019 Release Shapfiles)

DATE:	SCALE @ A0:	DRAWN:	CHECKED:
FEB 2021	1:1000 @ A0	KW	RDN

PROJECT:	DRAWING No:	REV:
HYD444	100	d

DO NOT SCALE

LEGEND:

- WIDER SITE OWNERSHIP
- DEVELOPMENT SITE AREA

EXISTING FEATURES

- CONTOURS
- 17.5m LEVELS
- TOP OF BANK (ESTIMATED BASED ON AERIAL IMAGERY & SITE OBSERVATIONS)
- 8m EASEMENT FROM TOP OF BANK

FLOOD ZONES

(BASED ON THE ENVIRONMENT AGENCY SHAPEFILE DATA OBTAINED FROM GOV.UK, PUBLISHED APRIL 2019)

- FLOOD ZONE 3
- FLOOD ZONE 2

REV	DATE	BY	DESCRIPTION	CHK
D	18.02.21	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
C	10.02.20	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
B	07.08.19	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
A	05.08.19	KW	PRELIMINARY FOR REVIEW	RDN

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel. 01244 280041 inquiries@betts-hydro.co.uk

L32 TRADING LTD

PROJECT:

KIRKBY VALLEY GOLF CLUB
LIVERPOOL

TITLE:

FLOOD ZONE PLAN
WITH PLANNING LAYOUT
(Based on EA 2019 Release Shapfiles)

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
FEB 2021	1:1000 @ A0	KW	RDN

PROJECT No:	DRAWING No:	REV:
HYD444	200	D



DO NOT SCALE

LEGEND:

- WIDER SITE OWNERSHIP
- DEVELOPMENT SITE AREA

EXISTING TOPOGRAPHY

- CONTOURS
- 17.5m LEVELS

SURFACE WATER EXTENTS
(BASED ON THE ENVIRONMENT AGENCY RoFSW SHAPEFILE DATA OBTAINED FROM GOV.UK, PUBLISHED APRIL 2019)

- 1 IN 30YR EXTENTS (HIGH RISK)
- 1 IN 100YR EXTENT (MEDIUM RISK)
- 1 IN 1000YR EXTENT (LOW RISK)

REV	DATE	BY	DESCRIPTION	CHK
D	18.02.21	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
C	10.02.20	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
B	07.08.19	KW	UPDATED RED EDGE FROM NEW LAYOUT	RDN
A	05.08.19	KW	PRELIMINARY FOR REVIEW	RDN

PLANNING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel. 01244 260041 enquiries@betts-consultants.co.uk

L32 TRADING LTD

PROJECT:
KIRKBY VALLEY GOLF CLUB
LIVERPOOL

TITLE:
SURFACE WATER FLOOD EXTENTS WITH PLANNING LAYOUT PLAN
(Based on EA 2019 Release Shapfiles)

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
FEB 2021	1:1000 @ A0	KW	RDN

PROJECT No:	DRAWING No:	REV:
HYD444	201	D

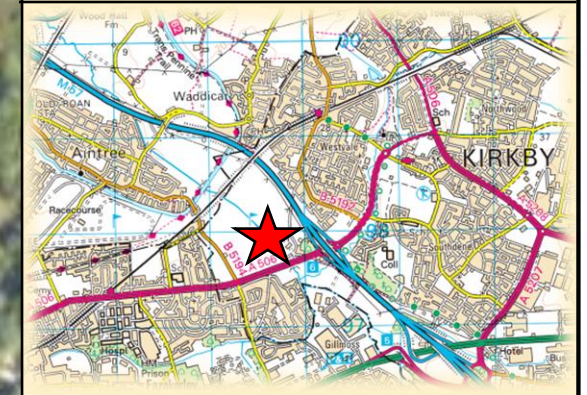
APPENDIX M: PROPOSED DRAINAGE PLANS

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SITE: Kirkby Valley Golf Club, Liverpool
REF: HYD444
REV: 2.2
DATE: 18/02/2021

BETTS HYDRO CONSULTING ENGINEERS

PRELIMINARY PROPOSED DRAINAGE STRATEGY PLAN



LEGEND

Site Extent

Existing Drainage Features

- Main River
- Ordinary Watercourse
- Ponds

Existing Sewer Network

- Public Foul Water Sewer
- Public Surface Water Sewer
- Private Surface Water Sewer
- Public Combined Water Sewer
- Public Overflow Sewer
- Existing SW Connection (assumed)

Proposed Drainage Connections

Opt.1: Surface Water to Ground

- *Soakaways*
- *Permeable Surfacing*

Opt.2: Surface Water to Watercourse

- *Connection to River Alt*
- Tee/Land Drainage Proposed
- Foul Water to Public Sewer

FURTHER NOTES:

This drawing is not a drainage 'design' it is a preliminary drainage strategy showing indicative sewer locations. No hydraulic simulation or assessment of these proposals has been undertaken. Proposed points of connection to the existing culverts require invert levels to be accurately established. Surcharging of the proposed outfall will require modelling to satisfy the requirements of united utilities along with full hydraulic analysis.

SITE: Kirkby Valley Golf Club, Liverpool

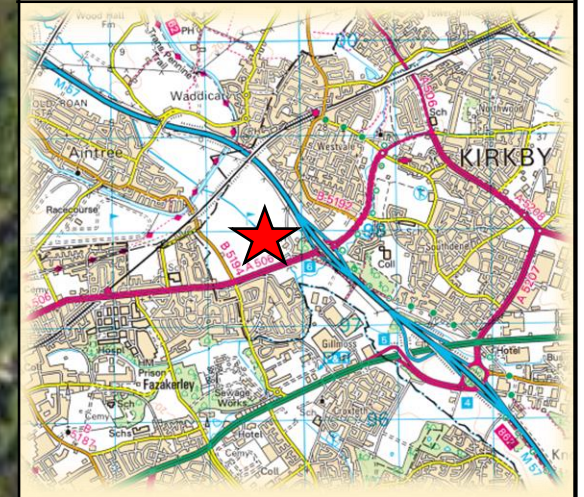
REF: HYD444

REV: 0

DATE: 06/08/2019

BETTS HYDRO CONSULTING ENGINEERS

EXISTING DRAINAGE PLAN



RIVER ALT

M57

INGOE LANE

AINTREE LANE

VALLEY ROAD (A506)

FIELD LANE

LEGEND

Site Extent

Existing Drainage Features

- Topography
- Main River
- Ordinary Watercourse
- Ponds

Existing Sewer Network

- Public Foul Water Sewer
- Public Surface Water Sewer
- Private Surface Water Sewer
- Public Combined Water Sewer
- Public Overflow Sewer

FURTHER NOTES:

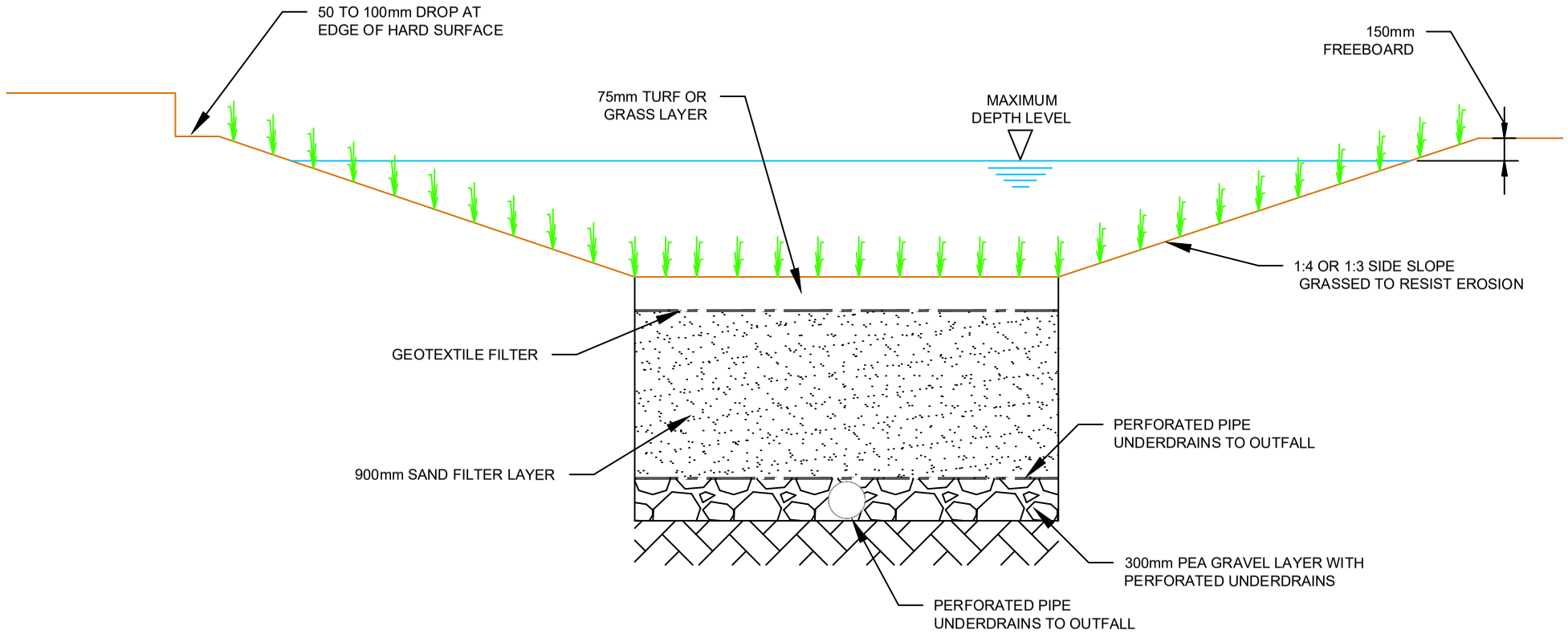
This drawing is not a drainage 'design' it is a preliminary drainage strategy showing existing sewer locations. It should be noted the drainage plan only shows key UU sewers within proximity to the site. Please see UU sewer records in Appendix C for full details

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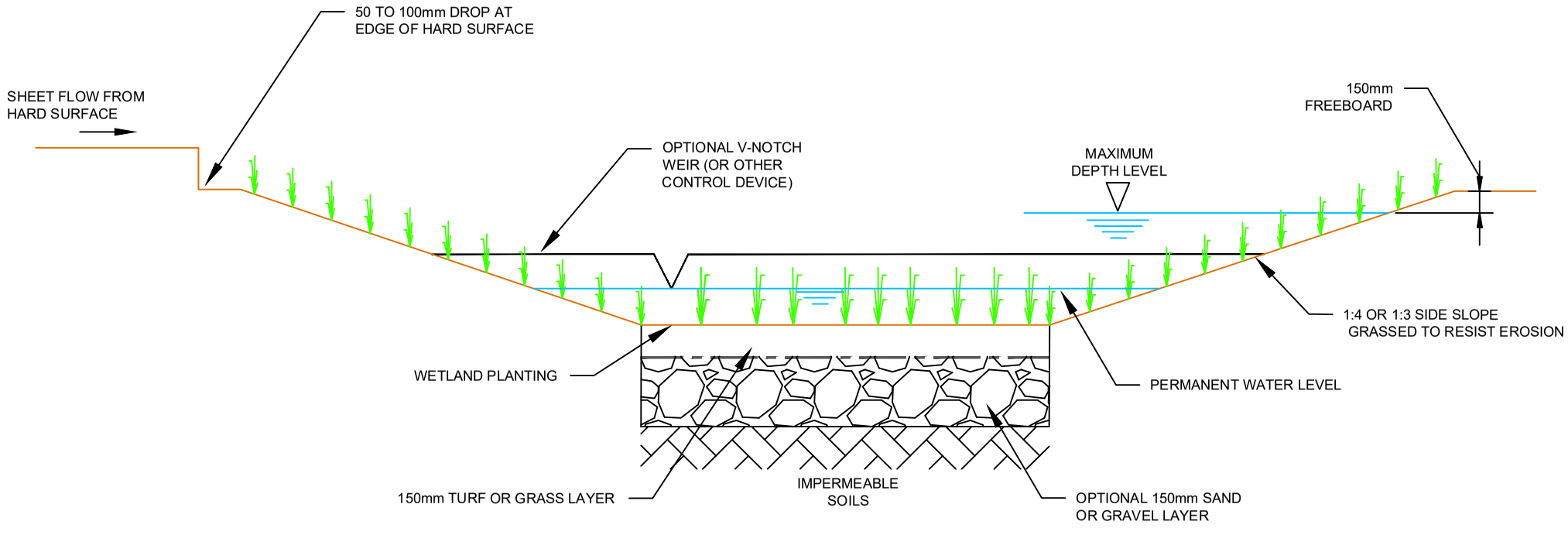
APPENDIX N: TYPICAL SUDS DETAILS

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DO NOT SCALE



DRY SWALE



WET SWALE

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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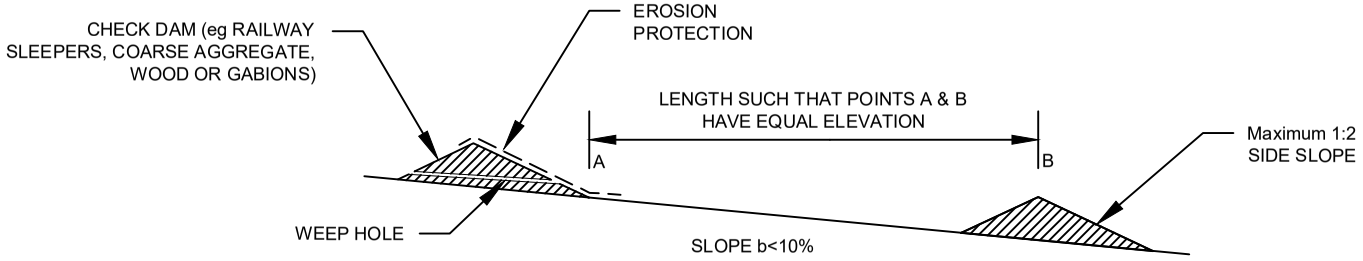
PROJECT: TYPICAL SUDS DETAIL

TITLE: SWALES (1 of 2)

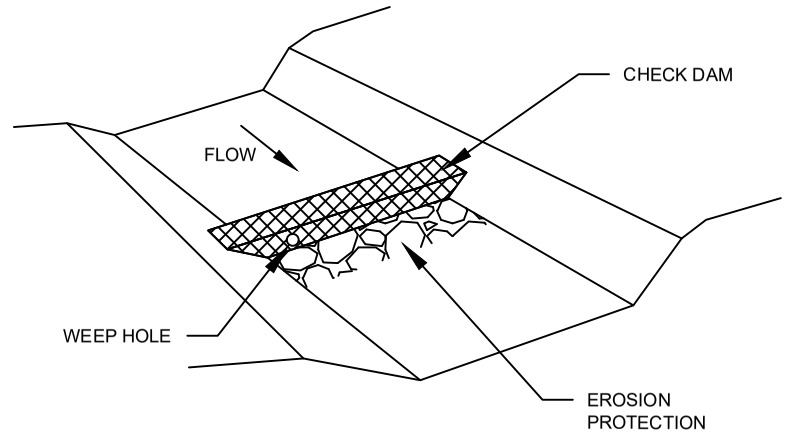
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	103	A

DO NOT SCALE

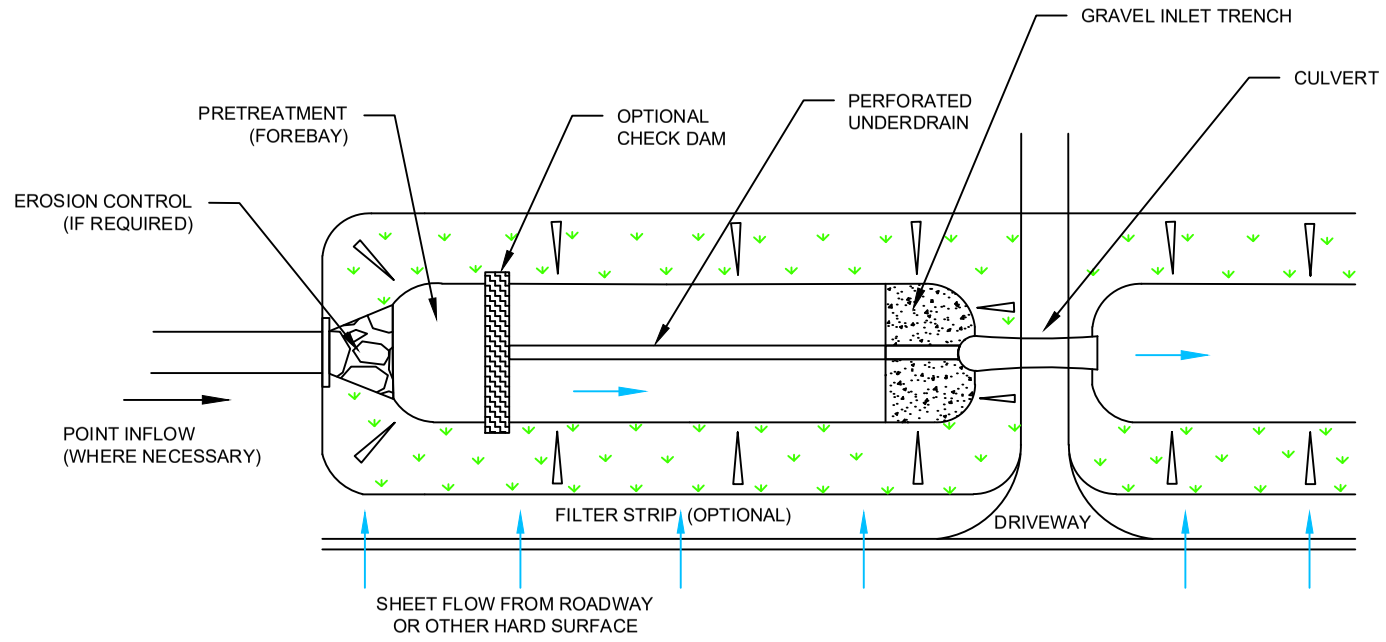


ELEVATION



SCHEMATIC

CHECK DAM



ENHANCED DRY SWALE

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

BETTS ASSOCIATES
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Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
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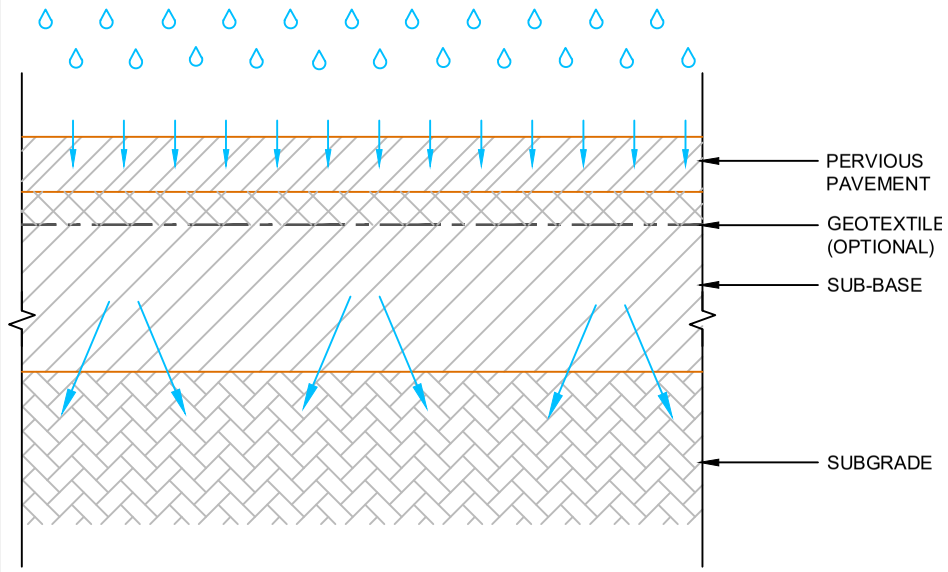
PROJECT: TYPICAL SUDS DETAIL

TITLE: SWALES (2 of 2)

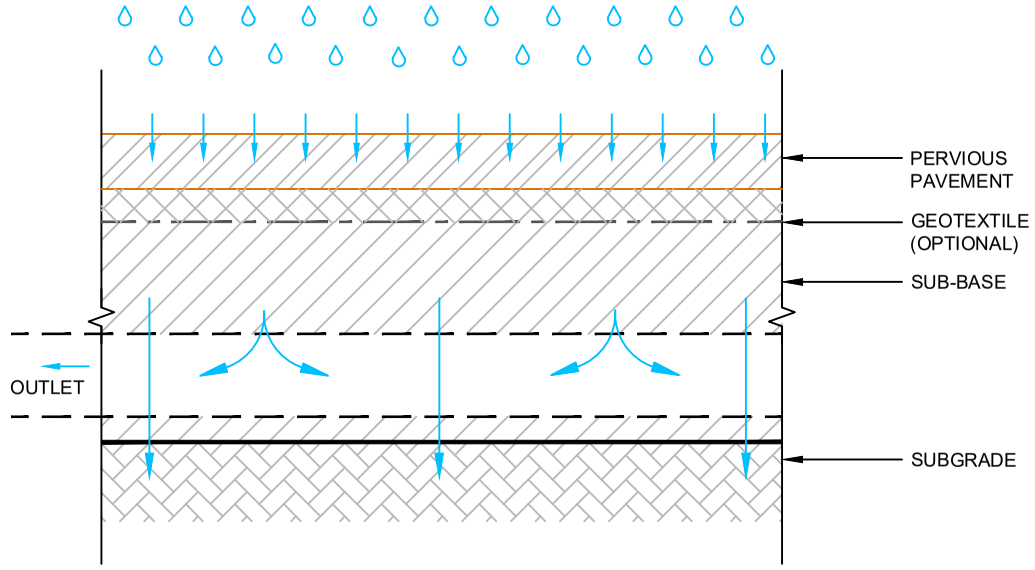
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SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	104	A

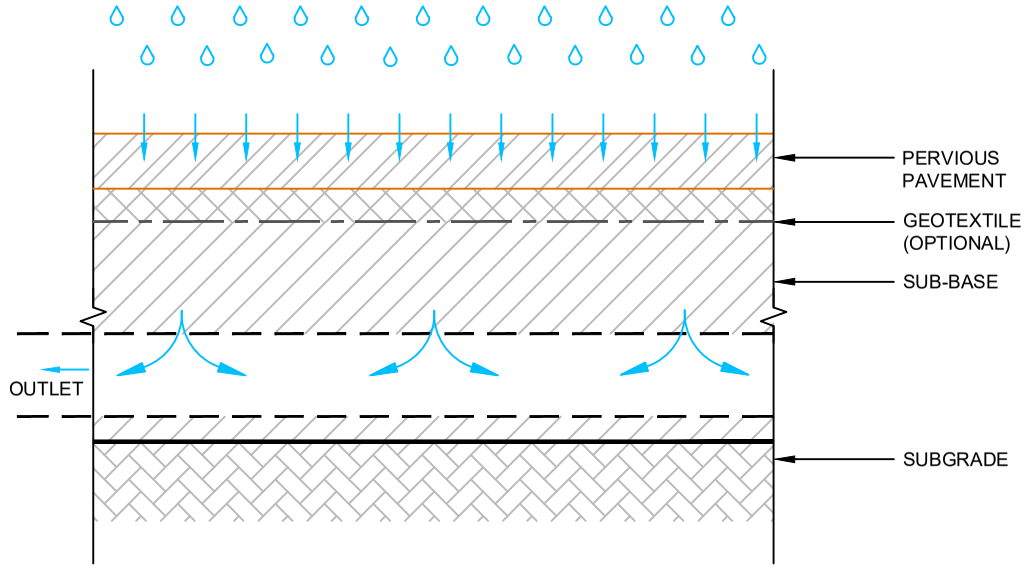
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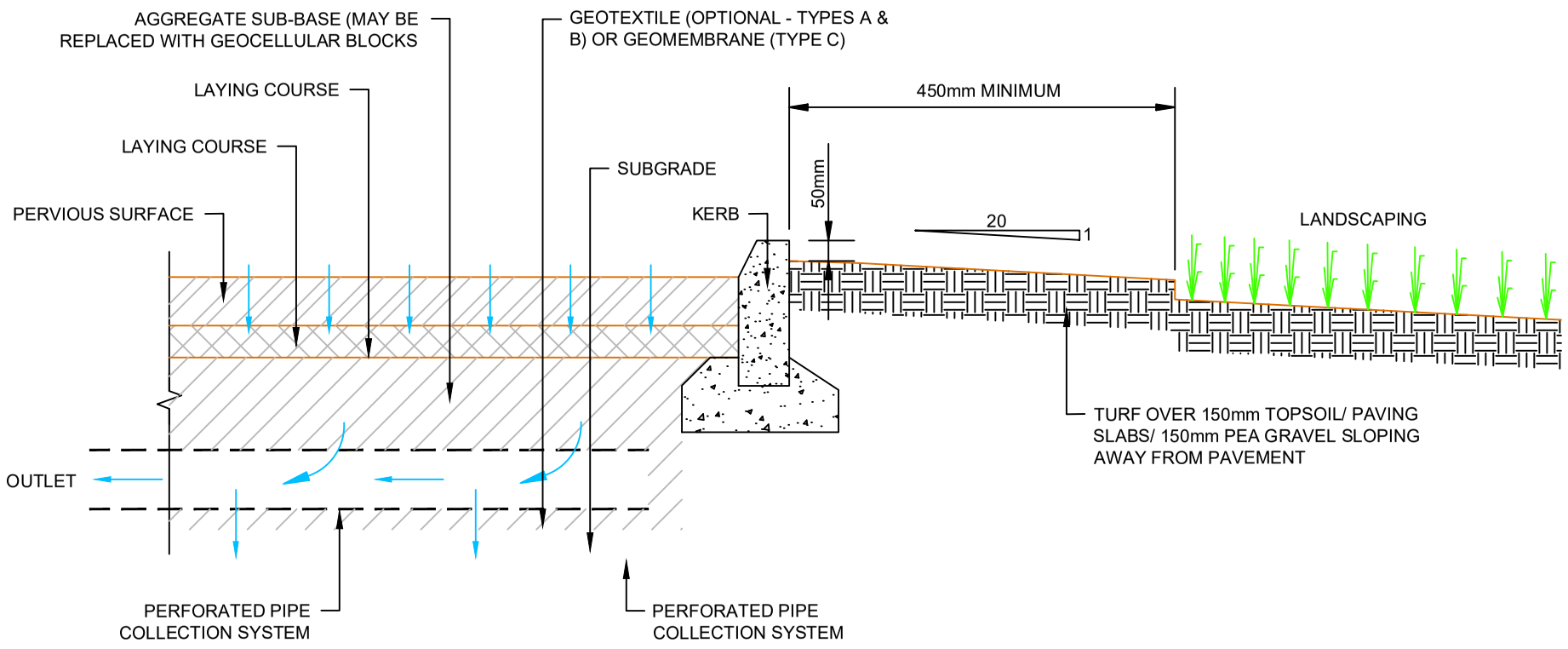
TYPE A: TOTAL INFILTRATIPN



TYPE B: PARTIAL INFILTRATION



TYPE C: NO INFILTRATION



LANDSCAPING DETAIL

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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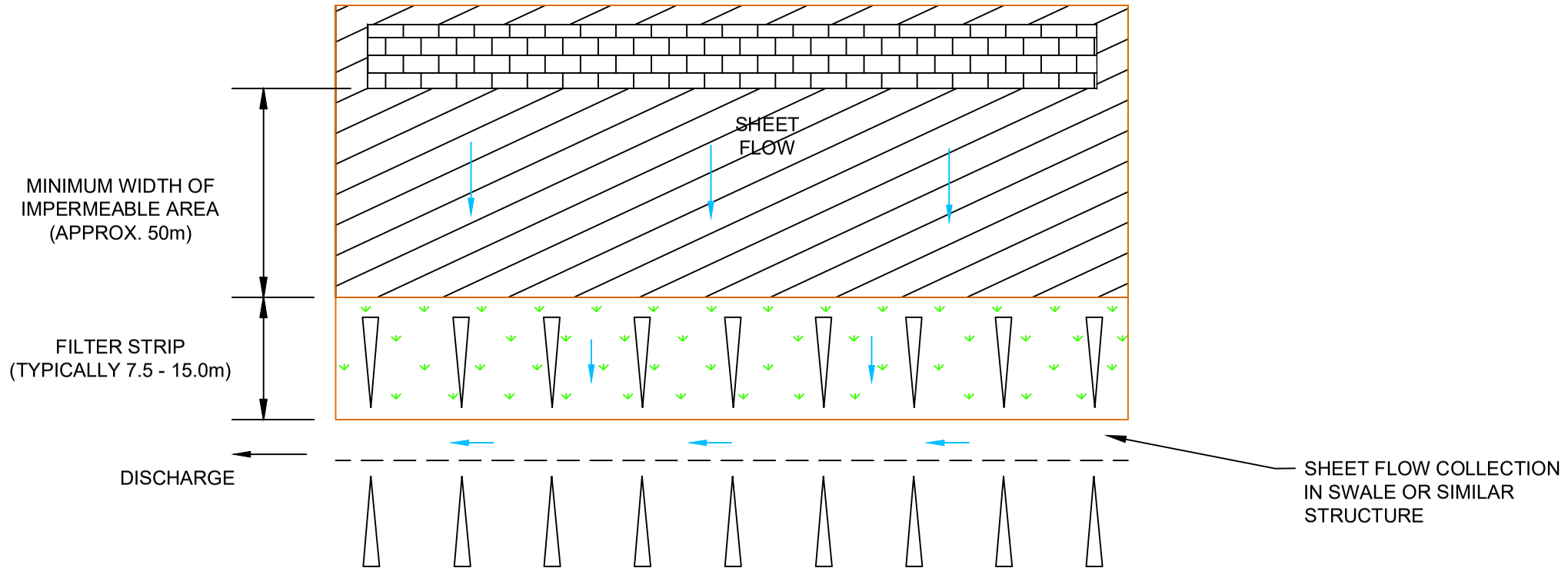
PROJECT: TYPICAL SUDS DETAIL

TITLE: PERVIOUS PAVEMENTS

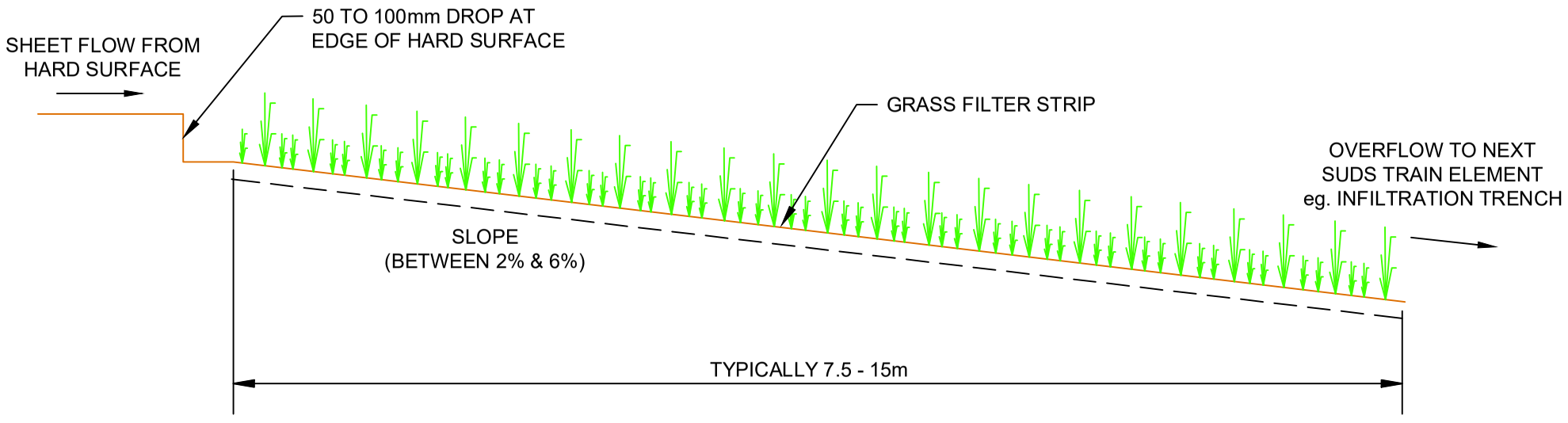
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SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	105	A

DO NOT SCALE



PLAN



ELEVATION

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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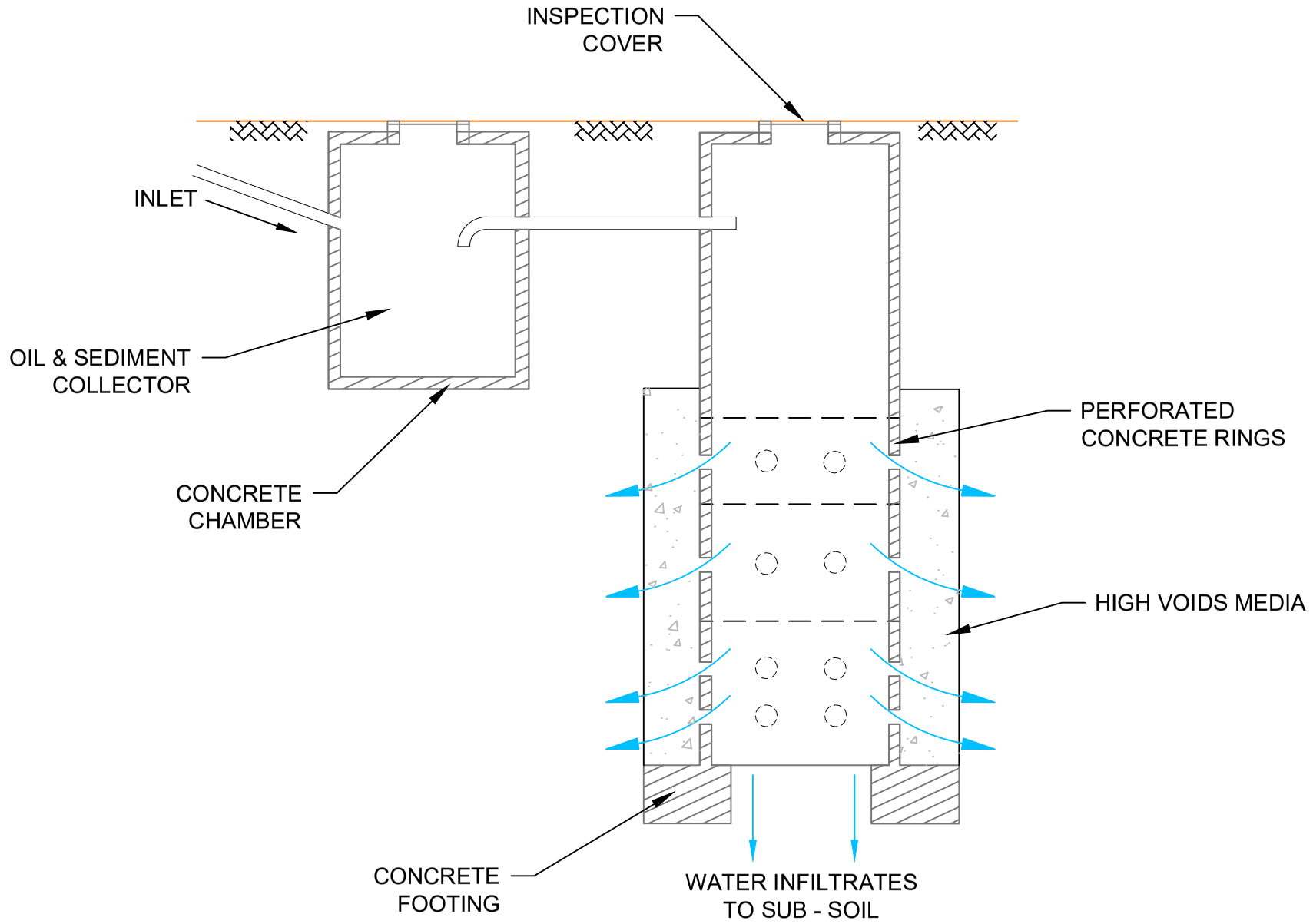
PROJECT: TYPICAL SUDS DETAIL

TITLE: FILTER STRIPS

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	107	A

DO NOT SCALE



SOAKAWAY DETAILS (INCLUDING PRE-TREATMENT DEVICE)

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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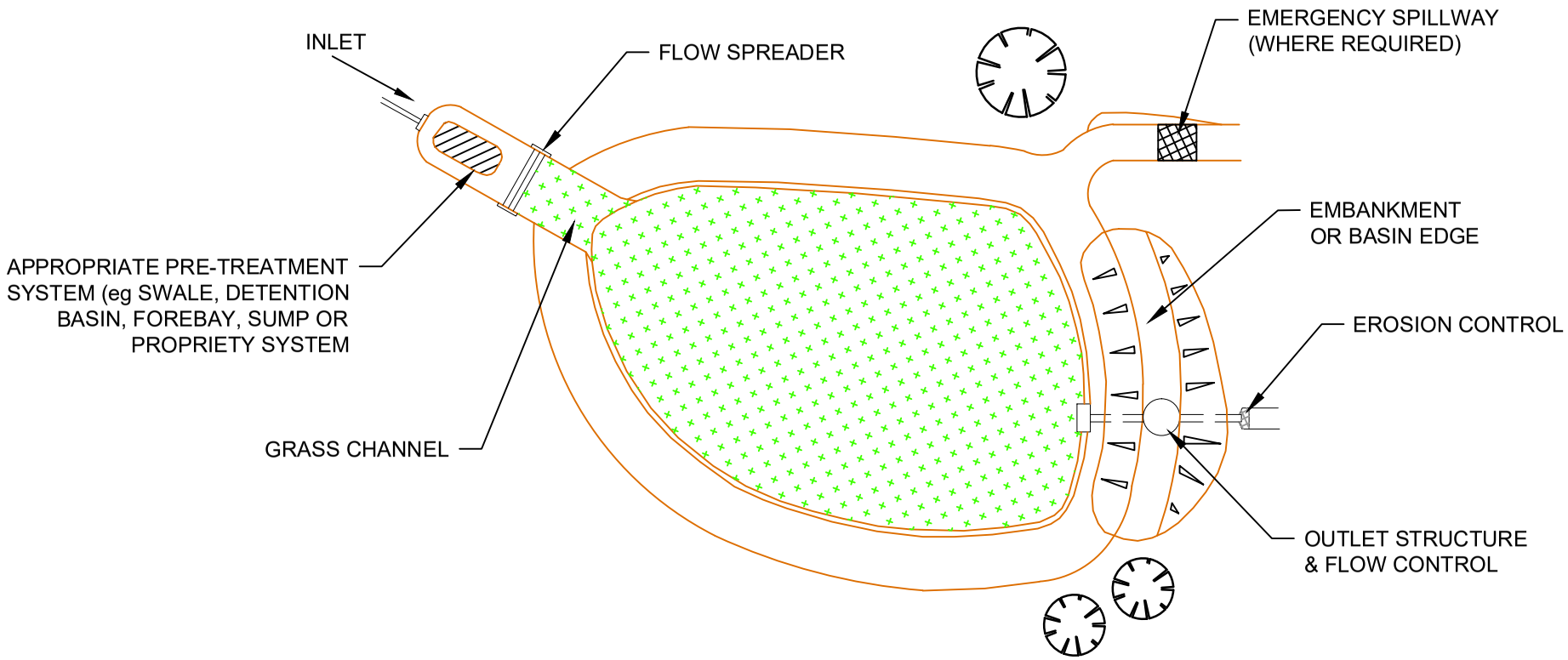
PROJECT: TYPICAL SUDS DETAIL

TITLE: SOAKAWAYS

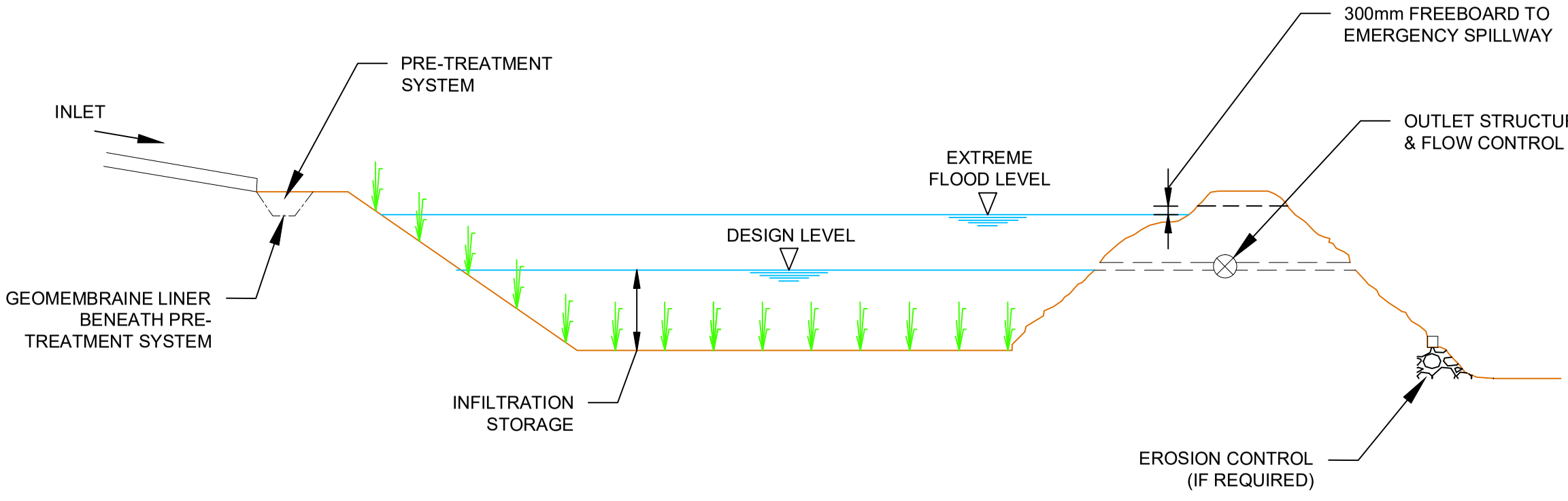
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	108	A

DO NOT SCALE



PLAN VIEW



ELEVATION

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

BETTS ASSOCIATES
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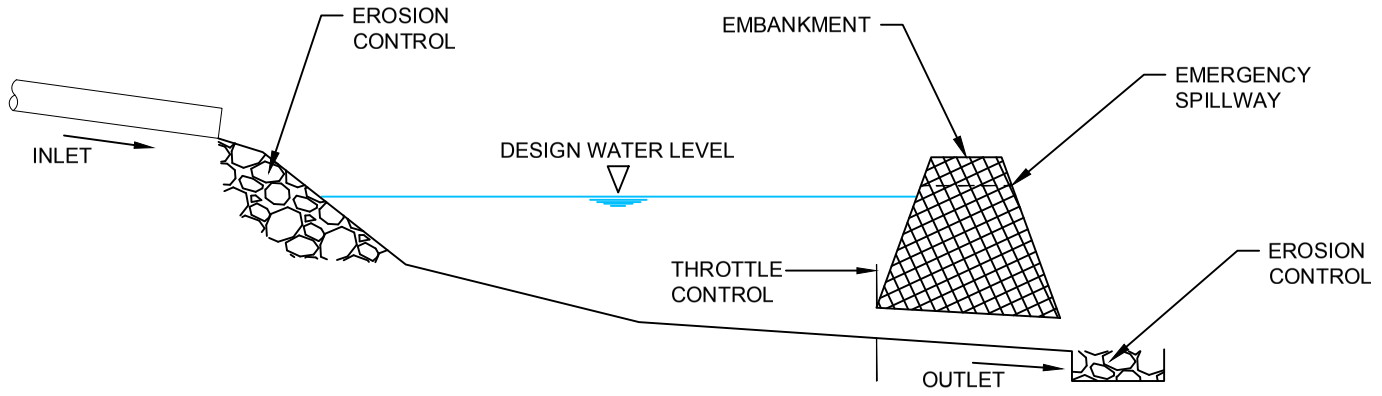
PROJECT: TYPICAL SUDS DETAIL

TITLE: INFILTRATION BASINS

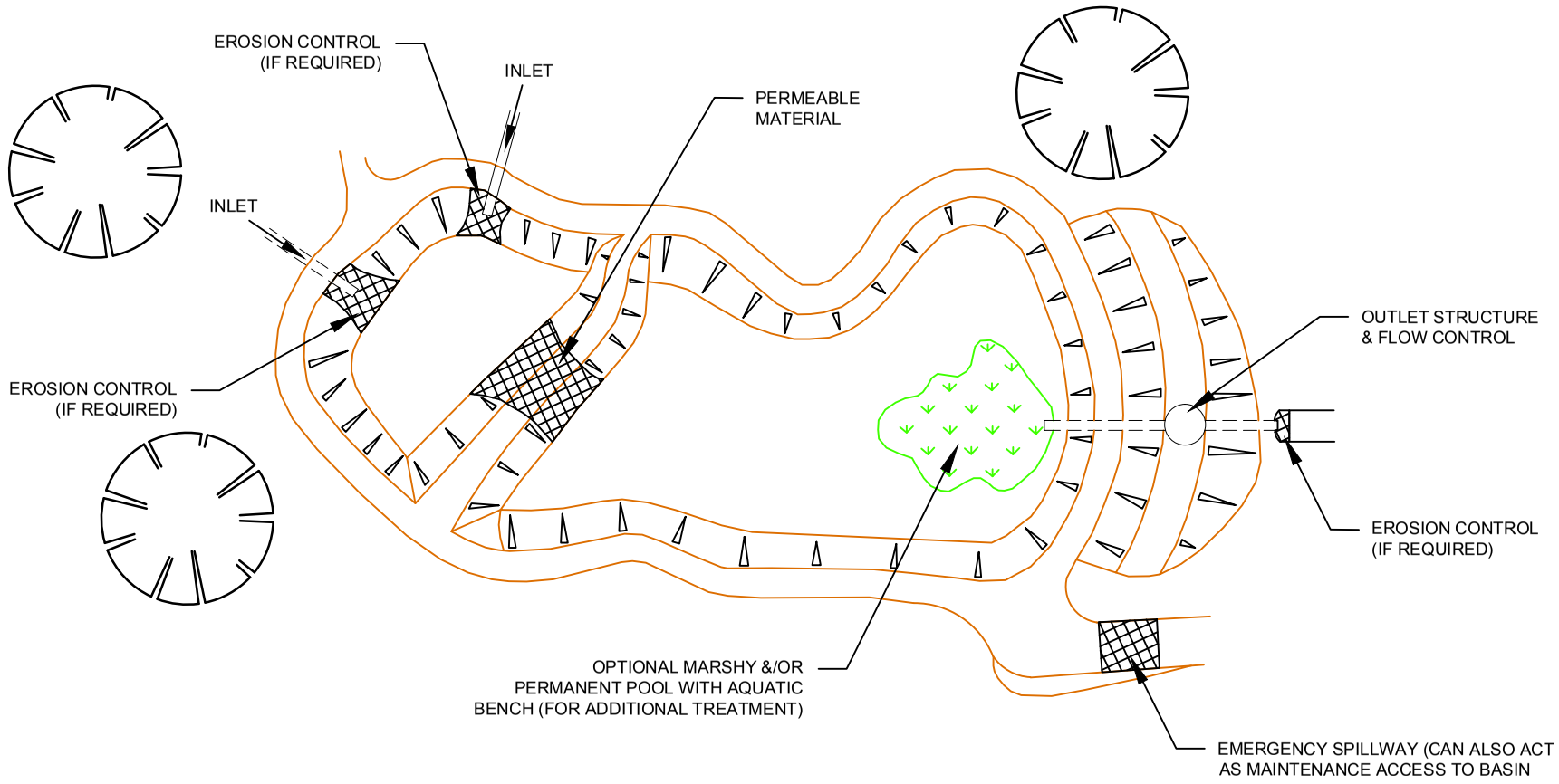
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SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	109	A

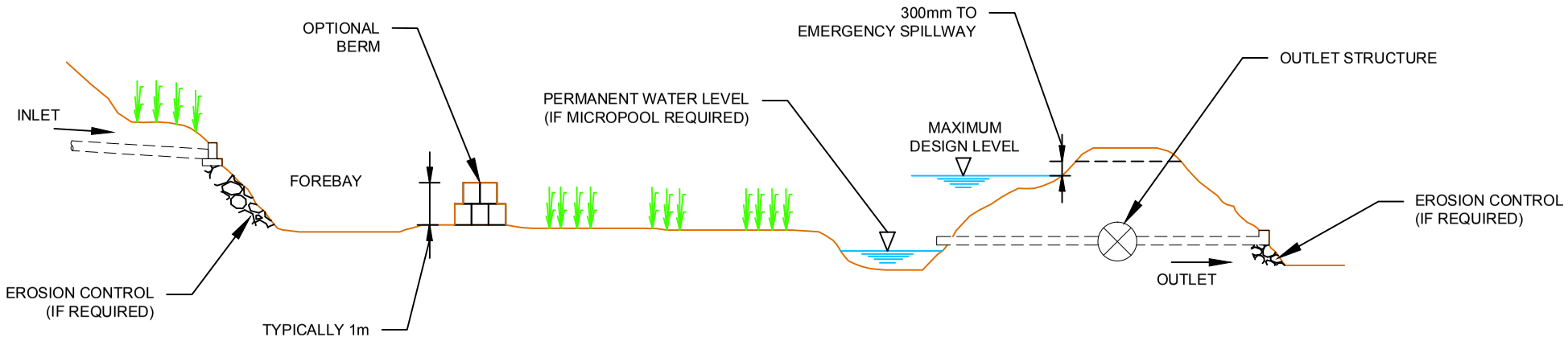
DO NOT SCALE



SCHEMATIC OF DETENTION BASIN PROFILE



PLAN VIEW



ELEVATION

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

BETTS ASSOCIATES
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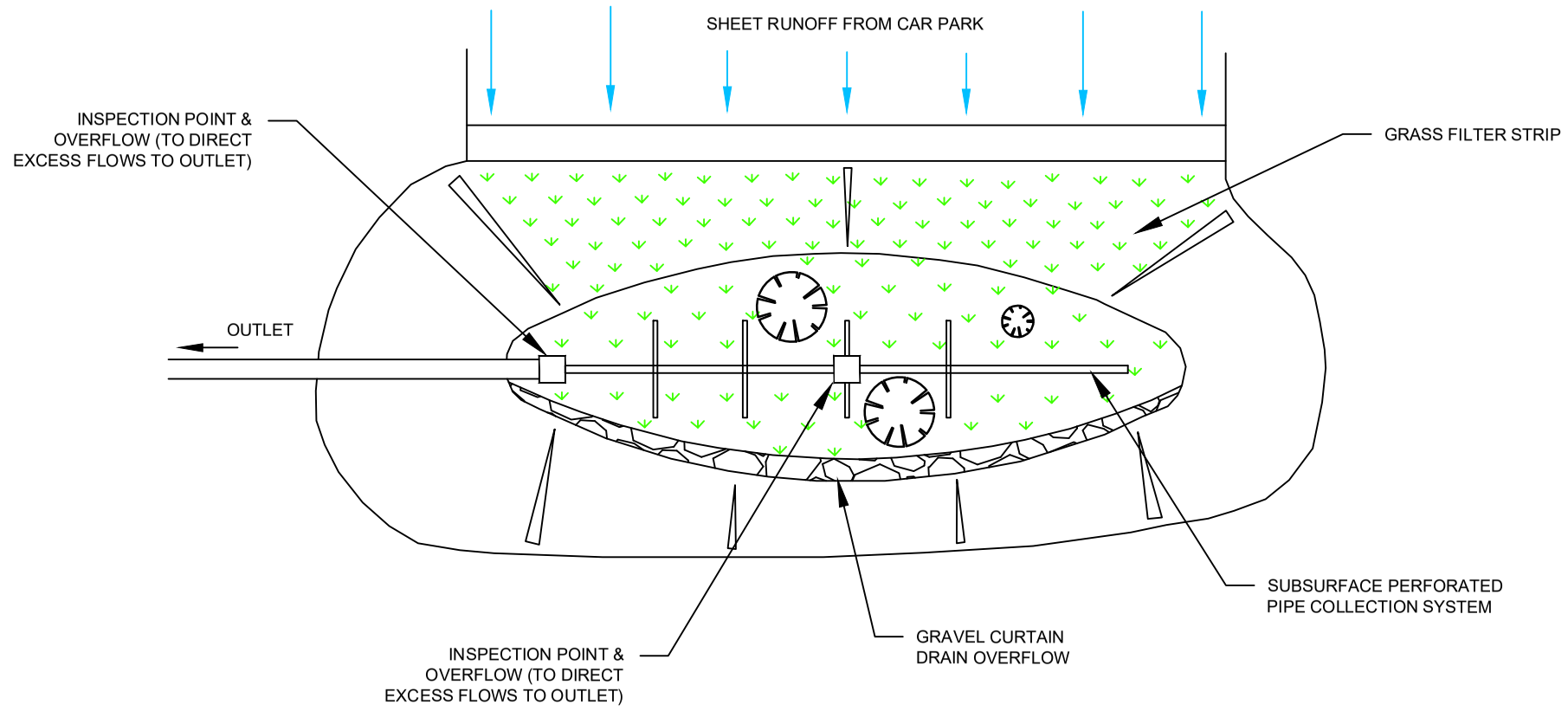
PROJECT: TYPICAL SUDS DETAIL

TITLE: DETENTION BASINS

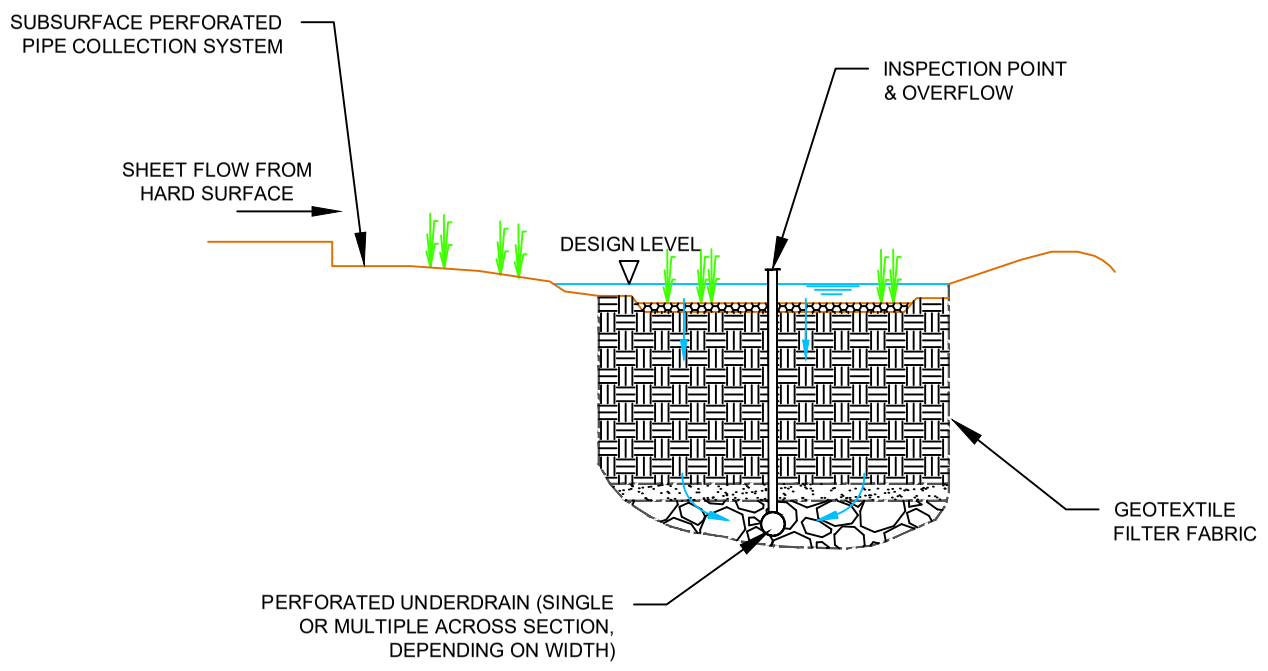
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SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	110	A

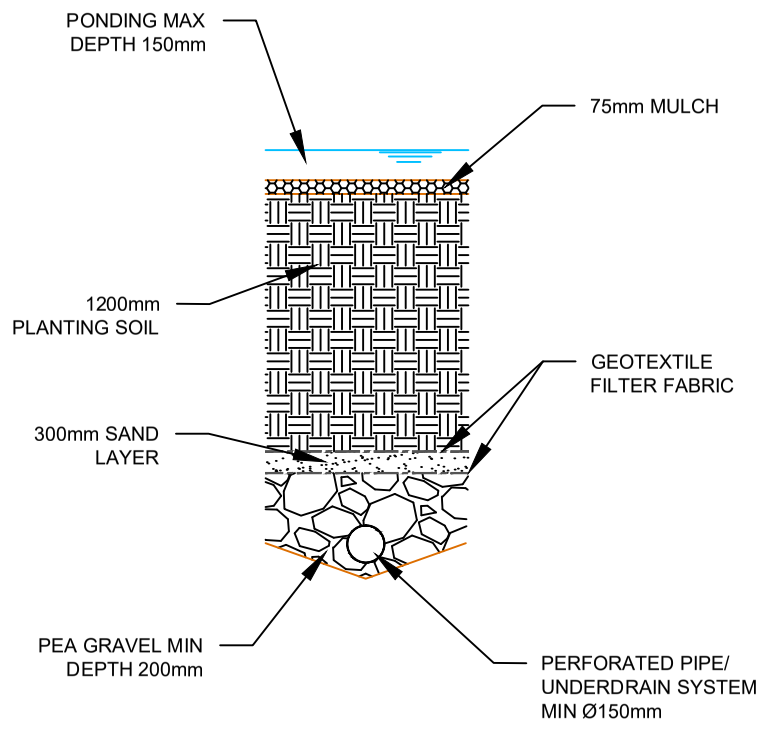
DO NOT SCALE



PLAN VIEW



PROFILE



TYPICAL SECTION

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

BETTS ASSOCIATES
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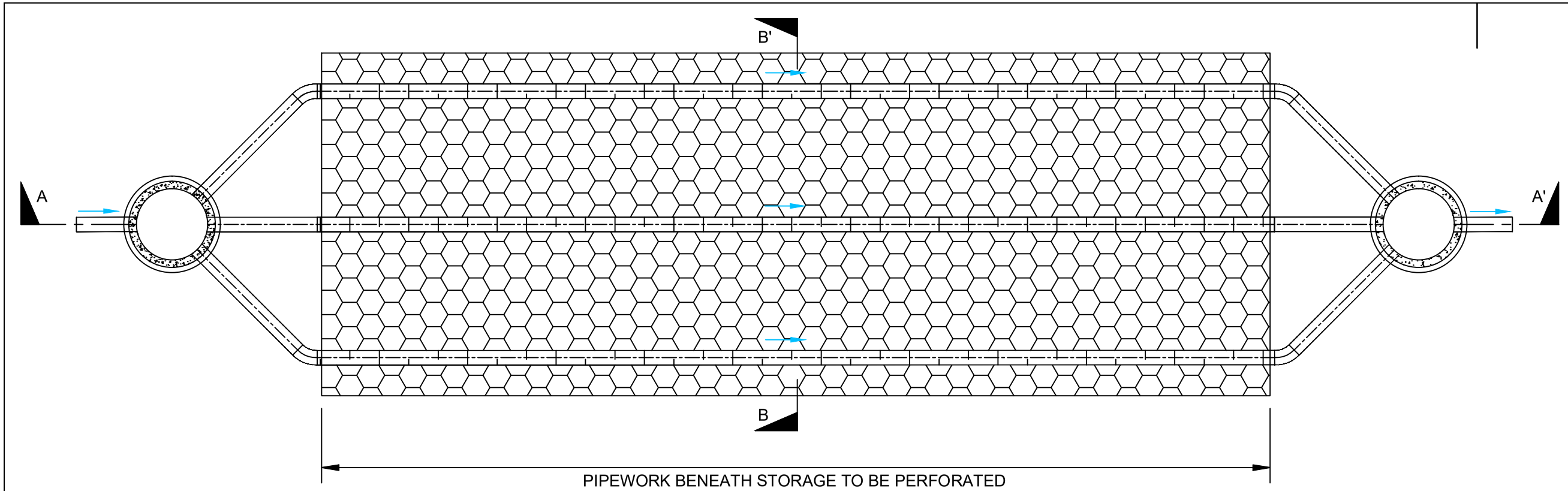
PROJECT: TYPICAL SUDS DETAIL

TITLE: BIORETENTION APPLICATIONS

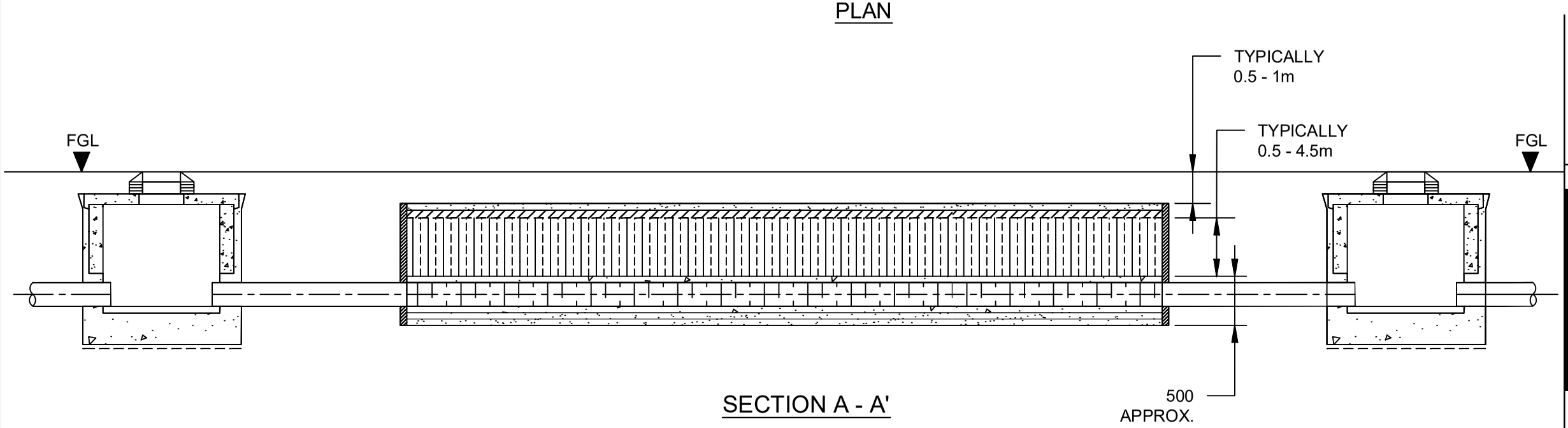
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	112	A

DO NOT SCALE

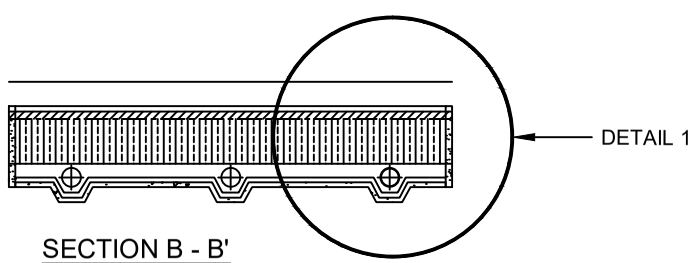


PLAN

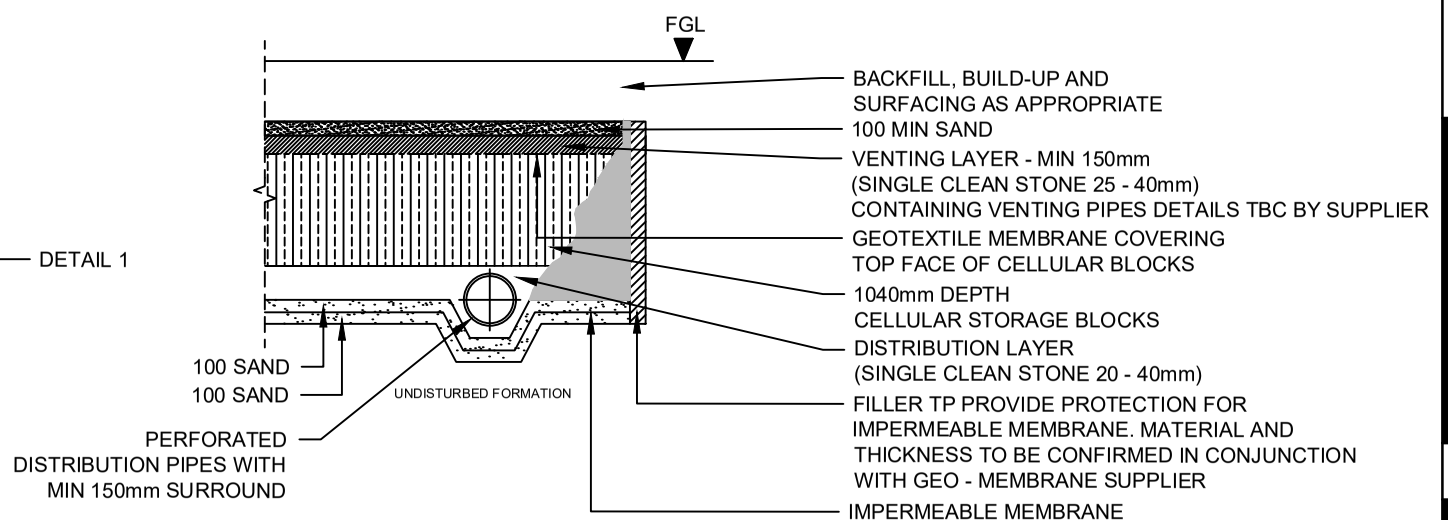


SECTION A - A'

ALL DIMENSIONS AND DEPTHS DEPENDENT ON REQUIRED VOLUME AND LOCAL GROUND CONDITIONS



SECTION B - B'



DETAIL 1

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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PROJECT: TYPICAL SUDS DETAIL

TITLE: CELLULAR STORAGE

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	113	A

APPENDIX O: NOTES OF LIMITATIONS

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

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

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This document has been prepared for the titled project only and should any third party wish to use or rely upon the contents of the report, written approval from Betts Hydro Ltd must be sought.

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