

Industrie Cartarie Tronchetti (ICT) UK Limited and Crag Hill
Estates Ltd (CHEL)

Paper Mill Facility, Plot C

Airfields, Northern Gateway

Environmental Statement

Part 2 – Water Environment Technical Paper 3

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I. Introduction

- I.1. Arcadis Consulting (UK) Limited ('Arcadis') has been commissioned by Industrie Cartarie Tronchetti (ICT) UK Limited ('the Client') and Crag Hill Estates Limited (CHEL) to prepare this Water Environment Technical Paper which forms part of the Environmental Statement for the proposed ICT Paper Mill facility at the Airfields site, Northern Gateway in Deeside.
- I.2. This Paper addresses the likely effects of the Proposed Development on the surface water environment, specifically flood risk, surface and foul water drainage and water quality aspects. Both effects on and caused by the Proposed Development are considered. A full description of the Proposed Development is given in the Environmental Statement Project Description (ES Part I Report). This Paper is informed by the Flood Consequences Assessment (FCA) in Appendix 3.1, as well as drainage information provided by the project design team. An assessment of the effects of the proposed process effluent discharge to the River Dee has also been undertaken and is reported on in Appendix 3.2.
- I.3. The Paper Mill Facility will be developed in three phases, as described in Section 2 of the ES Part I Report. In this Technical Paper both 'construction' and 'operation' phases of the development are assessed for the potential to result in effects on surface water quality, drainage patterns and flood risk. The potential impacts associated with the issues covered in this Technical Paper interact with other technical areas. This Paper should be read in conjunction with those Papers covering Geology and Ground Conditions (Technical Paper 1) and Ecology and Nature Conservation (Technical Paper 5).
- I.4. This Technical Paper is structured such that initially a summary of relevant legislation and policy is provided, together with a description of the other documents and resources that have been referenced. Details of the consultation undertaken, and the methodologies used to assess the potential significant effects of the Proposed Development are provided, and the existing characteristics of the water features on and near the Site are described. Alternatives are considered and the effects of the Proposed Development are then presented considering, for example, the proximity of development infrastructure to surface waterbodies and the types of construction activities required. Where impacts have not been prevented by design, measures to mitigate effects are described. This is followed by a summary of the remaining residual effects and an assessment of potential cumulative effects.

2. Documents Consulted

Legislation, Policy and Guidance

- 2.1. The assessment has been conducted with reference to relevant legislation specific to surface water quality, drainage and flood risk. In addition, relevant policy and guideline documents have also been considered.

Legislative Background

- 2.2. Relevant legislation that protects the water environment includes:
- The Water Framework Directive (WFD) Regulations, amended by the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019), specifically Regulation 20. This Regulation sets out that, following the EU Exit, the substance of the WFD regime which applied pre-EU Exit will continue to apply with only relatively minor amendments. The framework provides for the protection of surface (fresh) water, estuaries, coastal waters and groundwater. The objectives of the Directive are to enhance the status, and prevent further deterioration of aquatic ecosystems, promote the sustainable use of water, reduce pollution of water and ensure progressive reduction of groundwater pollution;
 - The Flood and Water Management Act 2010, that encourages the use of sustainable drainage techniques; and
 - The Water Resources Act 1991/2003, under which it is a criminal offence to knowingly permit any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters.

Policy

- 2.3. Planning Policy Wales (PPW) (Edition 11) sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes (TANs). The TAN applicable to this assessment is TAN 15: Development and Flood Risk. This advises on development and flood risk and provides a framework within which risks arising from both river and coastal flooding, and from additional runoff from development in any location, can be assessed.
- 2.4. Flintshire County Council (FCC) has produced a Unitary Development Plan (UDP) for its area, under The Town and Country Planning Act 1990, as amended by the Planning and Compensation Act 1991 and the Local Government Wales Act 1994. This Technical Report

pays attention to policies STR1 (part e & f), STR7 (part e & f), GEN1 (part i), EWPI6 and EWPI7 within the UDP.

2.5. The following standards and guidelines, which provide details of assessment methodologies and mitigation techniques, have also been referred to:

- Natural Resources Wales (NRW) Guidance for Pollution Prevention (GPP), formerly known as Pollution Prevention Guidelines (various publication dates);
- Construction Industry Research & Information Association (CIRIA) C741 – Environmental Good Practice on Site, 4th Ed.2015;
- CIRIA C753F – The SuDS Manual, 2015;
- CIRIA C649 – Control of Water Pollution from Linear Construction Projects, 2006;
- British Standards Institute (BSI)-Code of Practice for Earthworks (BS6031)
- Road Drainage and the Water Environment (LA 113) (Highways England & Welsh Government, 2020).

Documents Referenced for Baseline Data

2.6. To determine the likely effects of the Proposed Development, it was first necessary to gain an understanding of the current status of the surface water environment within the study area. The following resources were consulted to collect baseline data:

- Soils Map of England and Wales (1:250,000) (Soil Survey of England & Wales, 1983)
- Development Advice Map for Flintshire (Welsh Government and Natural Resources Wales, 2021)
- Dee River Basin Management Plan (Natural Resources Wales & Environment Agency, 2015)
- Dee Catchment Flood Management Plan Summary Report (Environment Agency, 2010)
- Dee Catchment Abstraction Management Strategy (NRW, 2015)
- Flintshire County Council Preliminary Flood Risk Assessment (FCC, 2011) and Addendum (FCC, 2018)
- Chronology of British Hydrological Events (cbhe.hydrology.org.uk)
- Flood Estimation Handbook Web Service (CEH, 2021)
- National River Flow Archive (CEH, 2021)
- NRW data request response providing available sampling/monitoring data (NRW, September 2019), updated using the online Water Quality data archive (DEFRA, 2021).

2.7. In addition, interactive maps on the NRW website have been used to collect information about the location and extent of flood risk zones. NRW have also provided access to reports

and hydraulic models developed for flood risk studies in the Dee catchment, as detailed in the FCA included as Appendix 3.1.

- 2.8. NRW's Public Register and the Lle Geo-Portal were reviewed to identify any existing licensed abstractions from surface water sources and consented discharges in proximity to the Site.
- 2.9. Dwr Cymru Welsh Water (DCWW) utilities plans illustrating foul and surface water drainage infrastructure within the study area were referenced to define baseline land drainage arrangements and details regarding drainage proposals were taken from the Project Description (ES Part 1 Report).

3. Consultations

3.1. NRW and FCC are key consultees for this Paper Mill Facility Proposal and the wider Northern Gateway development site as a whole. As such, consultation has been ongoing since the inception of the Northern Gateway development in 2006. Flood risk has been a key focus of the consultations and hence flood risk considerations, including strategic surface and foul water drainage solutions, have been built into the master planning design of the whole Northern Gateway development, benefitting the Paper Mill Development Site.

3.2. The consultation summarised in Table 3.1 is specific to the Proposed Development. A summary of previous consultation undertaken for the wider Northern Gateway development can also be found in the previous Environmental Statement associated with the grant of outline planning permission for the Sealand site, now referred to as the Airfields (ref: 058990) and the FCA and drainage information submitted with recent Plot C enabling works applications including approval of reserved matters (ref: 062057) and discharge of conditions application (ref: 061986).

Theme / Issue	Date	Consultee	Method	Summary of Discussion	Outcome / Output
Environmental Permitting	07-07-2021	National Resources Wales	Submission of request for pre-application advice	RPS Consulting are consulting with NRW regarding an Environmental Permit for the process water discharge from the paper mill.	Ongoing
Assessment Scope	09-08-2021	Flintshire County Council	Meeting	<p>The scope of the assessment was presented and key issues that need to be considered were identified.</p> <p>FCC Officer agreed with terms of the FCA outlined (i.e., in line with the principles previously approved Weetwood's FCA submitted to secure approval of Plot C enabling works)</p> <p>The FCC officer also queried the impact of phosphates and water quality in the River Dee. It was confirmed that phosphorous was one of the determinands included in the HI screening assessments for the paper mill process effluent discharge to the River Dee and it was screened out.</p>	FCC confirmed that a SuDs Approval Body (SAB) Report is not required in support of the planning application, but a SAB application will need to be submitted separately and in parallel with the planning application.

Theme / Issue	Date	Consultee	Method	Summary of Discussion	Outcome / Output
Assessment scope and flood risk/drainage mitigation	13/08/2021 and 02/09/2021	National Resources Wales	Correspondence	Engagement with NRW via paid pre-application discussions relating to the FCA and proposed surface water drainage arrangements.	NRW confirmed that the FCA should be prepared based on previous work undertaken for the wider Airfields site (planning reference 061986) and proposals for flood risk mitigation should align with those already agreed, including upgrade of the Sealand Bank culvert.

Table 3.1: Summary of Consultations and Discussions

- 3.3. As summarised above, Arcadis has worked closely with NRW and FCC during preparation of the FCA to identify potential sources of flood risk and agree on appropriate assessment methodologies.

4. Methodology and Approach

4.1. The following tasks have been undertaken in completion of this assessment:

- Desktop study to obtain baseline and historical data;
- Identification of the likely effects of the development and assessment of their significance based on the importance of the attributes of the receiving environment and the magnitude of the predicted effects;
- Identification of options for the mitigation of potential effects in accordance with applicable legislation, policies and guidance; and
- Assessment of the significance of the residual effects of the Proposed Development and consideration of the potential for cumulative effects associated with progress of development within the Northern Gateway strategic allocation, including consented development on the Airfields (CHEL) and former Corus Garden city site (PGNGL).

4.2. The assessment has been undertaken in accordance with DMRB LA 113 (formerly HD45/09). DMRB LA 113 (Highways England, 2020) sets out methods for the assessment of the potential effects of highways schemes on the water environment but is routinely adopted for assessing the effects of other forms of development. Where scoping identifies a likely significant adverse effect on the water environment, a 'simple' assessment, as detailed in Table 3.2 of LA 113, shall first be undertaken. Where any of the 'simple' assessments described confirm a likely significant adverse effect and mitigation is not incorporated to prevent the adverse effect, a 'detailed' assessment shall be undertaken using methods set out in Table 3.2 of LA 113. The assessment in this Technical Paper is also informed by the guidance on assessing significance provided in LA 113.

4.3. This assessment is also informed by the FCA (Appendix 3.1) and Marine Discharges Assessment including application of the HI screening tests (Appendix 3.2) which was prepared in line with the requirements of TAN15 and NRW guidance respectively.

Study Area

4.4. Study areas for the assessment have been set as follows. The implications for water resources (e.g. existing abstractions and discharges), located within a 1km radius of the Site are considered and the potential for effects on flood risk and land drainage (surface and foul) are considered at a catchment wide scale. Regarding water quality, all surface waterbodies that flow through, receive land drainage or operational discharges from the Proposed Development have been scoped into the assessment.

Receptors

- 4.5. The first stage in the methodology involves identifying receptors that could be affected by the construction or operation of the development and making a judgement as to the sensitivity value (or importance) of each receptor. The receptors are all shown on the Receptors Plans in Appendix II of the ES Part I Report. Table 3.2 presents a set of published criteria commonly used to assess the sensitivity value of receptors in the surface water environment.

Designation	Receptors
International	<p>Feature or attribute with very high quality and rarity, and important at an international scale.</p> <p>Examples include: Designated Salmonid watercourse, WFD class 'High', site protected under EU wildlife legislation (e.g. SAC, SPA), Designated Washland, supports public potable water supply to a large population or an industrial/agricultural abstraction of >1000m³/day.</p>
National	<p>Feature or attribute with high quality and rarity, important at a National scale.</p> <p>Examples include: Designated 'Main River > 10m wide.</p> <p>Major Cyprinid fishery, WFD class 'Good', site protected under UK wildlife legislation e.g. NNR, SSSI, LNR),</p> <p>Floodplain or defence protecting > 100 residential properties or industrial premises from flooding, potable public or private water supply supporting a small population or an industrial/agricultural abstraction of 500 to 1000m³/day.</p>
Regional	<p>Feature or attribute with medium quality and rarity, important at a Regional scale.</p> <p>Examples include: Designated 'Main River < 10m wide Undesignated fishery, Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding.</p>
County	<p>WFD Class Moderate, floodplain or defence protecting 10 or fewer industrial properties from flooding, supports a private water supply serving < 50 people or industrial/agricultural abstraction of between 50 and 499m³/day.</p>
Borough / District	<p>Feature or attribute with medium quality and rarity, important at a County scale.</p> <p>Examples include: Designated Ordinary watercourse < 5m wide or ditch managed to provide a land drainage function, WFD Class Moderate, floodplain with limited constraints and a low probability of flooding of residential properties.</p>
Local/Neighbourhood	<p>Feature or attribute with low quality and rarity, important at a Borough scale.</p> <p>Examples include: Not a fishery, WFD Class Poor, floodplain with limited constraints and a low probability of flooding of residential and industrial properties, not supporting a public or private water supply or an industrial/agricultural abstraction.</p>

Table 3.2 : Receptors (adapted from LA 113 Road Drainage and the Water Environment)

Environmental Impacts

- 4.6. Each potential impact (change) arising from the Proposed Development, which may be short, medium or long term, direct or indirect, is then assigned a magnitude, as per the criteria set out in Table 3.3. They incorporate consideration of both the scale of the impact and the value of the receptor. Effects may be beneficial (positive) or adverse (negative).

Magnitude	Environmental Impact
Major	Results in the loss of a receptor or one or more of its attributes. Examples include loss of EC designated Salmonid fishery, significant loss of flood storage/increased flood risk, change in the WFD status of river reach or pollution of a potable source of abstraction.
Moderate	Results in change to the integrity of a receptor or loss of part of a receptor or its attributes. Examples include loss of productivity of a fishery, contribution of a significant proportion of effluent in the receiving river, but insufficient to change its WFD status.
Minor	Results in a measurable change to a receptor but one that is limited in size and/or proportion.
Negligible	An effect of insufficient magnitude to change the use or integrity of a receptor, for example discharges to a watercourse that result in no loss of quality, fisheries or biodiversity value.
Neutral	An effect resulting in no change to identified receptors.

Table 3.3: Methodology for Determining Impact Magnitude

Significance of Effects

- 4.7. The significance of effect is determined using the significance matrix in Section 6 of the Environmental Statement Part I Report. This matrix draws on the sensitivity value of the receptor and the magnitude of the impact to identify the significance of an effect.
- 4.8. Based on professional judgement, a “significant” effect in terms of the Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 (hereinafter referred to as ‘the EIA Regulations’) is considered to be one of Moderate overall significance or above.

Impact Prediction Confidence

- 4.9. It is also of value to attribute a level of confidence by which the predicted impact has been assessed. The criteria for these definitions are set out below in Table 3.4:

Confidence Level	Description
High	The predicted impact is either certain i.e. a direct impact, or believed to be very likely to occur, based on reliable information or previous experience.
Low	The predicted impact and its levels are best estimates, generally derived from first principles of relevant theory and experience of the assessor. More information may be needed to improve confidence levels.

Table 3.4: Confidence Levels

5. Baseline Information

- 5.1. This section sets out the baseline data that has been collected to inform the proposals and the assessment of the environmental impact on the water environment.
- 5.2. Information to characterise baseline conditions has been collected through consultation with NRW and FCC, in addition to undertaking a desk study, drawing on available published data sources. The results of flood modelling and drainage studies undertaken as part of the Airfield, Plots C and D FCA Addendum, Final Report VI (Weetwood, October 2020) has also informed the establishment of baseline conditions.
- 5.3. The application site occupies the north western part of the Airfields site and previously comprised developed land associated with the former RAF Sealand, as well as grassland and scrub. The Site currently comprises managed grassland, with all of the former RAF Camp building bases and site roads having been removed. Further description is provided in the ES Part I Report.
- 5.4. Future baseline conditions are forecast, drawing on current best practice guidelines. For example, regarding fluvial flood risk and drainage likely impacts of climate change have been considered. The likely effects of implementation of future cycles of Water Framework Directive (WFD) management plans on the ecological and chemical quality of waterbodies have also been considered when assigning value to water environment resources and receptors.
- 5.5. Several surface water features border the Site boundary and others are located within the wider study area. These are briefly described in Table 3.5.

Water Feature	Description
River Dee	The River Dee, a main river, flows from east to west, approximately 0.4km to the south of the development Site and its flow regime is tidally dominated. The river is canalised between substantial earth embankments and discharges to the Dee Estuary, which is designated as an SSSI, Ramsar, SPA and Natura2000 Site.
Shotwick Brook	Flows in a southern direction and is culverted under the disused railway line in the north west corner of the Site before flowing in open channel along the western boundary of the Site. The Brook discharges to the River Dee via a flapped outfall after being culverted under the John Summers building. It is a designated main river. Its catchment comprises parts of the Deeside Industrial Park and rural areas to the north-west and is relatively flat and low lying, with a pumping station in the upper catchment at Burton. The catchment drains a total area of approximately 25km ² .

Northern Drain	This drain, a designated ordinary watercourse, is culverted under the disused railway line and subsequently flows in an open watercourse from east to west along the northern boundary of the Site to its confluence with the Shotwick Brook. It drains a catchment area of approximately 1 km ² . A swale connects this drain with Garden City Drain via a culvert through the Phase 1 Employment spine road.
Garden City Drain	This watercourse is a designated main river that enters the Site via a 900mm culvert in the north-east corner of the Site. The watercourse flows in open channel in a westerly then south westerly direction, outfalling to the Garden City Drain West. It drains a total catchment area of approximately 12 km ² .
Manor Drain	This drain, a designated main river, enters the Site via a 1200mm diameter culvert under the A494 before flowing in open channel in a north westerly direction along the south east boundary of the Site to its confluence with Garden City Drain West. It has a total catchment area of approximately 2 km ² .

Table 3.5: Watercourses within the study area

- 5.6. These water features are shown in the appended FCA Figure 2-3. Their existing water quality, flooding and hydrological attributes are described below. Information about the geology and hydrogeology of the study area is provided in Technical Paper 1 – Geology and Ground Conditions.

Existing Water Quality

- 5.7. NRW monitors the water quality of designated 'Main Rivers' in line with the requirements of the Water Framework Directive (WFD). The Dee and the Garden City Drain are included in the WFD monitoring scheme. Current WFD classifications have been published by NRW and the EA in their joint Dee River Basin Management Plan. The Dee (a transitional waterbody, representing the tidal influence on its flow regime) and Garden City Drain are designated as 'Heavily Modified' waterbodies. As a result, they have a target to achieve good ecological potential, instead of good ecological status. Ecological potential is measured on the scale High, Good, Moderate, Poor and Bad, and the overall classification is assigned to a waterbody following consideration of a suite of 'supporting elements'.
- 5.8. A summary of the data available for the Garden City Drain and Dee, based on Cycle 2 of the WFD is provided in Table 3.6. The Garden City Drain data is from 2019 and the Dee data from 2018.

WFD Parameter	Garden City Drain (GB111067056960)	Dee (GB531106708200)
Current Ecological Status	Moderate	Moderate
Current Chemical Status	Fail	Fail
Supporting Elements		

Hydromorphological Supporting Elements	Supports Good	N/A
Ammonia	Bad	High
Dissolved Oxygen	Bad	High
pH	High	N/A
Temperature	High	N/A
Phosphate	Poor	N/A
Dissolved Inorganic Nitrogen	N/A	Moderate
Mercury	N/A	Moderate
Biological Quality Elements	Bad*	Good

*based on aquatic invertebrates and fish

Table 3.6: WFD Data Summary (Cycle 2)

5.9. The Manor Drain, Northern Drain and the Shotwick Brook are not monitored under the WFD. The Garden City Drain and Shotwick Brook have catchments that are similar with regard to their hydrology, physical and land use characteristics; therefore, these watercourses may be expected to share similar water quality attributes. The smaller local ditches are likely to be subject to drying (i.e. not maintaining year-round flow) and are more vulnerable to pollution from diffuse urban runoff as there is less dilution available.

5.10. Water quality data for the study area was also requested from NRW and data records were provided for the Shotwick Brook at a sampling location sited at Sealand Avenue. The data is summarised in Table 3.7.

Parameter	Recorded Range*	Average	Environmental Quality Standard (EQS)
pH	7.57 to 8.03	7.74	6-9 (95 th percentile)
Temperature** (°C)	6.8 to 15.4	11.56	Maximum allowable (98 th percentile) 23 Maximum allowable change (98 th percentile) 3
Conductivity (µS/cm)	276.9 to 1794	1115	n/a
Dissolved oxygen (mg/l)	5.97 to 11.1	7.79	> 9 (50 th percentile)
Orthophosphate (mg/l)	0.058 to 0.351	0.165	< 0.3
Nitrate (mg/l)	0.275 to 3.02	0.74	50
Ammonia (mg/l)	0.152 to 0.923	0.352	0.6 (90 th percentile)

*14 samples recorded between November 2014 and December 2015

***Temperature standards for a salmonid river are used as there are no temperature standards defined for estuaries*

Table 3.7: Summary of NRW Monitoring Data – Shotwick Brook at Sealand Avenue

- 5.11. The data records indicate that water quality in the Garden City drain is generally in compliance with the Environmental Quality Standards for the parameters monitored.
- 5.12. NRW also provided records of temperature data for the River Dee, recorded at the Queensferry Blue Bridge. The data records date from July 2021 to September 2019 and sampling was at a monthly frequency. The data set shows a recorded temperature range between 4.8 and 21.8 degrees Celsius, with a mean temperature of 11.4.
- 5.13. Four pollution incidents which impacted the surface water environment have been reported to NRW within the study area (incidents prior to 2013 formerly reported to Environment Agency Wales), though none are recent, as shown in Table 3.8. One incident was assessed as having a Major impact on water.

Date	Location	Pollutant Type	Incident Category
15 May 2001	Deeside Industrial Park	Contaminated water	Minor
4 February 2002	Deeside Industrial Park	Waste materials	No impact
16 October 2007	Deeside Industrial Park	Waste materials	Major
7 March 2017	Sealand	Waste materials	Category 2: High Minor or Significant Incident

Table 3.8: Summary of Pollution Incidents

Existing Flood Risk

- 5.14. The Planning Policy Wales Technical Advice Note 15 – Development and Flood Risk (TAN15) Development Advice Map (DAM) classifies the Site as being located within Flood Zone C1. Flood Zone C1 is defined as, “Areas of the floodplain which are developed and served by significant infrastructure, including flood defences”.
- 5.15. NRW flood mapping confirms the Site to be at low risk of flooding from the sea (annual chance of between 1 in 1000 and 1 in 200), when accounting for the effect of the Dee flood defences. These defences, in the study area, comprise sheet piled earth embankments with an effective crest height varying between 7.0 m AOD and 7.5 m AOD and a typical crest width of 6m.
- 5.16. The NRW map shows that the risk of flooding across the Site from rivers is variable, ranging from low to medium, with parts of the access route at high risk (greater than 1 in 30 annual chance). Further details are provided in the Appended FCA.

- 5.17. The surface water flood risk map shows that, except for small pockets of land at low risk, the risk of flooding from this source is very low.
- 5.18. Detailed hydrological analysis and hydraulic modelling of tidal and river flooding has been undertaken by Weetwood to support the discharge of relevant planning conditions linked to enabling works activities on the Plot C Site and data from the Airfields, Plots C and D FCA assessment (Weetwood, October 2020) has been used to inform the appended FCA (Appendix 3.1).
- 5.19. Under baseline 1 in 100 annual chance conditions, the modelling predicts shallow (depths less than 0.25m) fluvial flooding on a small central area of the Site. Inundation extents increase when allowances for climate change are included. Floodwaters propagate from the Shotwick Brook and the Northern Drain.
- 5.20. Flapped sluices at the outlets of the Shotwick Brook and Garden City Drain West prevent backflow through culverts in the flood defence embankment during high water conditions in the River Dee. At low tide both the Shotwick Brook and the Garden City Drain discharge freely to the Dee and the risk of fluvial flooding is perceived to be low. However, when these watercourses, and the associated system of interconnecting ditches and culverts, are tide-locked there is potential for fluvial flooding in surrounding areas. The hydraulic model confirms that flooding of the Site is controlled by downstream River Dee tidal boundary conditions (tide-locking) rather than flows from the catchments draining to the Shotwick Brook, Northern Drain and Garden City Drain.
- 5.21. The modelling also represents baseline tidal flood risk under overtopping and breach scenarios. Owing to the River Dee embankment strengthening carried out by Welsh Government in 2015, the risk of structural failure of the existing defences in proximity to the Site is very low. In line with NRW guidance two breach locations, one upstream and one downstream of the Site were included in the model.
- 5.22. No flooding of the Site is predicted from overtopping floodwater in the present day 1 in 200 or 1 in 1000 annual chance flood events, nor over the 75 year development lifetime.
- 5.23. In the upstream breach scenario, floodwater is predicted to affect southern and central parts of the Site in the 75 year development lifetime 1 in 200 annual chance event. No flooding of the Site is predicted in the downstream breach scenario.

- 5.24. With regard to artificial sources of flooding, the NRW Risk of Flooding from Reservoirs Map shows the Site is located outside of the flood extent associated with reservoir failure. The Shropshire Union Canal joins the River Dee over 8km upstream of the Site and also does not pose a flood risk to the Site.
- 5.25. Further details regarding baseline flood risk are provided in the FCA (Appendix 3.1) and a summary of existing groundwater flood risk is included in Technical Paper I – Geology and Ground Conditions.
- 5.26. The flooding history of the Proposed Development Site has been researched with reference to the Chronology of British Hydrological Events (CBHE) database, through consultation with NRW, Flintshire County Council and the local community, and with reference to previous studies, including the latest Tidal Dee Flood Mapping Update report and the Corus Shotton Works Eastern Site FRA. No anecdotal historical records of coastal flooding have been identified at the Site. There is one record of flooding affecting the Site in 1964 which is attributed to main river flooding according to the NRW Historic Flood Outlines dataset.

Surface Water Abstractions and Discharges

- 5.27. Review of the NRW Public Register has identified no licensed abstractions within 200m of the Site.
- 5.28. With regard to consented discharges, review of the Geo-Portal for Wales – Lle, has identified several active consents, the majority for the purpose of discharging final treated effluent or pumping station and storm sewer overflows. These discharges are received by the Dee Estuary, and the Garden City Drain, as well as several other watercourses.

Existing Drainage (Surface Water and Foul)

- 5.29. The existing surface water drainage network within the study area has been modified in recent years to serve the Northern Gateway site. Some works are complete, including removal of existing culverts on the Garden City Drain and culverts connecting this watercourse to the Northern Drain. Other works are partially complete, for example, channel widening on the Northern Drain to create a 2-stage channel, and creation of a series of swales to provide flood storage and facilitate drainage of surface water from the new development platforms to the

River Dee. A swale between Plot C and neighbouring Plot D is proposed to connect to the swale constructed as part of the works associated with the Welsh Government spine road, with ground levels to be lowered locally to allow water to spill from Shotwick Brook into this proposed swale. Further details are provided in the FCA (Appendix 3.1).

- 5.30. Details of the foul water drainage infrastructure within the study area are provided in the Project Description (ES Part 1 Report).

Receptor Importance Summary

- 5.31. The importance assigned to the receptors in Table 3.9 is based on the baseline information gathered.

Attribute	Receptor(s)	Assigned Importance	Justification
Dee Tidal Floodplain	People and property	National	The Dee flood embankment protects more than 100 residential properties in Garden City and surrounding areas
Shotwick Brook and Garden City Drain floodplain	People and property	Regional	Between 1 and 100 residential properties located in the floodplain of the Garden City/Manor Drains
Water Quality	River Dee	International	EA Main River >10m wide, drains to Dee Estuary which is protected under EU and UK wildlife legislation
	Shotwick Brook	Regional	EA Main River < 10m wide, assumed WFD status 'Moderate Potential'
	Garden City Drain	Regional	EA Main River < 10m wide, WFD status 'Moderate Potential'
	Northern Drain	Borough	Ordinary watercourse, not a fishery, assumed WFD status 'Poor'
	Manor Drain	Borough	Main River, not a fishery, assumed WFD status 'Poor'
Foul Drainage	River Dee	Regional	Receives foul drainage from existing sewer system, environmentally sensitive but considerable potential for dilution especially during high tides

Surface Water Drainage	Shotwick Brook	County	Receives local land drainage via a new network of swales constructed to serve the Site and surrounding development plots.
	Northern Drain	Borough	Receives local land drainage via a new network of swales constructed to serve the Site and surrounding development plots.
Dilution/Transport of Effluent	River Dee	Regional	Receives consented discharges of final treated, pumping station and storm sewer overflow effluents, with good capacity for dilution
	Garden City Drain	County	Receives storm overflows, moderate capacity for dilution

Table 3.9: Summary of Receptors and Assigned Sensitivity Values

6. Alternatives Considered

- 6.1. Several considerations have influenced the evolution of the Proposed Development as detailed below.
- 6.2. The alternatives considered in relation to this assessment concern setting of Finished Floor Levels (FFLs) for the Proposed Paper Mill Facility and the temperature of the proposed Paper Mill's effluent discharge.
- 6.3. FFLs have been set according to the degree of flood risk from fluvial and tidal sources. To achieve a development that is flood free in the both the tidal and fluvial Design events, raised development platforms will be created by modifying existing ground levels. In addition, floodable areas (for tidal and fluvial floodwater storage) will be created by lowering land adjacent to the development. A cut and fill exercise has been undertaken to balance the area required for the development platforms and the floodable areas with the requirement to use as little material from offsite as possible. The required FFLs are detailed in the Cut and Fill Earthworks Model in Appendix 12 of the ES Part 1 Report. As illustrated, all of the main process buildings would have FFLs at 5.25 mAOD, with offices and dispatch areas having higher FFLs (exceeding 6m AOD). These are in accordance with the minimum levels agreed with Natural Resources Wales (NRW) and reported on in The Airfield, Plot C Enabling Works FCA (Weetwood, October 2020). The proposed FFL for one building is below the minimum agreed threshold and would be subject to additional flood risk mitigation measures. Further detail is provided in the appended FCA (Appendix 3.1).
- 6.4. The Proposed Development includes the construction of a new outfall from the Paper Mill to facilitate discharge of operational effluent to the River Dee. The chemical composition, temperature and frequency/duration of the discharge will achieve compliance with the conditions set out in the developments Installation Permit, granted by NRW. A Waste Water Treatment Plant (WWTP) has been embedded into the design of the development to treat wastewater generated from the Paper Mill Facility. Following treatment, the discharge will need to be to an acceptable temperature, similar to the receiving waterbody, as required to comply with the consent issued by NRW, using the most practicable option.

7. Potential Environmental Effects

7.1. The following section reports the potential environmental effects of the Proposed Development in both construction and operational phases. The potential risks are identified below.

7.2. The Proposed Development has the potential to result in effects on the surface water environment, in addition to people and property within the existing community and future employees at the Proposed Development Site, including:

- Degradation of the water quality of local waterbodies associated with construction phase activities e.g. earthworks, excavation, and receipt of operational phase waste water or materials;
- Increased loading on foul drainage infrastructure, with greater volumes of effluent discharged to receiving waterbodies and increased risk of sewer flooding incidents (on and off Site);
- Increases in rates and volumes of surface water runoff, with implications for localised changes to catchment hydrology and increased surface water flood risk; and
- Loss of floodplain storage, resulting in an increase in fluvial flood risk on third party lands, and increasing the number of people living and working in the defended tidal floodplain of the River Dee.

7.3. These effects are discussed in the following sections. Their significance has initially been assessed in accordance with the methodology outlined in section 4 of this Technical Paper, accounting for the measures that have been embedded within the scheme design to mitigate water quality, drainage, and tidal and fluvial flood risk effects. These embedded measures are detailed in the following text and additional mitigation techniques and residual effects post mitigation are then presented in Sections 8 and 9.

Construction Phase

7.4. Several construction activities have the potential to result in contamination of waterbodies located in the vicinity of the works. Construction activities which may give rise to such pollution include:

- Earthworks (cut and fill) to create development platforms, creation of temporary stockpiles of soils and construction materials, construction of a new outfall to the River Dee, deposition of mud and dust by construction machinery and delivery vehicles along Site access roads, with increased risk of the generation of runoff with elevated concentrations of sediment which may enter surface waterbodies.

- Excavation for the construction of foundations and trenching to accommodate utilities infrastructure, with the associated need for dewatering works, generating silt laden wastewater.
- Transportation, storage and use of oils and fuels for construction plant and handling of wet cement and/or concrete, with increased risk of surface water contamination.
- Handling of construction waste materials and wastewater

- 7.5. During the construction phase temporary sanitary facilities will be provided for construction site staff. The wastewater generated from these facilities could introduce an additional source of pollution that is not currently present, with the potential for nutrient enrichment of receiving waterbodies.
- 7.6. As construction progresses impermeable land cover will increase, changing the current land drainage regime. Increased rates and volumes of rainfall runoff will be generated, with potential to increase loadings on existing sewerage infrastructure and local watercourses. This, coupled with an increased risk of blockages of waterways by silt or construction wastes, could cause an increased risk of flooding (both on and off Site). However, measures to mitigate effects on the existing surface water drainage regime have been embedded within the scheme design, comprising the creation of a network of swales and other landscape buffer zones, which provide for the storage, attenuation and conveyance of surface water flows.
- 7.7. Land raising will be required to create the development platform for the Proposed Paper Mill Facility, such that the Proposed Development is safe from flooding over its lifetime (assumed to be 75 years for commercial developments). This will cause a loss of storage in the defended Dee floodplain, that may result in an increase in flood risk on third party land and increase the number of people working in the defended tidal floodplain of the River Dee. As the Proposed Development is of a large scale and would have the potential to increase flood risk to many existing residential and industrial properties, flood risk was recognised as a key issue in the earliest stages of the project. As a result, several measures have been embedded within the development design and layout that act to mitigate the potential for tidal and fluvial flood risk impacts, and these would be constructed to serve all three development phases, as described in Section 8 of this Technical Paper.
- 7.8. Table 3.10 summarises the significance of the impacts during construction.

Nature of Impact	Receptor (Designation)	Environmental Impact	Significance of Effect	Confidence Level
Water Quality – pollution with silt, oils, hydrocarbons, concrete, cement residues and other construction materials/wastes	River Dee (International)	Moderate negative	High/Substantial adverse	High
	Shotwick Brook (Regional)	Moderate negative	Moderate adverse	High
	Garden City Drain (Regional)	Negligible	Negligible	High
	Northern Drain (Borough)	Moderate negative	Moderate adverse	High
	Manor Drain (Borough)	Minor negative	Minor adverse	High
Increased rates/volumes of rainfall runoff from additional impermeable areas	Shotwick Brook (County)	Minor negative	Minor adverse	High
	Northern Drain (Borough)	Minor negative	Minor adverse	High
Pollution from temporary sanitary facilities	River Dee (International)	Minor negative	Moderate / High adverse	High
Increased tidal and fluvial flood risk due to creating raised development platform	People and Property (National)	Minor negative	Minor /Moderate adverse	High

Table 3.10: Significance of Effects - Construction Phase

Operational Phase

- 7.9. The following are potential environmental impacts from the operation phase that have been assessed.
- 7.10. The construction phase impacts on water quality, the land drainage regime, and on flood risk from rivers and the tides, are applicable to the operational phase of the development. Albeit, once the construction phases of the Proposed Development are complete, the risk of pollution of watercourses local to the Site with silt and construction materials such as concrete and cement will markedly reduce.
- 7.11. During operation of the Proposed Development there would be an increase in the generation of foul water and an increase in consumption of potable water to supply staff welfare facilities and to support the Paper Mill manufacturing processes.

- 7.12. Pollution risks during the operational phase link to waterbodies receiving runoff from roads and parking areas, which may be elevated in oils, metals etc. deposited by vehicles. There is also a risk of pollution of the River Dee, which will receive wastewater discharges from the manufacturing process.
- 7.13. The Waste Water Treatment Plant (WWTP), which will be constructed as part of Phase I of the Proposed Paper Mill Facility, will process waste water from the paper manufacturing process. Following treatment, wastewater will be discharged to the River Dee in accordance with the requirements of the bespoke Installation Permit issued by NRW. Consultations are currently ongoing with NRW regarding the Installation Permit, however this will set the permissible duration and frequency of discharges, as well as set limits on the physico-chemical composition of the discharge, including its temperature. Findings from a Marine Discharges Assessment (Appendix 3.2) suggest that the impact of the discharge on the water quality of the River Dee will be negligible.
- 7.14. Table 3.11 summarises the significance of the impacts during operation.

Nature of Impact	Receptor (Designation)	Environmental Impact	Significance of Effect	Confidence Level
Water Quality – pollution from runoff generated from roads and car parking areas	River Dee (International)	Minor negative	Moderate adverse	High
	Shotwick Brook (Regional)	Minor negative	Minor adverse	High
	Garden City Drain (Regional)	Negligible	Negligible	High
	Northern Drain (Borough)	Moderate negative	Minor adverse	High
	Manor Drain (Borough)	Negligible	Negligible	High
Increased rates/volumes of rainfall runoff from additional impermeable areas	Shotwick Brook (County)	Minor negative	Minor adverse	High
	Northern Drain (Borough)	Minor negative	Negligible	High
Foul Drainage – increased loading of sewerage infrastructure causing water quality detriment and increased flood risk	River Dee (International)	Minor negative	Moderate Adverse	High
	People and Property (Regional)	Minor negative	Minor adverse	High

Reduced tidal flood risk from the Dee	People and Property (National)	Minor positive	Minor benefit	High
Reduced fluvial and surface water flood risk	People and Property (Regional)	Minor positive	Minor benefit	High
Water Quality - pollution due to the receipt of operational wastewater discharge	River Dee (International)	Negligible	Minor adverse	Low*

Table 3.11: Significance of Impacts – Operational Phase

* Confidence will increase following detailed water quality modelling scoped, reviewed and approved by NRW

8. Proposed Mitigation

- 8.1. The mitigation discussed in this section considers the integrated measures embedded in the design of the development as well as any additional measures or construction methods of working which should be adhered to.

Construction Phase

- 8.2. The principal means of mitigating the effects of the Proposed Development on the water quality attributes of the watercourses within the study area is through implementation of good working practices and pollution prevention techniques that are routinely adopted at construction sites.
- 8.3. A Construction Environmental Management Plan (CEMP) will be produced to document all construction phase mitigation measures to safeguard surface and groundwater resources, including a Pollution Control Plan. This would consider the following:
- A Drainage Management Plan will be produced to ensure that potential silted or otherwise contaminated water is appropriately managed and treated prior to entering into any waterbody or drainage system.
 - No water from foundation excavations will be discharged directly into a watercourse. Any dewatering works will take place prior to the placement of concrete and no subsequent dewatering will occur until any concrete has sufficiently cured to prevent runoff of cement grout, unless the discharge is appropriately treated.
 - If samples of water from excavations are unnaturally discoloured or have an unusual odour the water will be pumped to suitable containers, or removed by vacuum tanker, and then taken to a licensed waste disposal site.
 - Refueling, repair and maintenance of plant and vehicles will be carried out within a bunded area with drip trays placed under standing machinery whilst refueling to avoid pollution from spillages and leaks.
 - Machinery will be refueled using a transfer hose and will be locked when unattended. A suitable supply of spill absorbent material will be retained on Site as part of an emergency spillage control kit.
 - A designated area will be used for any washing down or equipment cleaning, away from the surface water drainage system.
 - Any temporary storage facilities for wastewater will comply with best practice guidelines and will be provided to suit the scale of construction and the construction phasing. Options to be considered, subject to agreement with DCWW and NRW, are a temporary connection to the existing sewer network, provision of standalone facilities that will be removed from Site to a treatment works subject to DCWW agreement, or onsite treatment.

- A full time wheel wash will be constructed in order to mitigate transport of mud from the Site during deliveries and removal of materials. This will use recycled water collected from surface runoff in a sustainable manner.
- During prolonged periods of dry weather, damping-down will be undertaken using recycled Site runoff water to prevent excess generation of dust.
- Stores of construction materials will be sited on impervious bases and surrounded by impervious bund walls. The volume of the bunded compound will be at least equivalent to the capacity of the tank plus 10%. The drainage system of the bund will be sealed with no discharge to any waterbody, land or underground strata.
- Excavated materials will be stored in association with DEFRA Good Practice Guidance for Handling Soils to prevent the generation of silty runoff. Where possible material on Site will be reused to minimise the volume of imported fill material required.

8.4. It is considered that the detailed content of the CEMP and subsequent implementation of the measures, is capable of being adequately controlled by means of a suitably worded planning condition attached to any forthcoming planning permission for the Site. Please refer to the Framework CEMP included at Appendix 15 of the ES Part 1 Report.

8.5. Work site drainage would be managed appropriately during construction, and wastewater generated from construction compounds would be disposed of via appropriate means, for example, pumped out and removed from Site by tanker.

8.6. The contractor should sign up for NRW flood warnings (for coastal/tidal events) during construction. Other flood risk measures that would be put in place during construction, to mitigate flood risk during the lifetime of the development include:

- Lowering ground levels along the left (south) bank of Northern Drain to 4.20 m AOD.
- Lowering ground levels along the left (east) bank of Shotwick Brook to 4.20 m AOD.
- Creation of a swale between Plots C and D that will connect to the swale constructed as part of the works associated with the Road 2 and 3 Welsh Commercial Spine Road.
- Lowering ground levels over the existing DCWW rising main to 4.38 m AOD to allow water to spill from Shotwick Brook and into the proposed swale between Plots C and D.
- Earthworks and modifying ground levels to create development that broadly achieves the minimum recommended development platform and finished floor levels derived from detailed hydraulic modelling studies and provision of a retaining wall around the foundation slab of the proposed High Bay Warehouse at 1m high, to provide in excess of the standard of flood protection required (further details of these measures are provided in the appended FCA).

- 8.7. The agreed flood mitigation strategy for the Airfields site (including Plot C) also comprises of an upgrade to a culvert at Sealand Bank Farm. The works, which include a new 2m by 1.25m box culvert, are programmed for completion in March 2022, prior to commencement of construction of the Proposed Development. It is expected that works to this culvert, which are under the control of the adjacent landowner PGNGL, would be secured and controlled via a Grampian planning condition to ensure the works are undertaken prior to commencement of the Proposed Development. The culvert works will also be undertaken in parallel with the Road 2 and 3 commercial spine road, which will be undertaken first to facilitate access into the Paper Mill Site.

Operational Phase

- 8.8. During the operational phase of the Proposed Development, tidal, fluvial and surface water flood risk effects will be mitigated through the measures embedded within the scheme design, outlined for the construction phase above, as well as by a suite of land drainage works (described in the baseline section) that have been constructed, are partially constructed or will be constructed by the landowner (CHEL).
- 8.9. A SuDS based surface water drainage system will therefore be operational to serve the Plot C Paper Mill Facility and wider site. The Surface Water Drainage Strategy centres on provision of storage to attenuate surface water flows during periods over which outfalls to the River Dee are tide locked. This storage is provided by a network of swales and open channels that have been, or are soon to, be constructed. This network, which is illustrated in a plan in Appendix A of the Paper Mill Facility FCA (Appendix 3.1) will serve the Proposed Development, which would have a number of individual surface water outfalls, and discharges into the Northern Drain, which eventually discharges into Shotwick Brook and finally into the River Dee.
- 8.10. Surface water discharges have been estimated assuming a 90% impermeable land cover (applied to industrial plots), using MicroDrainage for a 1% annual chance rainstorm, including a 40% increase in peak rainfall intensity to account for climate change. These discharges have then been applied to the fluvial flood models and a reduction in flood risk across the Site has been demonstrated.

- 8.11. The Drainage Strategy has been developed in line with NRW guidelines and ensures there will be no significant flood risk to the Proposed Development from surface water sources. The FCA in Appendix 3.1 contains further details.
- 8.12. As well as providing flood risk mitigation, the drainage system will also provide water quality treatment by removing pollutants via filtration and sedimentation. Runoff from the lorry park hardstand will be routed via an oil interceptor to allow for removal of hydrocarbons prior to discharge into the swale network. The regular car parking areas would be formed of porous paving which will provide for a degree of water quality treatment also. The area for unloading process chemicals will be covered with a roof and have a sealed system to allow for full containment in the event of any spillage. Provision of appropriate facilities for the storage and disposal of solid waste generated from the Proposed Development will also mitigate the associated pollution risk.
- 8.13. The Proposed Development will also be served by a foul drainage system. Foul flows will be drained by a gravity and pumped systems and will discharge into a new foul sewer that has been designed and is being constructed to serve the wider Airfields Northern Gateway development site.
- 8.14. The discharge of operational waste water effluent to the River Dee will be agreed in accordance with the conditions of a bespoke Installation Permit, granted by NRW. Adherence to the conditions of this Permit will safeguard the water quality of the River Dee, and will be informed by the results of initial H I pollution risk screening assessments (see Appendix 3.2), and any further detailed water quality modelling required and that will be and approved by NRW.
- 8.15. A new headwall is proposed to facilitate the discharge of process waters to the River Dee. This headwall has been designed in consultation with NRW and any temporary works to construct the outfall, as well as the operation of the structure, would be subject to the conditions of a Flood Risk Activity Permit issued by NRW. Details of the headwall design are provided in Appendix 9 of the ES Part I Report. Adhering to these requirements will avoid adverse effects on the River Dee.

9. Potential Residual Effects

- 9.1. The following tables show the residual significance of the environmental effect from drainage and flood risk post mitigation through both the construction and operation phase.
- 9.2. Overall, the residual effect on both construction and operational phase water quality is classified as Negligible.
- 9.3. With regard to construction and operational drainage effects (surface water and foul), given the effectiveness of the measures both incorporated into the Site's design and those detailed and controlled through the CEMP, it is considered that the residual effects on the surface water environment will be Negligible to Minor Adverse.
- 9.4. The flood risk mitigation strategy brings forward beneficial effects for the wider community, with regard to reducing the tidal flood risk through raising and strengthening of the Dee tidal flood defence (already completed) as well as managing the fluvial flood risk through works to local watercourses, altering ground levels on Site and providing flood compensation areas. Surface water drainage proposals also deliver a flood risk benefit.
- 9.5. A summary of construction and operational phase residual impacts is presented in Tables 13.12 and 13.13.

Potential Residual Effects – Construction Phase

- 9.6. The potential for residual water quality effects is restricted to the possibility of localised, contained spills and/or silt releases during the construction phase or typically small-scale accidental spills on roads or in parking/storage areas during the operational phase of the development. The procedures in place, to be documented in the CEMP, will limit the consequences of construction phase incidents such that they would be minor and rapidly cleaned up, with no impact to the wider area. Similarly, during the operational phase any accidental spills would be contained, and runoff would receive treatment prior to discharge to any watercourse.
- 9.7. The overall impact of the proposal in terms of water quality, flood risk and drainage issues during the construction phase is highlighted in the table below.

Nature of Impact	Receptor (Designation)	Environmental Impact	Significance of Effect	Confidence Level	Mitigation	Residual Significance of Effect
Water Quality – pollution with silt, oils, hydrocarbons, concrete, cement residues and other construction materials/wastes	River Dee (International)	Moderate negative	High/Substantial adverse	High	Good working practices and pollution prevention techniques, CEMP	Negligible for all receptors
	Shotwick Brook (Regional)	Moderate negative	Moderate adverse	High		
	Garden City Drain (Regional)	Negligible	Negligible	High		
	Northern Drain (Borough)	Moderate negative	Moderate adverse	High		
	Manor Drain (Borough)	Minor adverse	Minor adverse	High		
Increased rates/volumes of rainfall runoff from additional impermeable areas	Shotwick Brook (County)	Minor negative	Minor adverse	High	Surface water drainage strategy using SuDs	Negligible for all receptors
	Northern Drain (Borough)	Minor negative	Minor adverse	High		
Pollution from temporary sanitary facilities	River Dee (International)	Minor negative	High / Moderate adverse	High	Temporary treatment facilities to be provided to meet current legislation and consents	Negligible
Increased tidal and fluvial flood risk due to creating raised development platform	People and Property (National)	Minor negative	Minor / Moderate adverse	High	Works programmed to create compensation areas prior to raising ground levels on Site, and other flood risk management measures detailed in paragraph 8.6.	Negligible

Table 13.12: Residual Significance of Effect - Construction Phase

- 9.8. It is concluded that the residual significance of the construction phase of the Proposed Development on water environment receptors is not classified as Significant in accordance with the EIA Regulations.

Potential Residual Effects – Operational Phase

- 9.9. Operational effluent discharges to the River Dee would be made in strict accordance with a bespoke Installation Permit issued by NRW. The operational discharge would be routinely monitored to demonstrate compliance with the Permit conditions. These measures will safeguard the River Dee in terms of its water quality during the operational lifetime of the Proposed Development. The overall impact of the proposal in terms of water environment issues during the operational phase is highlighted in the table below:

Nature of Impact	Receptor (Designation)	Environmental Impact	Significance of Effect	Confidence Level	Mitigation	Residual Significance of Effect
Water Quality – pollution from runoff generated from roads and car parking areas	River Dee (International)	Minor negative	Moderate / High adverse	High	Surface water drainage including treatment measures	Negligible for all receptors
	Shotwick Brook (Regional)	Minor negative	Minor adverse	High		
	Garden City Drain (Regional)	Negligible	Negligible / Minor adverse	High		
	Northern Drain (Borough)	Moderate negative	Moderate adverse	High		
	Manor Drain (Borough)	Negligible	Negligible	High		
Increased rates/volumes of rainfall runoff from additional impermeable areas	Shotwick Brook (County)	Minor negative	Minor adverse	High	Surface water drainage strategy using SuDs	Negligible for all receptors
	Northern Drain (Borough)	Minor negative	Minor adverse	High		
Foul Drainage – increased loading of sewerage infrastructure causing water quality detriment and increased flood risk	River Dee (International)	Minor negative	Moderate / High adverse	High	Existing sewer network upgraded. Sewers to be maintained under adopting authority or private agreements	Negligible
	People and Property (Regional)	Minor negative	Minor adverse	High		Negligible

Reduced fluvial and surface water flood risk as a result of the flood mitigation strategy.	People and Property (Regional)	Minor positive	Minor benefit	High	Creation of development free buffers along watercourses. Provision of compensation storage for floodwaters	Minor beneficial
Reduced tidal flood risk from the Dee	People and Property (National)	Minor positive	Minor / Moderate benefit	High	Works completed to strengthen and raise of River Dee defences	Minor / Moderate beneficial
Water Quality - pollution due to the receipt of operational wastewater discharge	River Dee (International)	Negligible	Minor adverse	Low*	WWTP embedded in the design of the scheme to treat effluent from the Paper Mill prior to discharge. The discharge will comply with the conditions of the bespoke permit issued by NRW.	Neutral

* Confidence will increase following detailed water quality modelling scoped, reviewed and approved by NRW

Table 13.13: Residual Significance of Effect - Operation Phase

- 9.10. It is concluded that the residual significance of the operational phase Proposed Development on water environment receptors is not classified as Significant in accordance with the EIA Regulations.

10. Additive Impacts (Cumulative Impacts and their Effects)

10.1. For the purposes of this ES we define the additive cumulative effects as:

‘Those that result from additive impacts (cumulative) caused by other existing and/or approved projects together with the project itself’

10.2. The developments that are likely to have a cumulative impact when considered with the proposed development have been scoped with the Local Authority and Key Consultees during the preparation of this ES (a full list is included within Section 9 of the ES Part I Report). The following table includes the agreed list of cumulative developments that have been assessed in respect of the Water Environment. These are also shown geographically on the plan included at **Appendix 13** of the ES Part I Report.



No.	Cumulative Development	Details	Status	Justification for Inclusion in Cumulative Assessment
1	<p>Airfields (former RAF Sealand) Site (Northern Gateway)</p> <p>LPA ref: 049320 and last varied S73 application LPA ref: 061125.</p> <p>Applicant: Crag Hill Estates Ltd.</p>	<p>Outline application for the redevelopment of a strategic brownfield site for an employment led mixed use development with new accesses and associated infrastructure including flood defences and landscaping.</p> <p>The Net Cumulative Development associated with the Airfields site after deducting the floor space ((124,344m²)) taken up by the Proposed ICT Paper Mill Facility (B2, B8, ancillary B1a) and operational Amazon development (ref: 060222) is as follows:</p> <p>Development comprises:</p> <p>Residential (C3): 689 units Retail (A1): 4,646m² Office (B1a): 6,533m² B2 /B8 Employment: 860,044² Car Dealership (Sui generis): 7,779m² Total floorspace: 689 units / 79,002m²</p>	<p>LPA ref: 049320 Planning permission granted by Flintshire County Council in January 2013.</p> <p>The last varied S73 application was granted on the 26 April 2021 (ref: 061125) to remove conditions 26, 28, 30, 34 and 44 and vary condition 13.</p> <p>Development expected to come forward over the next 0-5 years.</p>	<p>Although the ICT Mill Facility is proposed on part of the Airfields Site the remaining quantum of development which has outline planning permission should still be assessed as cumulative development in flood and drainage terms.</p>
2	<p>Former Corus Garden City Site (Northern Gateway)</p> <p>Applicant: PGNGL</p> <p>Outline (LPA ref: 054758) / S73 application (LPA ref: 059635)</p>	<p>Employment-led mixed-use development, incorporating Logistics and Technology Park (B1, B2, B8) with residential (C3), local retail centre (A1), hotel (C1), training and skills centre (C2, D1), new parkland; conversion of buildings, demolition of barns; and associated infrastructure comprising construction of accesses, roads, footpaths / cycle paths, earthworks and flood mitigation / drainage works at Northern Gateway, Land off Welsh Road, Deeside.</p> <p>Development comprises:</p> <p>Residential (C3): 770 units Retail (A1): 2500m²</p>	<p>Outline planning permission granted by Flintshire County Council in May 2014.</p> <p>The last permission to be granted under a S73 application was approved in June 2020 (ref: 059635) was for removal of conditions 6, 8, 11 and 32 and variation of conditions 7, 31, 36 and 44.</p> <p>Development expected to come forward over the next 0-10 years.</p>	<p>Neighbouring site.</p>

No.	Cumulative Development	Details	Status	Justification for Inclusion in Cumulative Assessment
		Office (B1a): 3300m ² Light industrial uses (B1b, B1c): 7400m ² Hotel Uses (C1): 3000m ² Training and skills centre (C2, D1): 4000m ² Logistics Park (B2, B8, ancillary B1a): 120000m ² Total floorspace: 770 units / 140,200m²		

Table 13.14: Cumulative Development

- 10.3. The receptors considered are the tidal River Dee, the Shotwick Brook, Garden City Drain, Northern Drain and the Manor Drain, which all flow in proximity to or receive discharges (drainage and process effluents) from the Proposed Paper Mill Facility Site. In addition, the potential for cumulative effects on the people that live and work in the study area and the property and infrastructure in this area has also been considered. The importance assigned to each of these attributes is summarised in Table 3.9 in Section 5.
- 10.4. Both Construction and Operational phases have been considered and the short, medium and long term impacts assessed.

Short Term

- 10.5. Construction phase activities for the developments listed in Table 13.14 are likely to be very similar to those described in Section 7, having the potential prior to mitigation, to result in similar effects, for example, degradation of the water quality attributes of receiving watercourses, increases in surface water runoff rates from additional impermeable surfaces and the potential for pollution from temporary sanitary facilities for construction site staff. Due to the increase in the scale of construction activity within the catchments of the surface watercourse receptors, prior to mitigation there is potential for cumulative impacts of greater significance than those presented in Table 13.12. However, construction of the development on the Airfields and Former Corus Garden City sites that form part of Northern Gateway, would be expected to be subject to a suite of pollution control measures and management plans, such that the significance of the combined residual water quality effects of the

neighbouring developments is unlikely to be greater than that determined for the individual developments.

- 10.6. This is also considered to apply to cumulative surface and foul water drainage effects. It is expected that the neighbouring developments on the Airfields site and developments on the wider former Corus Garden City Northern Gateway Site would be served by a Sustainable Drainage System that provides treatment and attenuation and mitigates the potential for impacts on surface water flood risk both on and off Site. Parts of this strategic network have already been constructed, as described in the baseline land drainage description in Section 5. An appropriate foul drainage system would also be constructed in line with the requirements of DCWW.

Medium and Long Term

- 10.7. The developments listed in Table 13.14 will have to comply with TAN15 and therefore must ensure that there is no increase in flood risk to third party land as a result of the development. Furthermore, new development must ensure that on-site runoff is managed using SuDS as approved by the local authority acting in its SuDS Approving Body (SAB) role. Furthermore, development of the Northern Gateway as a whole is bringing forward considerable flood risk benefits to the local area. This is exemplified by the River Dee embankment strengthening which has already been carried out by Welsh Government in 2015.
- 10.8. Operation of the other developments on the Airfields Site, and those on the wider former Corus Garden City Northern Gateway site would be expected to be subject to a suite of pollution control, foul drainage and surface water runoff management measures, such that the significance of the combined residual effects of the neighbouring developments is unlikely to be greater than that determined for the individual developments. Cumulative effects on the water environment are therefore concluded to be Negligible to Minor Adverse.

11. Conclusion

- 11.1. In addition to the embedded mitigation resulting from the design and layout of the Proposed Development, and those measures to provide for land drainage and flood risk mitigation, approved as part of the Plot C Enabling Works application (ref. 061986), further mitigation measures based on good construction practice and management, and appropriate surface water and foul drainage systems, will reduce the potential impacts of the construction and operation of the Proposed Development on water quality, drainage and hydrology, such that the overall residual impacts are Negligible/Minor Adverse, and therefore Not Significant in terms of the EIA Regulations.
- 11.2. With regard to flood risk from the tidal River Dee, effects have been assessed as beneficial for the people that live and work in the defended floodplain and for the properties and infrastructure in the locality. These receptors will benefit from an increased standard of protection as a result of the works proposed to strengthen and increase the crest height of the River Dee embankment. These improvements to the defences have already been undertaken but are included as part of the enabling works for the development. A reduction in fluvial flood risk is also anticipated as a result of the strategic flood risk mitigation measures designed to serve both the Application site and the wider development area. These effects are assessed as having minor beneficial significance, and so are not deemed Significant in terms of the EIA Regulations.
- 11.3. An assessment of the cumulative effects associated with the Airfields and Former Corus Garden City Northern Gateway developments has also been completed. This assessment concludes that, subject to the implementation of best practice construction methods and an effective CEMP, in addition to a suite of flood risk measures and a suitable drainage strategy for surface and foul water, cumulative effects on the water environment are unlikely to be greater than that determined for the individual developments. For most receptors cumulative impacts are Negligible.

12. Reference List

British Hydrological Society. (2019). Chronology of British Hydrological Events. Accessed July 2021 via: <https://www.cbhe.hydrology.org.uk/>

British Standards Institution (BSI). (2009). Code of Practice for Earthworks (BS6031).

Centre for Ecology and Hydrology. (2021). Flood Estimation Handbook Web Service.

Construction Industry Research & Information Association (CIRIA). (2015). C741 – Environmental Good Practice on Site, 4th Ed.

Construction Industry Research & Information Association (CIRIA). (2015). C753 – The SuDS Manual.

Construction Industry Research & Information Association (CIRIA). (2006). C649 – Control of Water Pollution from Linear Construction Projects.

Environment Agency. (2010). Dee Catchment Flood Management Plan Summary Report.

Environment Agency. (2016, updated 2019). Guidance for Pollution Prevention (GPP). Accessed July 2021 via: <https://www.gov.uk/guidance/pollution-prevention-for-businesses>

Flintshire County Council. (2011). Flintshire County Council Unitary Development Plan 2000-2015.

Flintshire County Council. (2011). Preliminary Flood Risk Assessment.

Flintshire County Council. (2018). Preliminary Flood Risk Assessment Addendum.

Highways England. (2020). Design Manual for Roads and Bridges. LA 113: Road drainage and the water environment.

Natural Resources Wales & Environment Agency. (2015). Dee River Basin Management Plan 2015 - 2021.

Natural Resources Wales. (2015). Dee Catchment Abstraction Management Strategy.

Soil Survey of England & Wales. (1983). Soils Map of England and Wales (1:250,000).

Welsh Assembly Government. (2004). Planning Policy Wales Technical Advice Note 15: Development and Flood Risk.

Welsh Government and Natural Resources Wales. (2019). Development Advice Map. Accessed July 2021 via: <https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en>

13. Appendices

Appendix 3.1 – Flood Consequences Assessment

Paper Mill Facility, Plot C Airfields, Northern Gateway

Industrie Cartarie Tronchetti (ICT) UK Limited and Crag Hill
Estates Limited (CHEL)

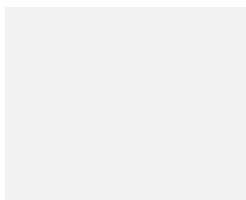
Flood Consequences Assessment

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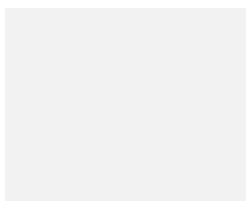
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Flood Consequences Assessment

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This report dated 08 September 2021 has been prepared for Industrie Cartarie Tronchetti (ICT) UK Limited and Crag Hill Estates Limited (CHEL) (the "Client") in accordance with the terms and conditions of appointment (the "Appointment") between the Client and **Arcadis UK** ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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Appendix A

Proposals Drawings

Appendix B

Weetwood 2020 Flood Consequences Assessment Addendum

Appendix C

Natural Resources Wales Pre-application Advice

Appendix D

Surface Water Drainage Assessment Report

1 Introduction

1.1 Overview

Arcadis Consulting (UK) Limited (“Arcadis”) has been commissioned by Industrie Cartarie Tronchetti (ICT) UK Limited and Crag Hill Estates Limited (CHEL) (“the Client”) to undertake a Flood Consequences Assessment (FCA) to support the development of a Paper Mill Facility at the Airfields site which forms part of the Northern Gateway development area in Flintshire. The Paper Mill Facility, here after referred to as the Proposed Development, covers 23.74 hectares (ha) of the wider Northern Gateway, which is approximately 170 ha in extent.

The Welsh Government Development Advice Map (DAM)¹ indicates that the majority of the Proposed Development site is within Zone C1 (i.e. within the extreme flood extent (1 in 1000 (0.1%) annual probability flood event) and served by significant infrastructure, including flood defences) and a small area, adjacent to the River Dee, is within Zone C2 (i.e. within the extreme flood extent (1 in 1000 (0.1%) annual probability flood event) and without significant defence infrastructure). An FCA is therefore required for planning purposes.

This FCA has been undertaken in accordance with Planning Policy Wales (PPW) Technical Advice Note 15 – Development and Flood Risk (TAN15)² and documents the approach taken to assess sources of flood risk to the Proposed Development including fluvial, tidal, groundwater, surface water and artificial sources.

1.2 Scope of Works

The scope of works for this FCA is as follows:

- Data collation and review.
- Desk based assessment of flood risk from all sources, informed by previous FCAs.
- Produce an FCA report, detailing any flood risk management measures to ensure compliance with TAN15 requirement, including for no detriment to third party flood risk.
- Identify further work that may be required to support detailed site design, where required.

1.3 Terminology

Flood risk is a product of both the likelihood and consequences of flooding. Throughout this document, flood events are defined according to their likelihood of occurrence. Floods are described according to an ‘annual chance’, meaning the chance of a particular flood occurring in any one year. This is directly linked to the probability of a flood. For example, a flood with an annual chance of 1 in 100 (a 1 in 100 chance of occurring in any one year), has an annual probability of 1%.

1.4 Limitations

This report has been compiled from a number of sources which Arcadis believes to be trustworthy. However, Arcadis is unable to guarantee the accuracy of information provided by others. The report is based on information available at the time of writing. Additional information may become available in the future which may have a bearing on the conclusions of this report and for which Arcadis cannot be held responsible.

¹ Welsh Government, 2004 & 2015, TAN 15 Development and Flood Risk – Development Advice Map, <http://data.wales.gov.uk/apps/floodmapping/> - accessed August 2021

² Welsh Assembly Government, 2004, Planning Policy Wales, Technical Advice Note 15: Development and Flood Risk

2 Background

2.1 Site Location and Description

The Proposed Development is located on part of the former RAF Sealand 'South Camp' site, now referred to as the Airfields, to the north-west of Garden City village as indicated in Figure 2-1. It is centred at approximate National Grid Reference (NGR) SJ 32184 69876 and covers an area of 23.74 ha in total. The main part of the site occupies an area of approximately 22 ha whilst the south-western arm of the site extends approximately 550m from the main part of the site to the River Dee. The south-western arm of the site indicates where a proposed pipe and outfall to the River Dee will be constructed (see Section 2.2 for more detail on the development proposals).

At present the site and its surroundings are predominantly managed grassland. The former RAF Camp buildings and site roads were removed during phase 1 enabling works associated with the Airfields site. The main area of the site is bounded to the north and north-west by Northern Drain and Shotwick Brook. The northern perimeter of the Proposed Development site abuts the existing disused rail corridor which now incorporates the Chester Millennium Greenway. Beyond this is the Deeside Industrial Park (DIP).

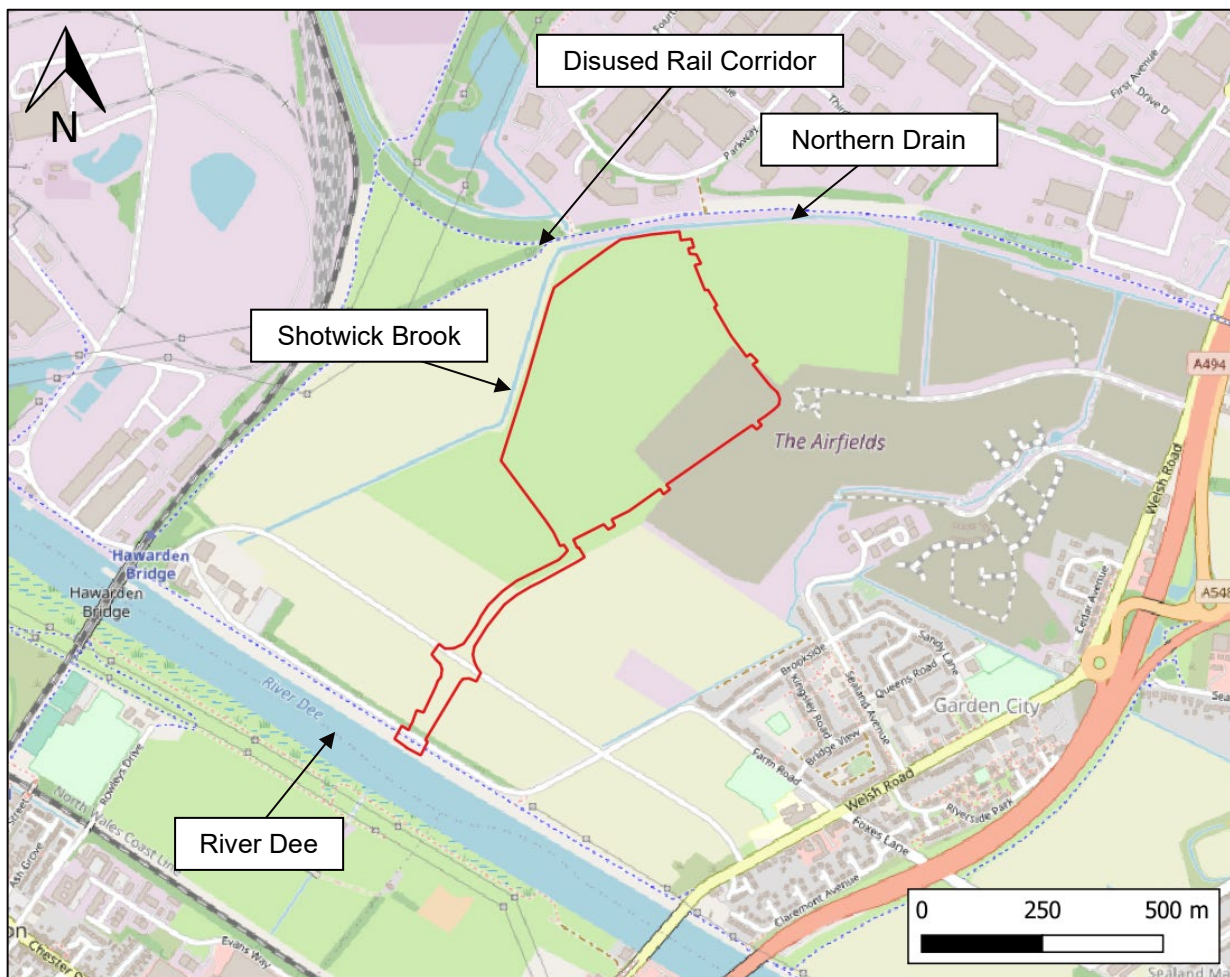


Figure 2-1: Site Location (red line boundary shown in red)
Background Mapping © OpenStreetMap contributors

2.2 Proposed Development

ICT UK Limited's bespoke operational requirements are such that they need a building that would exceed building height parameters approved within the extant planning permission for the Airfields site, which are currently set at 30 m for this plot and requires land outside the redline application boundary granted outline planning permission for the Airfields site. The planning application therefore seeks full planning permission for this development which is described below:

Full Planning Application for erection of Paper Processing Mill to produce and manufacture tissue paper (B2, B8 use class) with ancillary B1a office space; associated servicing and infrastructure including car parking, HGV parking and vehicle and pedestrian circulation; noise mitigation features; earthworks to create development platforms; creation of drainage features including a new outfall to the River Dee; water treatment plant; and landscaping.

The Paper Mill Facility will be developed in three phases, comprising employment floorspace including manufacturing and production areas (B2 use class), ancillary offices (B1a use class), and a warehouse section, (B8 use class) with car parking and HGV parking. The proposed phasing is summarised below:

- Planning Submission – 2021 (Q4)
- Planning Determination – 2022 (Q1)
- Initial Site Enabling Works – 2022 (Q3) – 2022 (Q4) (including cut and fill and creation of development platform)
- Phase 1 of the Paper Mill Facility – 2022 (Q3) – 2024 (Q1)
- Phase 2 of the Paper Mill Facility – 2024 (Q4) – 2026 (Q2)
- Phase 3 of the Paper Mill Facility – 2034 (Q1) – 2035 (Q3)

The table below provides a summary of the planning application proposals and more detail on phasing.

Table 2-1: Schedule of Accommodation

Phase	Use / Use Class	Size of Floor space (m ²)	Finished Floor Level (FFL)	Building heights	Maximum car parking spaces
Phase 1	B2, B8, ancillary B1a Uses	66,809 m ² (includes office, water treatment building, boiler room, mill station entrance gatehouse and drivers gatehouse)	Main Process Buildings at 5.25 mAOD, the office building at 6.15 mAOD and High Bay Warehouse (HBW) at 4.60 mAOD. Dispatch Area at 6.35 mAOD	10m – 40m above FFL	26 HGV spaces and a total of up to 255 car spaces including 16 disabled spaces, 8 motorcycle spaces and 70 cycle spaces
Phase 2	B2, B8 uses	17,002 m ²	All Buildings at 5.25m AOD	10m – 21.25 m above FFL	-
Phase 3	B2, B8 uses	40,533 m ²	Main Process Buildings at 5.25 mAOD, the office building at 6.15 mAOD and High Bay Warehouse (HBW) at 4.60 mAOD. Dispatch Area at 6.35 mAOD	10m – 40m above FFL	A total of 338 car spaces including 17 disabled spaces, 70 cycle spaces and 8 motorcycle spaces

Car Parking will be in accordance with Flintshire County Council car parking standards

The Paper Mill Facility would be predominantly constructed on Plot C of the Airfields site and the proposed pipe and outfall would extend from Plot C to the River Dee. Proposed layout plans are included in Appendix A of this FCA.

The Proposed Development includes the construction of a new outfall from the Paper Mill to facilitate discharge of operational effluent to the River Dee (see drawing C1242/441 in Appendix A). A new headwall is proposed to facilitate the discharge. This headwall has been designed in consultation with NRW and any temporary works to construct the outfall, as well as the operation of the structure, would be subject to the conditions of a Flood Risk Activity Permit issued by NRW. Details of the headwall design are provided in Appendix 9 of the ES Part 1 Report.

A Waste Water Treatment Plant (WWTP) has also been embedded into the design of the development to treat wastewater generated from the Paper Mill Facility prior to discharge. The south-western arm of the site follows the alignment of what will be Road 3 of the Welsh Government's proposed Commercial Spine Road which makes provision for a below ground easement to allow the discharge of waste water from the proposed Paper Mill Facility. The Commercial Spine Road is not the subject of this FCA and is now the subject of a reserved matters application submitted to Flintshire County Council (FCC) in June 2021 (ref: 063191 and 063187). Once determined, this road will provide highways access to the Proposed Development site.

A number of flood mitigation measures have been embedded into the design of the Northern Gateway, alongside strategic measures implemented by Welsh Government. To facilitate development, raised development platforms will be created by modifying existing ground levels. A cut and fill exercise has been undertaken to balance the area required for the development platforms and floodable areas with the requirement to use as little material from offsite as possible. This has resulted in the creation of flood storage and wetland areas. Further details on the cut and fill exercise are included in the Cut and Fill Earthworks Model in Appendix 12 of the Environmental Statement submitted to support the planning application. Minimum Finished Flood Levels (FFLs) have been recommended for development within the Northern Gateway site based on hydraulic modelling of tidal and fluvial flooding. The FFLs for the Proposed Development are summarised in Table 2-1 above and are discussed in further detail in Section 5.

Drainage works will be undertaken as part of Plot C/D enabling works, now approved. These drainage works include the construction of new swales and the widening of Northern Drain. Further detail on these works is included in Section 6.2 of this FCA.

2.3 Topography

The topography of the Proposed Development site has been defined through bespoke topography surveys and using LiDAR data (shown in extract in Figure 2-2). The data indicate that the site is generally flat with a gentle slope towards the River Dee. The highest elevations within the Proposed Development site boundary are in the most south-westerly part, where the River Dee embankment (see Section 2.6) is located. Within the site boundary, the maximum elevation of the embankment is 7.2 m Above Ordnance Datum (AOD). Ground levels across the remainder of the site generally range from 4.0 mAOD to 4.9 mAOD.

Offsite, much of the surrounding land is also flat, with local areas of higher ground corresponding to the disused rail corridor/Chester Millennium Greenway, the existing road network and parts of the DIP. The prevailing topography typically slopes towards the River Dee.

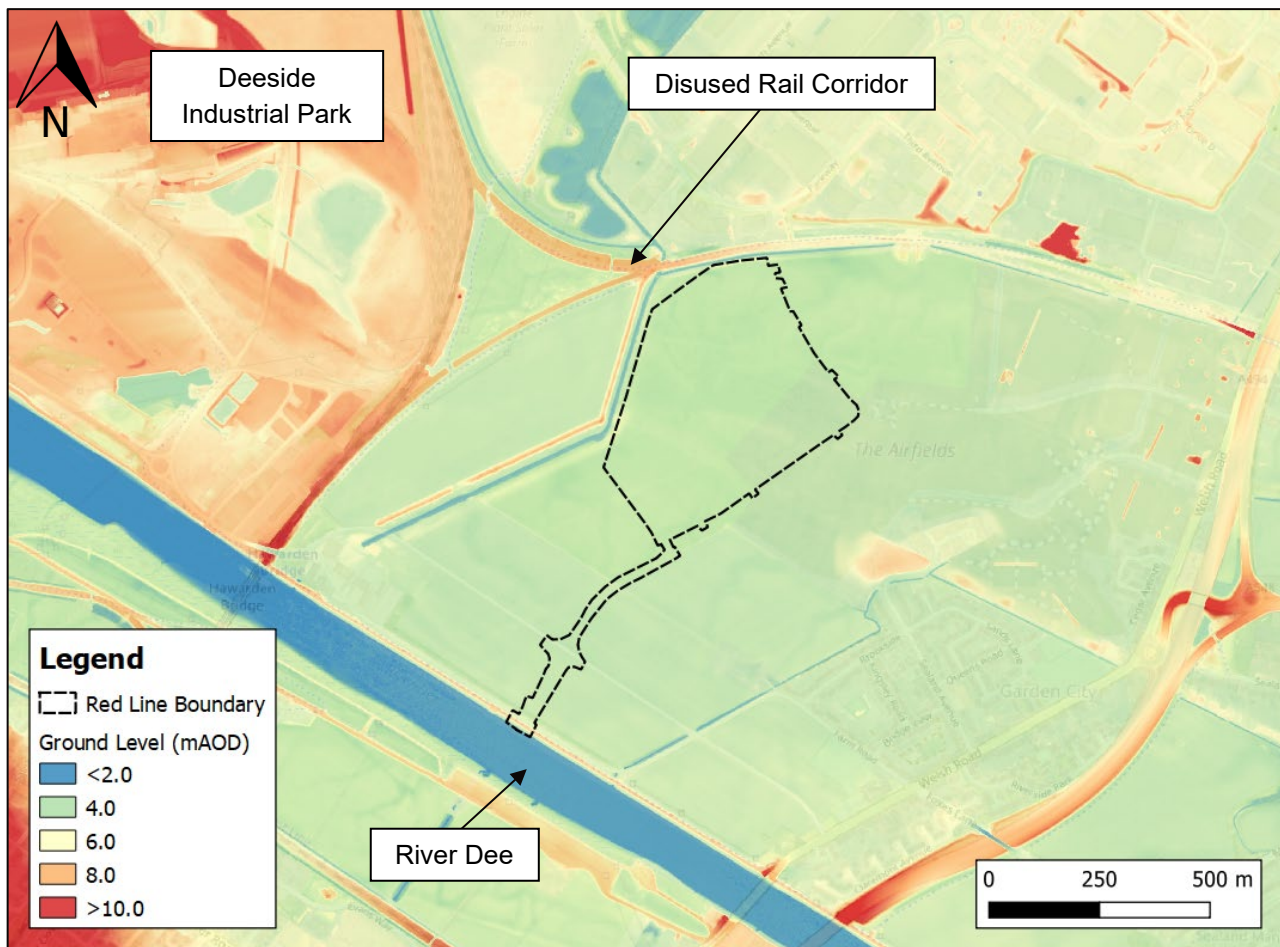


Figure 2-2: Site Topography (filtered lidar data shown)

Contains Natural Resources Wales information © Natural Resources Wales and/or database right

Background Mapping © OpenStreetMap contributors

2.4 Catchment Description

The descriptions of the watercourses below relate to the pre-development baseline. Proposed works to the watercourses are described in Section 6.2 of this FCA.

The River Dee, a Natural Resources Wales (NRW) designated Main River, flows in a north-westerly direction prior to its discharge into the Liverpool Bay area of the Irish Sea. The reach of the River Dee in the vicinity of the Proposed Development site is tidally influenced.

Shotwick Brook, an NRW designated Main River, enters the Northern Gateway from the north. This watercourse picks up the Northern Drain and flows, in a southern direction, as an open manmade channel before discharging into the River Dee via tidal flap valves. Shotwick Brook, along with its tributaries (Burton Mash Drain South, Finger Gutter East, Shotwick Drain West, Shotwick Drain East, Boundary Drain Shotwick) drains the DIP Zones 2 and 3 and rural areas further to the northwest, as indicated in Figure 2-3. The catchment of Shotwick Brook is relatively flat and low lying. As a result, in the upper catchment the Puddington pumping station lifts water into the Shotwick Brook at Burton.

The Northern Drain is an open watercourse running east to west and flows into the Shotwick Brook adjacent to the Proposed Development boundary. Two culverts (0.6m and 1.05m diameter) connect the Northern Drain to the Garden City Drain. Just downstream of the 1.05m diameter culvert, there is a small raised weir that diverts low flows from the Northern Drain into a culvert. Northern Drain conveys flows from Crown Drain that

runs along the east side of DIP Zone 1 and adjacent to the A550. Apart from DIP Zone 1, Crown Drain also drains the balancing ponds at the A550 roundabout and has numerous other highway drainage inlets along its length before it flows under the cycle way to its confluence with the Northern Drain.

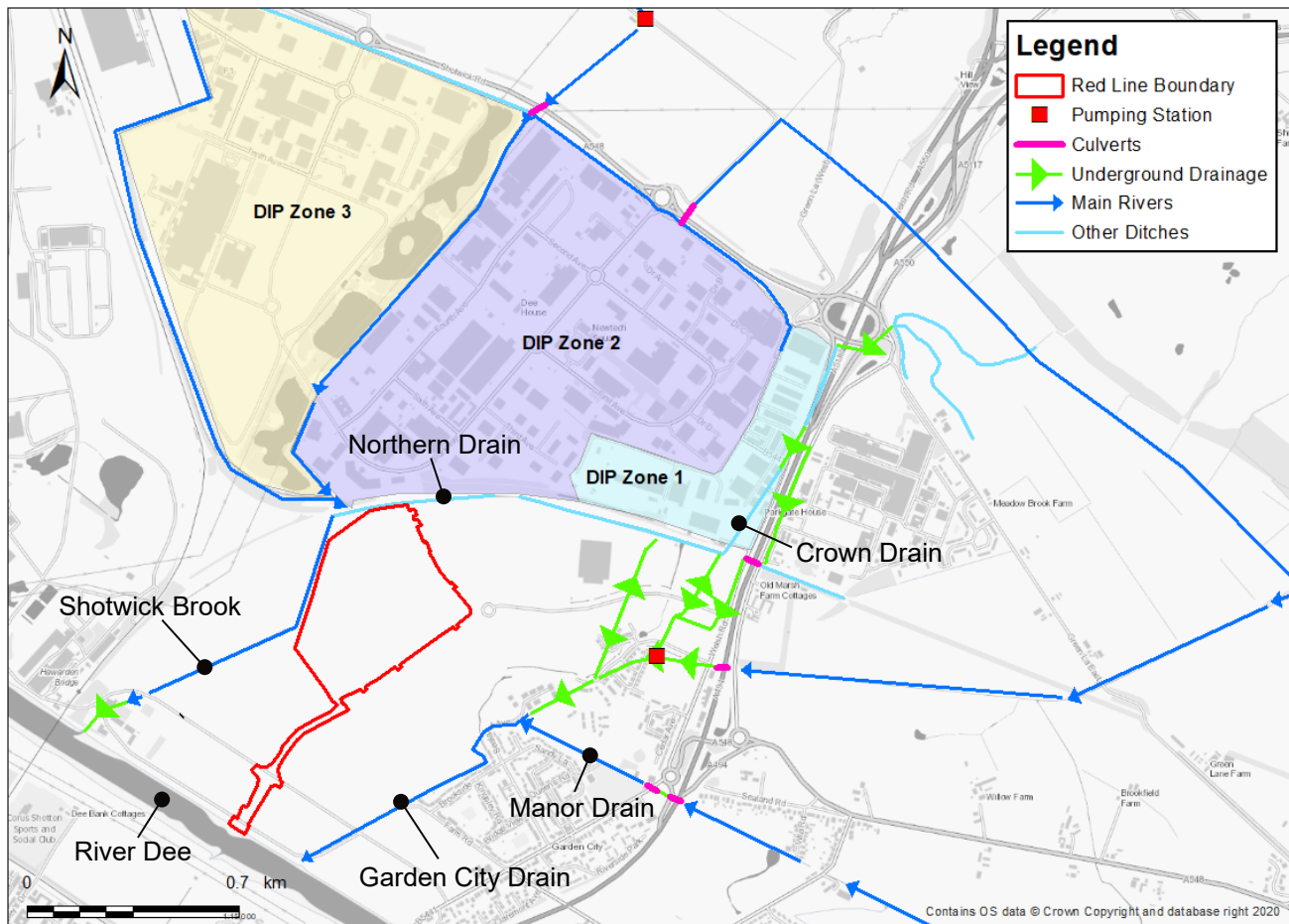


Figure 2-3: Existing Land Drainage Features

2.5 Historical Flooding

The NRW Recorded Flood Extents map (Figure 2-4) shows areas that have been recorded to have flooded in the past from rivers, the sea or surface water and small watercourses. This dataset shows there have been no incidents of flooding within the Proposed Development site boundary.

The recorded flood extents shown in Figure 2-4 correspond to the 1964 fluvial flood which affected large parts of the Shotwick Brook catchment, including lands that are now occupied by the DIP.

No other incidents of historical flooding at the site are identified in the Flintshire Preliminary Flood Risk Assessment (PRFA)³ and its Addendum⁴ and no further incidents of flooding in the area have been identified in the preparation of this FCA.

³ Flintshire County Council, 2011. Preliminary Flood Risk Assessment. [https://www.flintshire.gov.uk/en/PDFFiles/Land-and-Property/Preliminary-Flood-Risk-Assessment-June-2011-\(PDF-1MB-new-window\).pdf](https://www.flintshire.gov.uk/en/PDFFiles/Land-and-Property/Preliminary-Flood-Risk-Assessment-June-2011-(PDF-1MB-new-window).pdf) - accessed August 2021

⁴ Flintshire County Council, 2018. Preliminary Flood Risk Assessment Addendum. <https://www.flintshire.gov.uk/en/PDFFiles/Land-and-Property/PRFA-Addendum-Statement-2018.pdf> - accessed August 2021

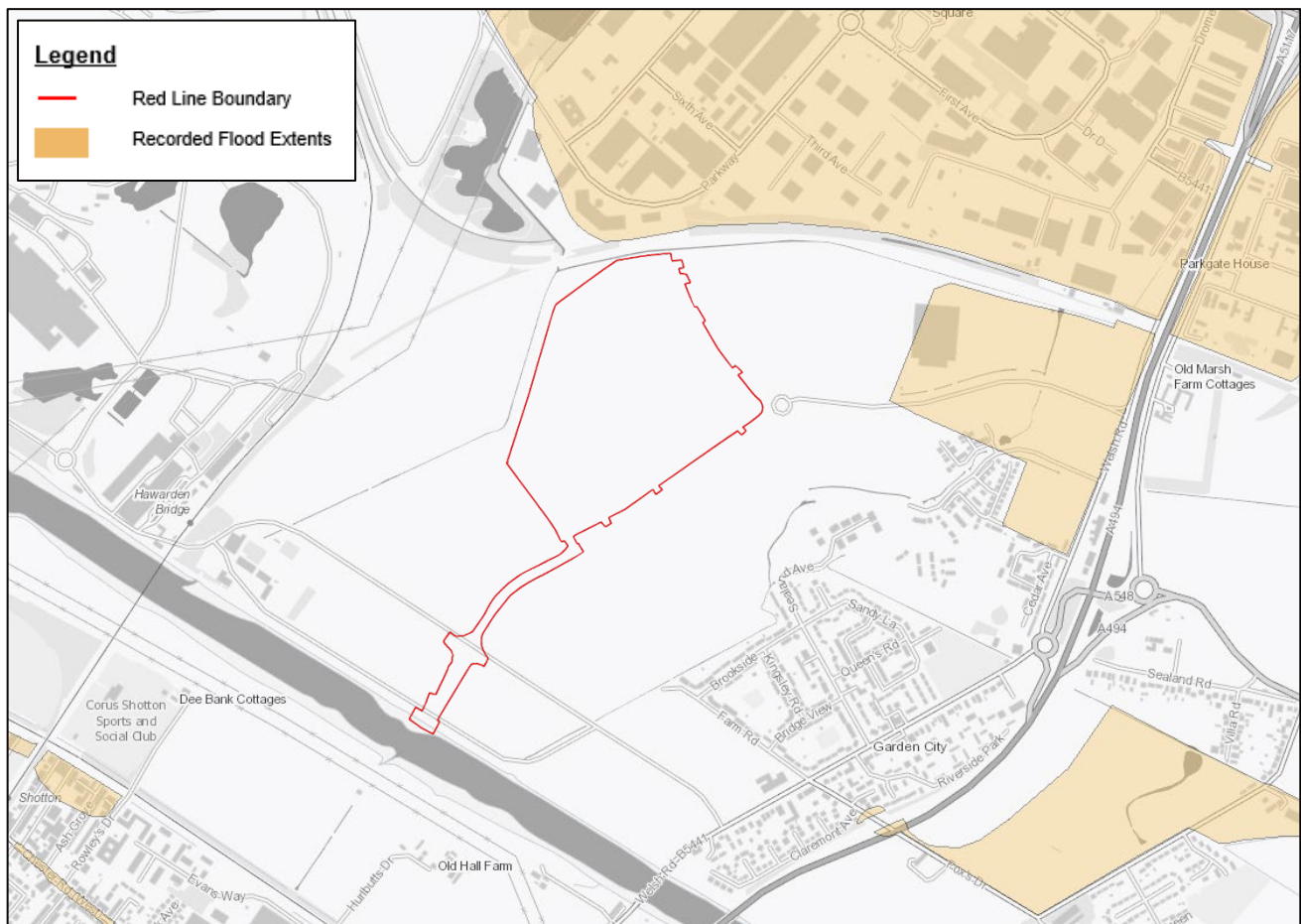


Figure 2-4: NRW Historic Flood Data

Contains Natural Resources Wales information © Natural Resources Wales and/or database right

2.6 Existing Flood Defences

The River Dee was canalised downstream of Chester Weir over 200 years ago and flood defences were constructed which are still maintained today. The Proposed Development site is protected from flooding by these defences which comprise substantial raised earth embankments on both sides of the estuary. In the vicinity of the Proposed Development site the average crest level of the embankment is 7.2 mAOD and the crest width varies between 5 and 7m (6m on average). Work was undertaken by the Welsh Government in 2015 to strengthen the defences, including constructing sheet pile walls along some sections⁵.

The current Shoreline Management Plan 2⁶ (SMP2) shows that the existing Coastal Defence Policy for the area (Policy 11a.5) is 'Hold the Line'. The 'Hold the Line' policy covers situations where work or operations are carried out in front of the existing defences to improve or maintain the standard of protection provided by the existing defence line. The SMP⁷ confirms that this existing policy will remain unchanged in future, both in the short term and anticipated long term. Within the wider Dee Estuary, the long-term plan is to continue to manage risks to commercial and industrial assets from flooding and erosion, but to also allow more natural evolution where appropriate. In order to mitigate the impacts of the defences on the evolution of the estuary in

⁵ Environment Agency and Natural Resources Wales, 2016. Dee River Basin District Flood Risk Management Plan 2015 – 2021 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/507153/LIT_10199_DEE_FRMP.pdf - accessed August 2021

⁶ Natural Resources Wales, 2019. Shoreline Management Plan 2 dataset. <https://lle.gov.wales/catalogue/item/ShorelineManagementPlan2/?lang=en> – accessed August 2021

⁷ Halcrow Group Limited, 2010. North West England and North Wales Shoreline Management Plan SMP2

combination with expected long-term future sea level rise, the management plan allows for creation of areas of new habitat by moving defences inland where opportunities exist.

Further information on the areas benefitting from the flood defences is given in Section 4.3 and the location of the defences is shown in Figure 4-2.

2.7 Previous Studies

Development at the Northern Gateway has been guided by a series of planning applications and supporting studies. The key studies which have been drawn on to inform this FCA are summarised below.

The Airfields site forms part of the Northern Gateway Strategic Mixed Use Development site allocated under Policy HSG2A in the Flintshire Unitary Development Plan (UDP)⁸. Outline planning permission (ref: 049320) was granted for an employment led mixed use redevelopment of the Airfields in January 2013 and subsequently varied with the last Section 73 application approved in April 2021 (ref: 061125). Following approval in 2013, it was planned that proposed development would be brought forward through a series of reserved matters applications for specific phases.

Condition 6 of the Decision Notice (when permission was granted in January 2013) required that, prior to the approval of reserved matters applications, a Development Brief be submitted to the Local Planning Authority. The key aspect of the Development Brief from a flood risk perspective was the Flood Mitigation Plan. An FCA was prepared by Weetwood Services Ltd ('Weetwood') in November 2013⁹ in support of the site wide Flood Mitigation Plan submitted as part of the Design Statement accompanying the application to discharge Condition 6 (ref: 051025). The 2013 FCA provided an overview of existing flood risk to the site and the overarching flood risk mitigation scheme to which future reserved matters applications should relate. The 2013 FCA was informed by hydraulic modelling of the site and surrounding land. It was approved by NRW and FCC and, subsequently, Condition 6 of the outline planning permission was discharged in November 2013. The overarching flood risk mitigation principles from the 2013 FCA are referred to in Section 5 of this FCA.

An FCA Addendum was prepared by Weetwood in October 2020¹⁰ to support Plots C/D (the Airfields) enabling works application, comprising drainage and landscaping details to discharge (in part) conditions 7, 15, 17, 18 and 19 of the outline planning permission. The 2020 FCA Addendum is included as Appendix B of this FCA.

It is noted in the 2020 FCA Addendum that the Plots C/D enabling works will be brought forward concurrently with Roads 2/3 of the Employment Spine Road, to be constructed by Welsh Government, and that approval of these works will enable the Sealand Bank Farm culvert to be upgraded (see Section 5.3 for further details). The 2020 FCA Addendum therefore considered these works holistically and was prepared in accordance with the October 2017 FCA Addendum¹¹ (prepared by Weetwood) and the associated Amended Flood Mitigation Plan. The 2020 FCA Addendum used the approved Weetwood tidal and fluvial hydraulic models to inform the proposed flood mitigation and the proposed mitigation measures were incorporated into the models. The model outputs have been used to inform the assessment of fluvial and tidal flood risk detailed in Section 4.2 and 4.3.

2.8 NRW Pre-application Response

A pre-application advice letter regarding the scope of this FCA has been received from NRW and is included in Appendix C. The advice states that NRW would expect the FCA to be based on previous work that has

⁸ Flintshire County Council, 2011. Unitary Development Plan 2000-2015

⁹ Weetwoods, 2013. Flood Consequences Assessment; The Airfields, Deeside

¹⁰ Weetwood, 2020. Flood Consequences Assessment Addendum; The Airfields, Deeside, Plots C/D Drainage & Landscaping Details

¹¹ Weetwoods, 2017. Flood Consequences Assessment Addendum; The Airfields, Deeside – Discharge of Condition 6 Amendment

been undertaken for the wider Airfields site and that the proposals should satisfy the agreed parameters for flood mitigation measures. These aspects are addressed in Sections 5 and 6 of this FCA. NRW have also outlined their concerns regarding the upgrade to the Sealand Bank Farm culvert in the pre-application advice letter. Their concerns and points raised in the letter are addressed in Section 5.2.1 of this FCA.

Table 2-2 below summarises the points NRW expect to be included in the FCA and where this information can be found within the FCA and its Appendices.

Table 2-2: NRW Pre-application Advice Summary

NRW Expectation for Inclusion in the FCA	Location within the FCA
An assessment of flood risk from both tidal and fluvial sources, including overtopping and breach for the tidal River Dee. This should be based on the work undertaken in previous FCAs. The previously agreed lifetime of development (i.e. to the year 2088) can be adopted for the FCA.	Detailed in Sections 4.2 and 4.3
The FCA will need to refer to the approved flood risk mitigation measures and demonstrate that the specific flood risk mitigation measures proposed for Plot C are in accordance with the agreed measures, including specification of development platform and finished floor levels. To reiterate, this needs to be based on the Alternative Flood Mitigation Plan.	The approved flood mitigation measures are outlined in Section 5 and referred to in Section 6.2 in regard to surface water drainage. Table 2-1 lists the FFLs for the proposed buildings and the Flood Mitigation Plans are discussed in Section 5.
We would expect detailed proposed level information to be submitted in support of the application. This should include proposed level plans which show the development platform and finished floor levels and proposed cross sections showing the transition in levels from the flood storage areas to the development platform and finished floor levels.	Table 2-1 lists the FFLs for the proposed buildings, detailed plans are included in Appendix A of the FCA.
As outlined above, an assessment of the development proposals on flood risk elsewhere will need to be undertaken, to demonstrate that the proposal would not result in an adverse impact on flood risk to third party land or property. This needs to include the impact of the loss of the flood storage area in the northern section of Plot C as a result of this area forming part of the raised development platform.	Reference should be made to Section 5 and Section 6 of this FCA.
We will require an 8-metre access easement to be provided along Shotwick Brook to allow access for our maintenance activities along this Main River. We would expect a plan to be submitted showing this easement. We would also request that gated access is provided off the road network.	The design includes for the 8m easements required along the Shotwick Brook for future maintenance access.
We would also expect the application to be supported by detailed design drawings for the proposed outfall through the River Dee defence. This will need to address the concerns that we have been raised as part of the Flood Risk Activity (FRAP) pre-application discussions with the site's consulting engineers (Sheperd Gilmour).	Details of the headwall design for the proposed outfall are included in the application, within Appendix 9 of the ES Part 1 Report.

3 TAN15 Development and Flood Risk

3.1 General

TAN15 provides guidance to local planning authorities in determining planning applications with regard to flood risk and provides an interpretation of how this guidance applies specifically to a site. It *'provides a framework within which risks arising from both river and coastal flooding and from additional run-off from development in any location can be assessed'*. This *'precautionary framework should be used for both forward planning and development control purposes'*. Its operation is governed by:

- A Development Advice Map (DAM) containing three zones (A, B and C with subdivisions C1 and C2) which should trigger the appropriate planning tests in relation to Sections 6 and 7 and Appendix 1 (TAN15, para 3.2).
- Definitions of vulnerable development and advice on permissible uses in relation to the location of development and the consequences of flooding (TAN15, para 3.2).

The approach is therefore a staged one:

1. Categorisation of site within TAN15 Flood Zones.
2. Application of TAN15 precautionary framework and determination of whether the proposed development is 'justified' in that zone (TAN15 Section 6 Test).
3. Assessment of flooding consequences (TAN15 Section 7 Test and Appendix 1) and production of a Flood Consequences Assessment report.

3.2 Categorisation of the Proposed Development Site within TAN15 Flood Zones

The TAN15 DAM is shown in Figure 3-1, overlain with the red line boundary. This shows that the majority of the Proposed Development site is located within Zone C1 (i.e. within the extreme flood extent (1 in 1000 (0.1%) annual probability flood event) and served by significant infrastructure, including flood defences). However, a small area, adjacent to the River Dee, is within Zone C2 (i.e. within the extreme flood extent (1 in 1000 (0.1%) annual probability flood event) and without significant defence infrastructure).

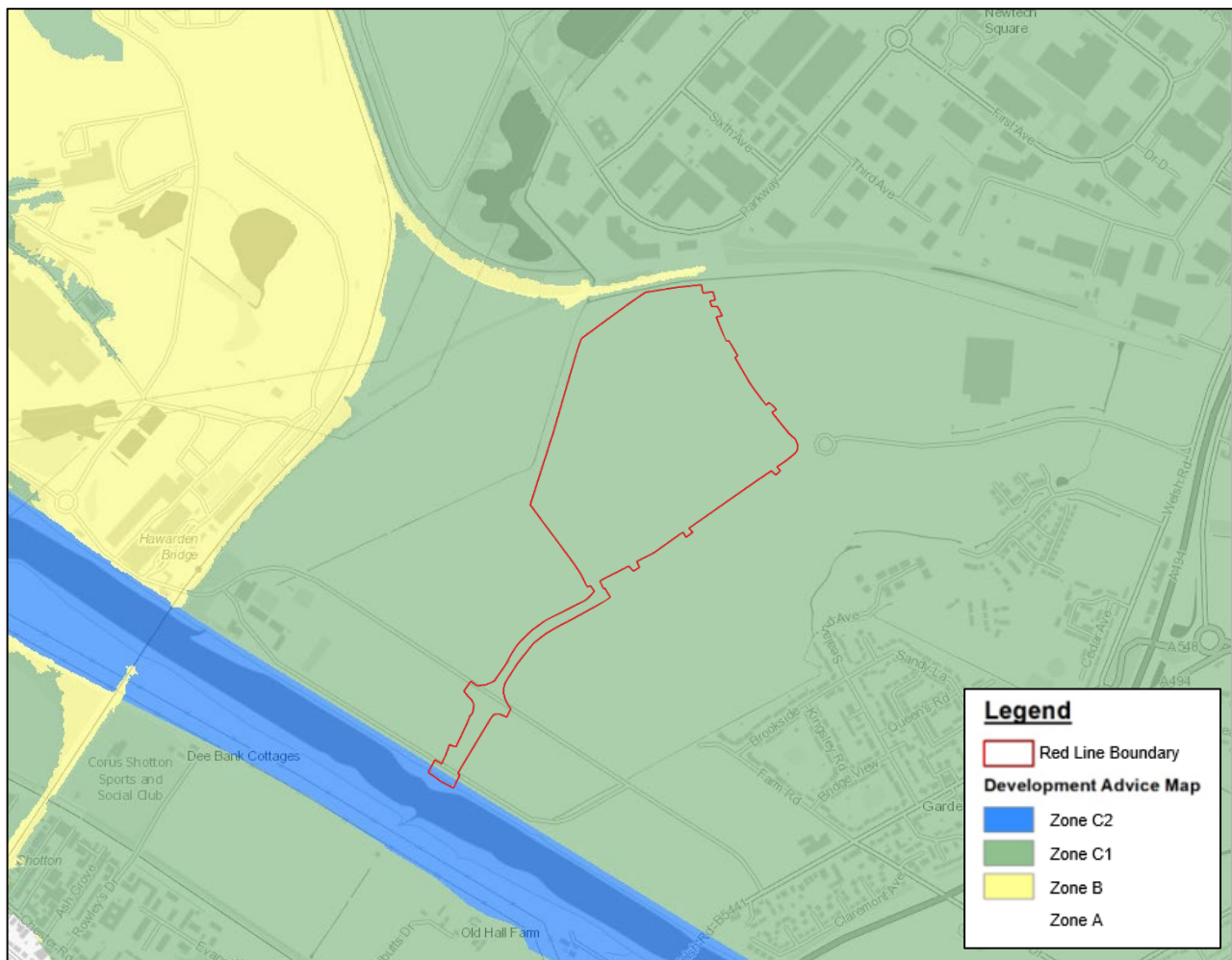


Figure 3-1: Development Advice Map

Contains Natural Resources Wales information © Natural Resources Wales and/or database right

3.3 Application of the Justification Test

The TAN15 DAM highlights that the Proposed Development site is located within a flood risk area, and, as a result, there is a requirement to apply the Justification Test. Paragraph 6.2 of TAN15 states that new development should only be permitted within Zones C1 and C2 if determined by the Planning Authority to be justified in that location.

The first part of the TAN15 Justification Test states that: *Development, including transport infrastructure, will only be justified if it can be demonstrated that:*

- i. *'Its location in Zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement' or,*
- ii. *'Its location in Zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region'*

As stated in Section 2.7, the Airfields site forms part of the Northern Gateway Strategic Mixed Use Development which has been allocated under Policy HSG2A in the Flintshire UDP. The Northern Gateway is

also justified by allocations in the National Development Framework 2020 - 2040¹², Wales Spatial Plan¹³ and West Cheshire/North East Wales Sub-Regional Spatial Strategy¹⁴. The proposed Paper Mill Facility would be a key employment provider and contribute to delivery of the strategic aims of the Northern Gateway. Given this, and the justification of the development by allocations within local and regional development plans, it is considered that the Proposed Development passes the TAN15 Justification Test. Furthermore, outline planning permission for an employment led mixed use redevelopment of the Airfields has been granted (see Section 2.7).

3.4 Assessment of Flood Consequences

Having established that the Proposed Development is justified with regard to flood risk in its proposed location, the next step is to assess the consequences of flooding. In order to comply with TAN15 guidance, an FCA must demonstrate that the consequences associated with flooding are acceptable and manageable. An assessment of the flood consequences is therefore provided in the following sections.

¹² Welsh Assembly Government, 2019. National Development Framework 2020-2040 Consultation Draft: 7 August – 1 November 2019

¹³ Welsh Assembly Government, 2008. The Wales Spatial Plan 2008 Update

¹⁴ Welsh Assembly Government, Cheshire County Council, Chester City Council, Denbighshire County Council, Ellesmere Port and Neston Borough Council, Flintshire County Council, Merseyside Policy Unit, North West Regional Assembly and Wrexham County Borough, 2008. West Cheshire/North East Wales Sub-Regional Spatial Strategy and Strategic Environmental Assessment Process Report 2006 – 2021

4 Potential Sources of Flooding

4.1 Overview

This section considers flood risk from the range of possible sources listed in Table 4-1.

Table 4-1: Sources of Flooding

Source of Flooding	Description
Flooding from rivers (fluvial)	Floodwater originating from a nearby watercourse when the amount of water exceeds the channel capacity of that watercourse.
Flooding from the sea (tidal)	High tides, storm surges and wave action, often acting in combination, flooding low-lying coastal land.
Flooding from surface water (pluvial)	Flooding caused by intense rainfall exceeding the available infiltration and/or drainage capacity of the ground.
Flooding from groundwater	Flooding caused when groundwater levels rise above ground level following prolonged rainfall.
Flooding from sewers	Flooding originating from surface water, foul or combined drainage systems, typically caused by limited capacity or blockages.
Flooding from reservoirs, canals, and other artificial sources	Failure of infrastructure that retains or transmits water or controls its flow.

4.2 Flooding from Rivers (Fluvial)

4.2.1 Pre-Enabling Works

The NRW Flood Risk Assessment Wales (FRAW) map¹⁵ shows areas which would be affected by flooding from rivers and the sea taking flood defences into account.

The map (Figure 4-1) indicates that the majority of the Proposed Development site is at risk of fluvial flooding to a varying degree, ranging from low (annual chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%)) to high (annual chance of flooding greater than 1 in 30 (3.3%)) risk. The exception is north east areas of the site, which are shown to be outside the extent of a flood with an annual chance of 1 in 1000 (0.1%).

There are no areas shown on the FRAW map as benefitting from defences against fluvial flooding.

¹⁵ Natural Resources Wales, 2021. Flood Risk Assessment Wales Map <http://data.wales.gov.uk/apps/floodmapping/> - accessed August 2021

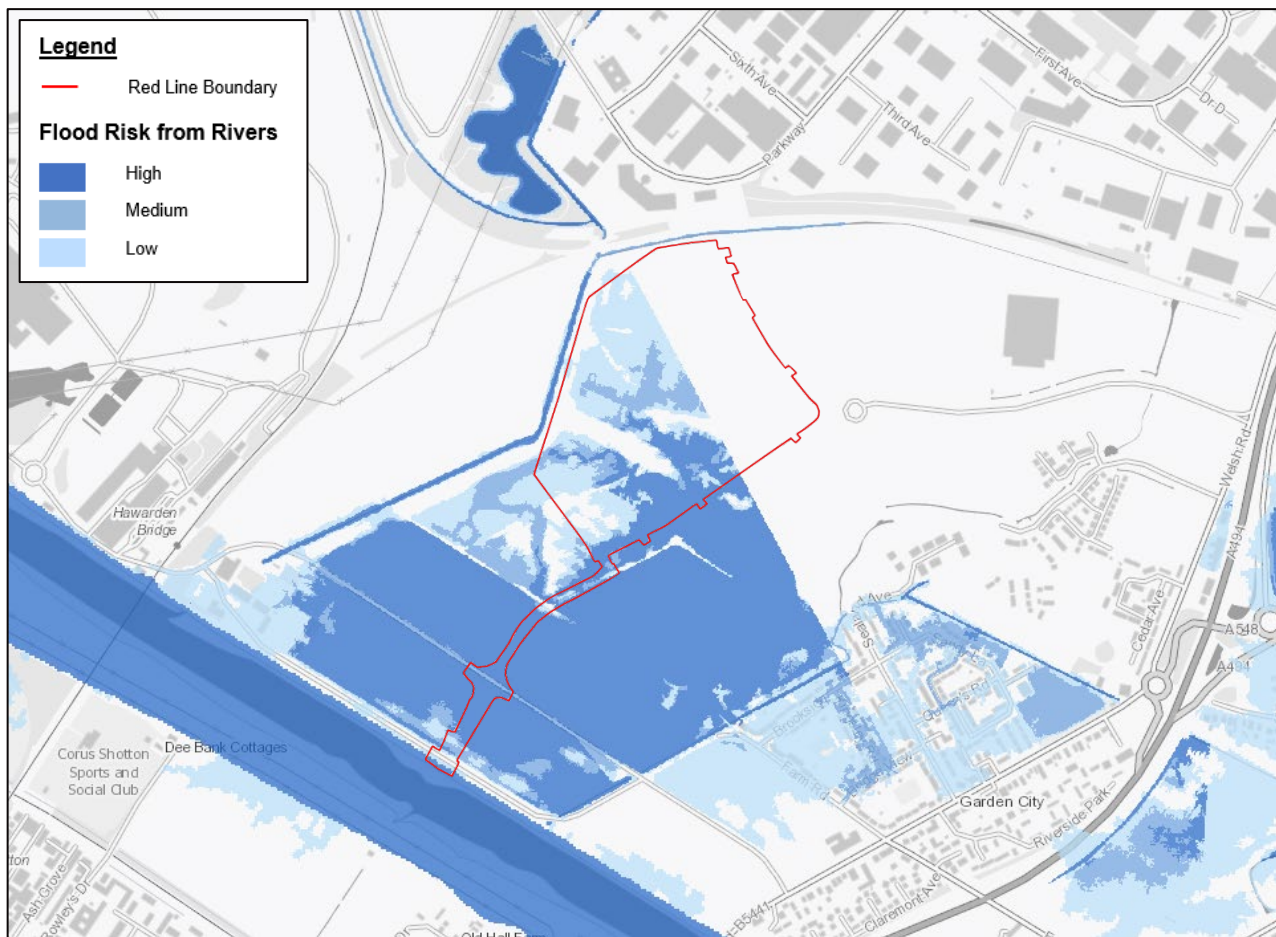


Figure 4-1: NRW Flood Risk from Rivers Map

Contains Natural Resources Wales information © Natural Resources Wales and/or database right

The Shotwick Brook and Garden City Drain are the two principal watercourses in the vicinity of the Proposed Development and these discharge via flap gates to the tidal River Dee. At low tide both the Shotwick Brook and the Garden City Drain discharge freely to the Dee and the risk of fluvial flooding is perceived to be low under these conditions. However, when Shotwick Brook and Garden City Drain are tide-locked, there is potential for flooding as flows are unable to discharge into the River Dee.

The Weetwood 2020 FCA Addendum (Appendix B) for the Airfields site has quantified fluvial flood risk. Full details of the modelling methodology are reported, including on the sensitivity analysis undertaken, and model outputs for fluvially dominated events are also provided.

The baseline modelling predicted a maximum flood level of 4.61 mAOD in the 1% (1 in 100) 2013 fluvial flood event and a maximum flood level of 4.80 mAOD in the 0.1% (1 in 1000) 2013 fluvial flood event. TAN15 guidance states that a 75-year development lifetime should be adopted for industrial development such as the proposed Paper Mill Facility. Outputs from the modelled 2088 events were therefore reviewed to inform this FCA. An allowance for climate change was incorporated into the 1% 2088 fluvial flood event, in line with TAN15 requirements, and a maximum flood level of 4.69 mAOD was predicted for the Airfields site in this event.

The baseline model outputs show that only small parts of the Proposed Development site would be inundated in the 1% 2013 fluvial flood event (with flood depths of up to 1.34m) whereas the majority of the Proposed Development site is shown to be inundated in the 1% 2088 fluvial flood event (with flood depths of up to 1.44m).

4.2.2 Post-Enabling Works

Modelling undertaken as part of the Weetwood 2020 FCA Addendum (Appendix B) incorporating the proposed flood risk mitigation measures suggests that the Airfields site, and therefore the Proposed Development site, would be flood free in all fluvial events modelled. The proposed mitigation measures in accordance with the Amended Flood Mitigation Plan are detailed in Section 5.

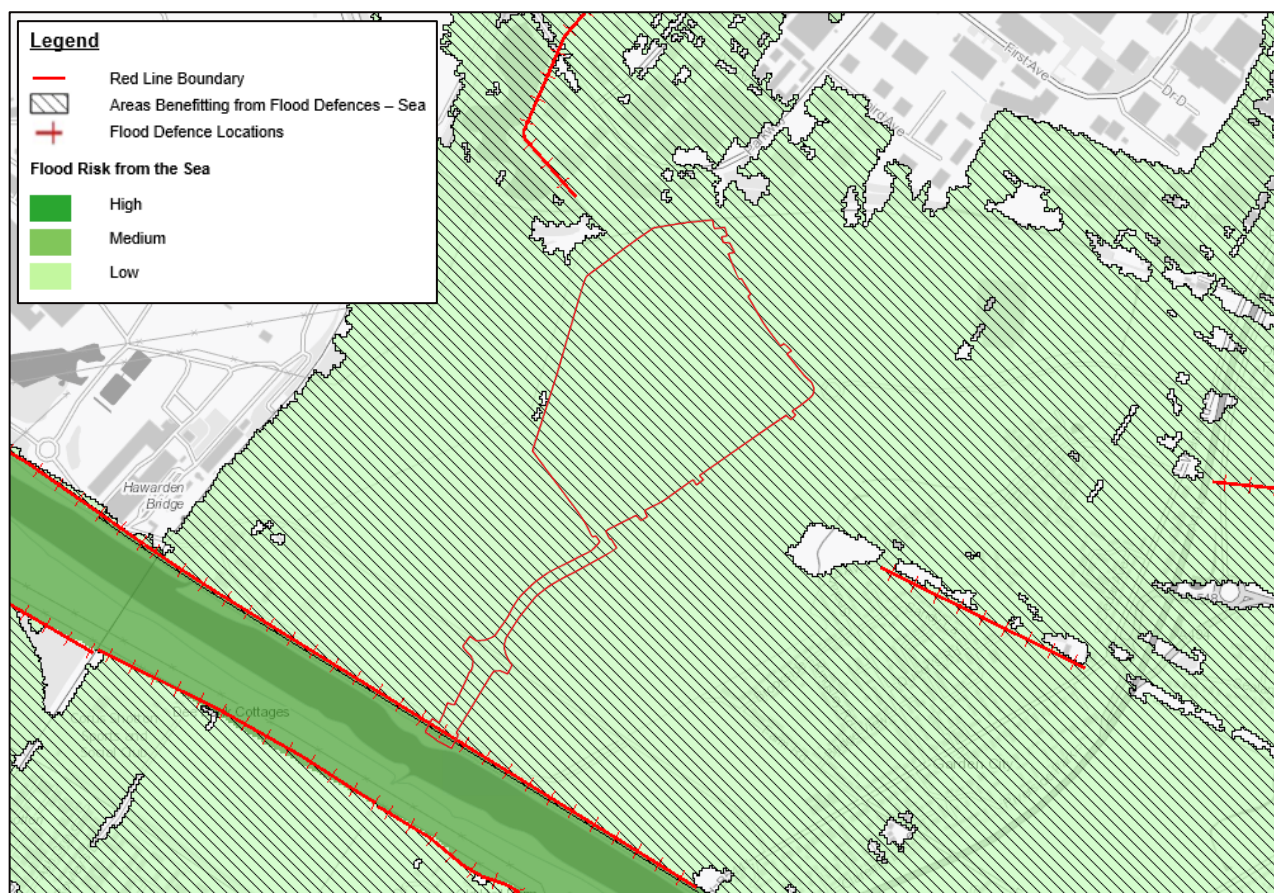
With the proposed flood risk mitigation measures in place, the Proposed Development site is considered to be at low risk of fluvial flooding.

4.3 Flooding from the Sea (Tidal)

4.3.1 Pre-Enabling Works

The NRW Flood Risk from the Sea Map (Figure 4-2) indicates that the Proposed Development site is at low risk of flooding from the sea, equivalent to an annual chance of flooding between 1 in 1000 (0.1%) and 1 in 200 (0.5%). A very small part of the site, in front of the Dee defences and corresponding to the proposed outfall location, is shown to be at high risk of flooding from the sea, equivalent to an annual chance of flooding greater than 1 in 30 (3.3%).

The Proposed Development site is also shown to be located within an Area Benefitting from Defences (ABD) and the locations of these defences are shown in Figure 4-2. The defences in the vicinity of the site are located along the banks of the River Dee, on the left bank of the Shotwick Brook and on the left bank of the Manor Drain.



The Weetwood 2020 FCA Addendum (Appendix B) for the Airfields site has quantified tidal flood risk during both defence overtopping and breach scenarios. Full details of the modelling methodology are reported, including on the sensitivity analysis undertaken, and model outputs for tidally dominated events are also provided.

The results show that no flooding of the Proposed Development site was modelled in the current day (2013) 0.5% (1 in 200) or 0.1% (1 in 1000) overtopping tidal events.

An allowance for sea level rise due to climate change was incorporated into the 2088 model scenario. Similarly, no inundation of the Airfields site, and therefore the Proposed Development site, due to overtopping was predicted in the 0.5% (1 in 200) 2088 tidal event.

Breaches along the right bank of the River Dee embankment were modelled, approximately 1.2 km upstream of the proposed outfall location and approximately 1 km downstream of the proposed outfall location. In the upstream breach scenario for the 0.5% (1 in 200) 2088 tidal event, model outputs predict that the southern portion of the main part of the Proposed Development site would be inundated along with the majority of the south-western arm of the Proposed Development site. In this modelled event flood depths are predicted to be up to 1.00 m within the Proposed Development site boundary. In the downstream breach scenario, no flooding of the Airfields site, and therefore the Proposed Development site, is predicted for the 0.5% 2088 tidal event.

4.3.2 Post-Enabling Works

Modelling undertaken as part of the Weetwood 2020 FCA Addendum (Appendix B) incorporating the proposed flood risk mitigation measures in accordance with the Amended Flood Mitigation Plan (see Section 2.7 and Section 5 for details) predict that the Airfields site, and therefore the Proposed Development site, would be flood free in all tidal events modelled.

Inundation of the site is also prevented by flapped sluices at the outlets of the Shotwick Brook and Garden City Drain, which prevent backflow through the culverts in the flood defence embankment during high water conditions in the River Dee.

Sensitivity analysis was undertaken as part of the Weetwood 2020 FCA Addendum (Appendix B). The model outputs from the sensitivity analysis indicate that the maximum depths of flooding do not exceed the tolerable conditions outlined in A1.15 of TAN15 (maximum depth of flooding set at 1000 mm for industrial development).

The proposed mitigation measures are detailed in Section 5.

With the proposed flood risk mitigation measures in place, the Proposed Development site is considered to be at low risk of tidal flooding.

4.4 Flooding from Surface Water

Flooding from surface water is a potential risk during short, intense rainstorm events or longer duration storms, when the capacity of underlying soils and drainage systems is exceeded, and rainfall runs overland to pond in depressions within the landscape. It is important that due consideration is given to changes in surface water runoff patterns that may result from the development proposals.

The NRW Flood Risk from Surface Water and Small Watercourse Map¹⁵ shows that most of the Proposed Development site is at very low risk of flooding from this source, equivalent to an annual chance of flooding less than 1 in 1000 (0.1%). There are some small, isolated areas of the site shown to be at low risk of flooding from surface water and small watercourses, equivalent to an annual chance of flooding between 1 in 1000

(0.1%) and 1 in 100 (1%). These are within depressions in the topography and are therefore not considered to pose a significant risk.

Development of the Paper Mill Facility will result in an increase in impermeable land coverage which could result in an increase in surface water runoff. This risk will be mitigated through the implementation of the surface water drainage strategy which will ensure no increase in flood risk off-site. An overview of the drainage strategy is provided in Section 6.

Overall, the Proposed Development site is considered to be at very low risk of flooding from surface water and small watercourses. Subject to the implementation of the drainage strategy, it is considered that surface water would be suitably managed, and the Proposed Development would not lead to an increased third party flood risk.

4.5 Flooding from Groundwater

Groundwater flooding occurs when groundwater rises to the ground surface. This may happen during winter and/or after prolonged or heavy rainstorms. There are generally two forms of groundwater flooding (i) 'clearwater flooding' associated with the water table rising to the surface in areas of permeable bedrock geology such as chalk; and (ii) 'river-groundwater interaction' where river levels interact with permeable superficial deposits within river valleys, flooding areas far from the river without necessarily overtopping raised river banks.

According to British Geological Survey (BGS) mapping¹⁶, the bedrock geology underlying the Proposed Development site comprises Pennine Middle Coal Measures Formation and Pennine Lower Coal Measures Formation overlain by Tidal Flat Deposits. The bedrock is designated as a 'Secondary A Aquifer' and the superficial deposits are designated as a 'Secondary (undifferentiated) Aquifer'. Secondary aquifers can be capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers. Given the absence of a Principal aquifer, the risk of clearwater flooding is considered remote.

Groundwater was recorded across the Airfields site at depths of between 1.1 and 2.7 m below ground level (bgl) according to a Geo-Environmental Appraisal¹⁷. Groundwater levels were recorded at depths of between 0.9 m and 3.9 m bgl, but typically in the order of 1.0 to 2.0 m bgl, during subsequent monitoring. Given the local topography, the shallow groundwater was inferred to be in hydraulic continuity with, and upgradient of the River Dee. As the River Dee is tidal in the vicinity of the Proposed Development site, it would not have high water levels for an extended period of time. Given this, and the network of drainage channels that drain the surrounding land, the risk of flooding from groundwater via this mechanism is considered remote.

Given the observed groundwater levels, it is possible that groundwater ingress could occur within the drainage swales that are proposed (See Section 6). However, any risk from this would be mitigated through the measures outlined in Section 5 and any potential groundwater flooding would likely have shallow depths. This is not anticipated to pose a risk to the future operation of the Paper Mill Facility.

Overall, it is considered that the risk of groundwater flooding to the Proposed Development site is low.

¹⁶ British Geological Survey, 2021. Geology of Britain Viewer. <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> - accessed August 2021

¹⁷ Capita Symonds, 2013. Phase 1 Geo-Environmental Appraisal Report.

4.6 Flooding from Sewers

Flooding from sewers can result from lack of sewer capacity, blockages within the sewer network or failure of infrastructure such as pumps. Any area that benefits from sewerage infrastructure has a potential risk of flooding, but the likelihood and consequences are most likely increased by topographic constraints such as low spots or flow paths that could influence the behaviour of floodwater originating from sewers.

The Proposed Development site is currently undeveloped but once served by a foul drainage network, with no history of sewer flooding events. The Paper Mill Facility would be served by gravity and pumped systems that will discharge into a new foul sewer that has been designed and is being constructed to serve the wider Airfields Northern Gateway development site.

The Proposed Development site is considered to have a low risk of flooding from sewers.

4.7 Flooding from Reservoirs, Canals and other Artificial Sources

The NRW Risk of Flooding from Reservoirs Map¹⁵ provides a general indication of areas that could be flooded if a large reservoir were to fail and release the water it holds. The Proposed Development site is not located within this flood extent. No other water features that could present a risk to the Proposed Development site, such as small reservoirs, ponds, water towers, etc. have been identified in the course of preparing this FCA.

The Proposed Development site is considered to have a low risk of flooding from artificial sources.

5 Flood Risk Mitigation

Flood risk mitigation for the Northern Gateway, inclusive of the Airfields site, has been developed strategically, to manage future flood risk from fluvial, tidal and surface water sources. A suite of measures has been developed and agreed with NRW and FCC, informed by detailed modelling studies.

In accordance with NRW pre-application advice provided for the Paper Mill Facility (summarised in Table 2-2) this FCA has been prepared based on the previous works undertaken and the flood risk mitigation measures have been aligned with those previously agreed.

The Amended Flood Mitigation Plan is contained and summarised within the appended Weetwood 2020 FCA Addendum report. As reported, some elements of the plan have already been constructed, some measures are under construction and others are yet to be constructed. For example, raising of the River Dee embankment crest between the A494 road bridge and the railway line to a minimum of 7.20 mAOD has been completed. Some works to the Garden City Drain and Northern Drain have not yet been completed. Works still to be completed include some culverting works, widening of the Northern Drain and landscape strategy works such as the creation of swales. For further detail reference should be made to Table 7 and 8 of Appendix B.

The Flood Mitigation Plan was derived based on overarching principles agreed with NRW and FCC as part of the original 2013 Northern Gateway outline planning application and was last updated in 2017 in support of an amended version of the approved Illustrative Land Use Masterplan and Design Statement. In support of this change Weetwood prepared a FCA Addendum and Amended Flood Mitigation Plan.

The enabling works for the Proposed Development site included implementation of the following flood risk mitigation measures from the Amended Flood Mitigation Plan:

- Lowering ground levels along the left (south) bank of Northern Drain to 4.20 m AOD.
- Lowering ground levels along the left (east) bank of Shotwick Brook to 4.20 m AOD.
- Creation of a swale between Plots C and D that will connect to the swale constructed as part of the works associated with the Roads 2/3 of the Welsh Government Spine Road (see Section 6.2 for further detail).
- Lowering ground levels over the existing Welsh Water (DCWW) rising main to 4.38 m AOD to allow water to spill from Shotwick Brook and into the proposed swale between Plots C and D of the Airfields.

The following text summarises the flood risk mitigation measures with reference to during the construction of the Paper Mill Facility and, following its construction, during its operation. As noted above, this FCA is based on the Amended Flood Mitigation Plan and not the Alternative Flood Mitigation Plan¹⁸. The Amended Flood Mitigation Plan is based on the Sealand Bank Farm culvert being upgraded whereas the Alternative Flood Mitigation Plan is based on the culvert as it is now (pre-upgrade). This is discussed further in Section 5.2.1 below.

5.1 During Construction

During construction of the Proposed Development, all works with the potential to impact on flow conveyance and flood risk from main rivers and ordinary watercourses will be undertaken in accordance with Flood Risk Activity Permits from NRW, for example the proposed outfall to discharge treated process waters to the River Dee, and Ordinary Watercourse Consent from FCC respectively. These consents require that works cause no detriment to the flow regimes of watercourses and no increase in flood risk either upstream or downstream. Therefore, undertaking the works in accordance with the permits and consents would ensure no increase in flood risk.

¹⁸ Weetwood, 2019. The Airfields, Deeside – Alternative Flood Mitigation Strategy, Condition 3: Flood Consequences Assessment Addendum, 10 December 2019

On a temporary basis it is proposed to spread and seed to grass topsoil on land that will be occupied by Phase 3 of the Proposed Development (see details in Table 2-1). During phases 1 and 2 the level of this area would generally achieve the minimum platform level specified in the agreed flood risk mitigation criteria of 4.83m AOD, with the surface being graded for this temporary period from 4.90 mAOD to reach 4.50 mAOD at the southern boundary of the area (matching the average existing ground level). In order to limit the transport of topsoil off site, topsoil would also be spread on land around the proposed High Bay Warehouse (HBW) building to a level of 5.05 mAOD. This level exceeds the approved minimum platform level criteria.

5.2 During Operation

As noted in the appended Weetwood 2020 FCA Addendum, the minimum approved FFL for Plot C of the Airfields site, the location of the Proposed Development, is 4.98 mAOD.

During Phase 1 of the Proposed Development, the main process building (5.25mAOD), office building (6.15mAOD) and the dispatch area (6.35mAOD) would all have FFLs higher than the approved minimum level. Similarly, in Phase 2 the proposed FFL for all buildings is 5.25m AOD. However, one part of the facility, the HBW would have a FFL of 4.60m AOD. There are technical reasons that justify the lower FFL of the HBW. These are described below and illustrated in Figure 5-1.

To operate as intended the loading bays of the Dispatch building need to be 1.2m above the external paved areas where HGV's will park to be loaded. These external areas in front of Dispatch loading bays are set at 5.15mAOD. The Dispatch building FFL therefore has correspondingly been set at 6.35mAOD (i.e 5.15mAOD plus 1.2m). The HBW concept needs a silo, designed under the dispatch building, to provide sufficient space to undertake essential maintenance activities. This requires a space of 1.75m below the Dispatch building FFL, which results in a FFL for the HBW of 4.60mAOD (6.35mAOD minus 1.75m).

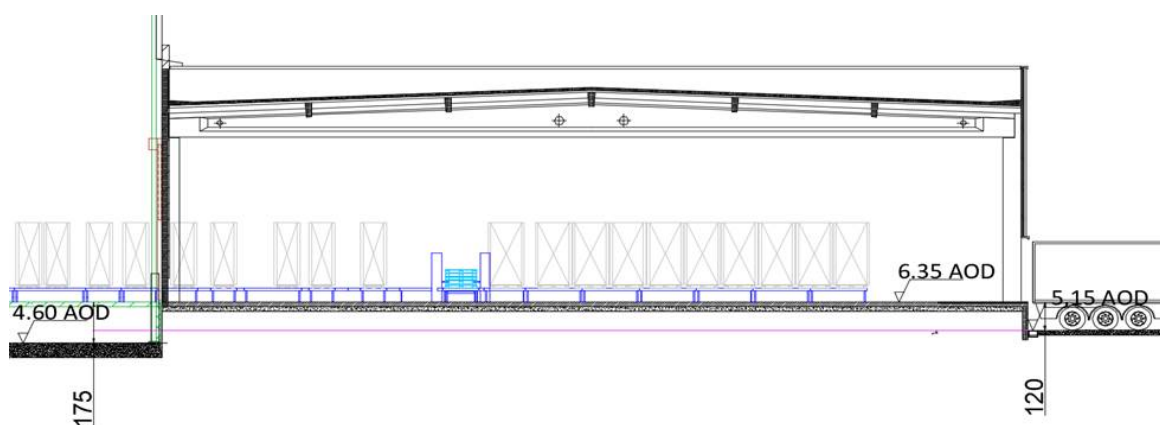


Figure 2-2 Illustration of the Dispatch building, loading bays and HBW

To ensure that the HBW is protected from flooding over the development lifetime, a retaining wall will be constructed to completely surround the HBW foundation slab. The retaining wall will be 1.0 m high and will therefore result in a level of protection of approximately 5.60 mAOD which is higher than the minimum agreed FFL for development on Plot C. This level of protection is also higher than the maximum flood level in the modelled baseline tidal 2088 0.5% (1 in 200) upstream breach scenario (5.09 mAOD) and the maximum flood level in the modelled baseline fluvial 1% (1 in 100) event (4.69 mAOD).

As discussed further in Section 6.2, Shotwick Brook and Northern Drain will be modified to improve their flood capacity. Detailed modelling has been undertaken to inform the proposed modifications, described in Appendix D.

5.2.1 Sealand Bank Farm Culvert

A key element of the Amended Flood Mitigation Plan is an upgrade to a culvert at Sealand Bank Farm. This culvert is on land owned by PGNGL and the works proposed include upgrade to a 2.00 m wide by 1.25 m high box culvert with natural bed material to a depth of 0.25 m. The culvert upgrade is referred to in the pre-application advice letter from NRW which is included in Appendix C of this FCA.

The target date for completion of the culvert works is March 2022 and as a key component of the flood risk management strategy for the wider Northern Gateway site, these works are subject to a tri-partite contractual agreement between Welsh Government, CHEL and PGNGL. As detailed in Section 2.2, the Paper Mill Facility Phase 1 works are programmed to commence in June 2022 (see Section 2.2), and this FCA is therefore based on the Amended Flood Mitigation Plan which assumes the Sealand Bank Farm culvert upgrade to be in place. An alternative approach is not required on the basis of the timing of the proposed culvert works. Works will be undertaken in parallel with the proposed Road 2 and 3 of the Commercial Spine Road which the proposed Paper Mill will be reliant on to facilitate access into the site.

As further surety, it is proposed that a Grampion planning condition could be attached to the decision notice for the Paper Mill Facility that prevents the start of the development until any off-site works to the culvert that the Flood Mitigation Plan relies on have been completed on land not controlled by the applicant.

6 Surface Water Management

6.1 Planning Policy Requirements

The Flood and Water Management Act 2010 (Schedule 3)¹⁹, which came into effect in Wales on 7 January 2019, requires new developments to include Sustainable Drainage (SuDS) features that comply with national standards.

Surface water should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flow regime prior to the proposed development. Opportunities to reduce flood risk to the site itself and elsewhere, taking climate change into account, should be investigated.

6.2 Surface Water Drainage Strategy

The Surface Water Drainage Assessment report prepared by Weetwood in October 2020²⁰ defines the overarching strategy for the management of surface water runoff at the Airfields site and is included as Appendix D of this FCA. The strategy details how surface water runoff would be managed sustainably and in line with national and local policy requirements. Surface water drainage is also addressed in the Weetwood 2020 FCA Addendum (Appendix B).

Pre-enabling works, the drainage networks serving the former RAF Sealand site discharged surface water to the Garden City Drain and Northern Drain. Surface water runoff was subsequently discharged to the tidal River Dee via Shotwick Brook and Garden City Drain. Post development, it is proposed to continue to discharge surface water runoff to the River Dee via the various watercourses within/adjacent to the Airfields site.

Where discharges are direct to a tidal estuary there would not normally be a requirement to attenuate surface water runoff. However, for the Airfields site surface water storage is required to attenuate flows for the period over which tide locking of the outfalls to the River Dee occurs.

Surface water discharges were estimated using MicroDrainage software for the 1% annual exceedance probability (AEP) (1 in 100) rainfall event, including a 40% increase in peak rainfall intensity to account for climate change, as stated in Appendix D. A network of swales has been designed to accommodate, store and transfer flows generated in this event, some of which border and would receive surface water runoff from the proposed Paper Mill Facility.

A new surface water swale will be provided between Plots C and D of the Airfields, connecting southwards to a new proposed new swale to the south of Plot C which will be constructed as part of the Welsh Government Commercial Spine Road, Roads 2 and 3. The swales proposed to serve the Proposed Development site are shown on plan in Appendix A (drawing ref: Phase 2B Plots C & D Swale Provisions). This plan also indicates who the swales will be constructed by.

Within the Paper Mill Facility additional SuDS are also proposed, including permeable paving for the vehicle parking areas. The combination of swales and permeable paving will provide for water quality treatment as well as storage and attenuation of flows.

The surface water proposals for Plot C have been designed for an impermeable area of up to 19.477 ha. The total footprint of the buildings at the Paper Mill Facility will be approximately 12.4 ha (see Table 2-1), with

¹⁹ Her Majesty's Stationery Office (HMSO), 2010. Flood and Water Management Act 2010 <https://www.legislation.gov.uk/ukpga/2010/29/contents> – accessed August 2021

²⁰ Weetwood, 2020. Surface Water Drainage Assessment; The Airfields, Deeside.

some additional impermeable area coverage of concrete and tarmac. As this total area is less than 19.477 ha, the surface water drainage proposals will be sufficient to manage runoff from the Proposed Development.

Shotwick Brook and Northern Drain will receive surface water runoff from the Proposed Development site and works are proposed to these watercourses to facilitate this. Parts of the Shotwick Brook will be re-profiled to improve flood capacity. The Northern Drain will be widened and the banks reprofiled as part of enabling works to facilitate Plot C to be delivered separately by the landowner CHEL. These works will be granted approval as part of an application to discharge planning conditions (ref: 061986) on the outline planning permission (ref: 058990). The proposed works to Shotwick Brook and Northern Drain are shown on plan in Appendix A (drawing ref: Phase 2B Plots C & D Swale Provisions).

The surface water drainage strategy does not propose to discharge surface water runoff to the sewer network.

As noted in Appendix D, hydraulic modelling has shown that surface water can be discharged from Plot C in line with the surface water proposals without increasing flood risk elsewhere.

As stated in the Weetwood 2020 FCA Addendum (Appendix B), the impact of culvert blockage at the Airfields site is expected to be minimal given the interconnectivity of the channels (i.e. water is able to discharge from the site via Shotwick Brook and Garden City Drain) and the additional storage provided within the channels and swales. The risk of culvert blockage is also reduced through implementation of an appropriate Maintenance and Management Plan which will allow blockages to be identified and cleared prior to the onset of flooding. A management company has been created to maintain the network of swales and open channels at the Airfields site, as detailed by the Drainage Maintenance and Management Plan contained within Appendix B.

7 Conclusions

This FCA has been prepared to support the development of the Paper Mill Facility at the Airfields site, part of the Northern Gateway development area in Flintshire. The following has been concluded:

- The TAN15 DAM indicates that the majority of the site is within Zone C1 (i.e. within the extreme flood extent (1 in 1000 (0.1%) annual probability flood event) and served by significant infrastructure, including flood defences).
- The Proposed Development passes the TAN15 Justification Test given that it would be a key employment provider and the allocation of the site for the proposed use class within local and regional development plans.
- The Flood Risk Assessment Wales map indicates that the majority of the Proposed Development site is at risk of fluvial flooding to a varying degree. Baseline modelling reported in the Weetwood 2020 FCA Addendum shows that small parts of the Proposed Development site would be inundated in the 1% (1 in 100) current day (2013) fluvial flood event (with flood depths of up to 1.34m) whereas the majority of the Proposed Development site is shown to be inundated in the 1% (1 in 100) 2088 fluvial flood event (with flood depths of up to 1.44m).
- The Flood Risk Assessment Wales map indicates that the Proposed Development site is at low risk of flooding from the sea, equivalent to an annual chance of flooding between 1 in 1000 (0.1%) and 1 in 200 (0.5%). Baseline modelling reported in the Weetwood 2020 FCA Addendum shows that the Proposed Development site benefits from flood defence infrastructure up to and including the 1 in 1000 (0.1%) annual probability tidal flood event for current day (2013) conditions.
- A 75-year development lifetime has been adopted for the Proposed Development, in line with TAN15 guidelines and as agreed with NRW. When the potential impacts of sea level rise due to climate change are considered up to the year 2088, the baseline modelling predicts that the defences would be overtopped. However model outputs show that the Proposed Development site would remain flood free in this event.
- In the upstream breach scenario for the 0.5% (1 in 200) 2088 tidal event, baseline model outputs predict that parts of the Proposed Development site would be inundated, with flood depths up to 1.00 m within the site boundary. In the downstream breach scenario, no flooding of the Proposed Development site is predicted for the 0.5% 2088 tidal event.
- When the flood mitigation measures, in accordance with the Amended Flood Mitigation Plan, are included in the flood models, outputs indicate that the Proposed Development site would remain flood free during all modelled fluvial and tidal events.
- The proposed flood risk mitigation measures for the Proposed Development site, which are based on agreed flood risk mitigation criteria, have been summarised in this FCA. They include works to Shotwick Brook and Northern Drain, off site works to the Sealand Bank Farm culvert and setting Finished Floor Levels above the minimum agreed level (4.98m AOD) for all buildings except the HBW. The HBW is required to be set at a lower level (4.60mAOD) for the reasons described in Section 5.2. Flood protection to this facility would be provided by a base slab retaining wall set at 1m high. This measure would provide for flood protection in excess of the required minimum.
- The Proposed Development site is considered to be at low risk of flooding from groundwater, sewers and artificial sources.
- Although the Proposed Development site is considered to be at very low risk from surface water flooding, it would result in an increase in impermeable land cover at the site. Surface water runoff from the Proposed Development would be managed in line with national and local policy requirements through the implementation of the surface water drainage strategy which would utilise SuDS features and ensure no detrimental effects on site or to neighbouring land.

- This FCA has demonstrated that, subject to implementation of the agreed flood risk mitigation measures described in the Amended Flood Mitigation Plan, and the surface water drainage strategy, flood risk to the Proposed Development site would be acceptable and the development would not increase third party flood risk.

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Appendix A

Proposals Drawings

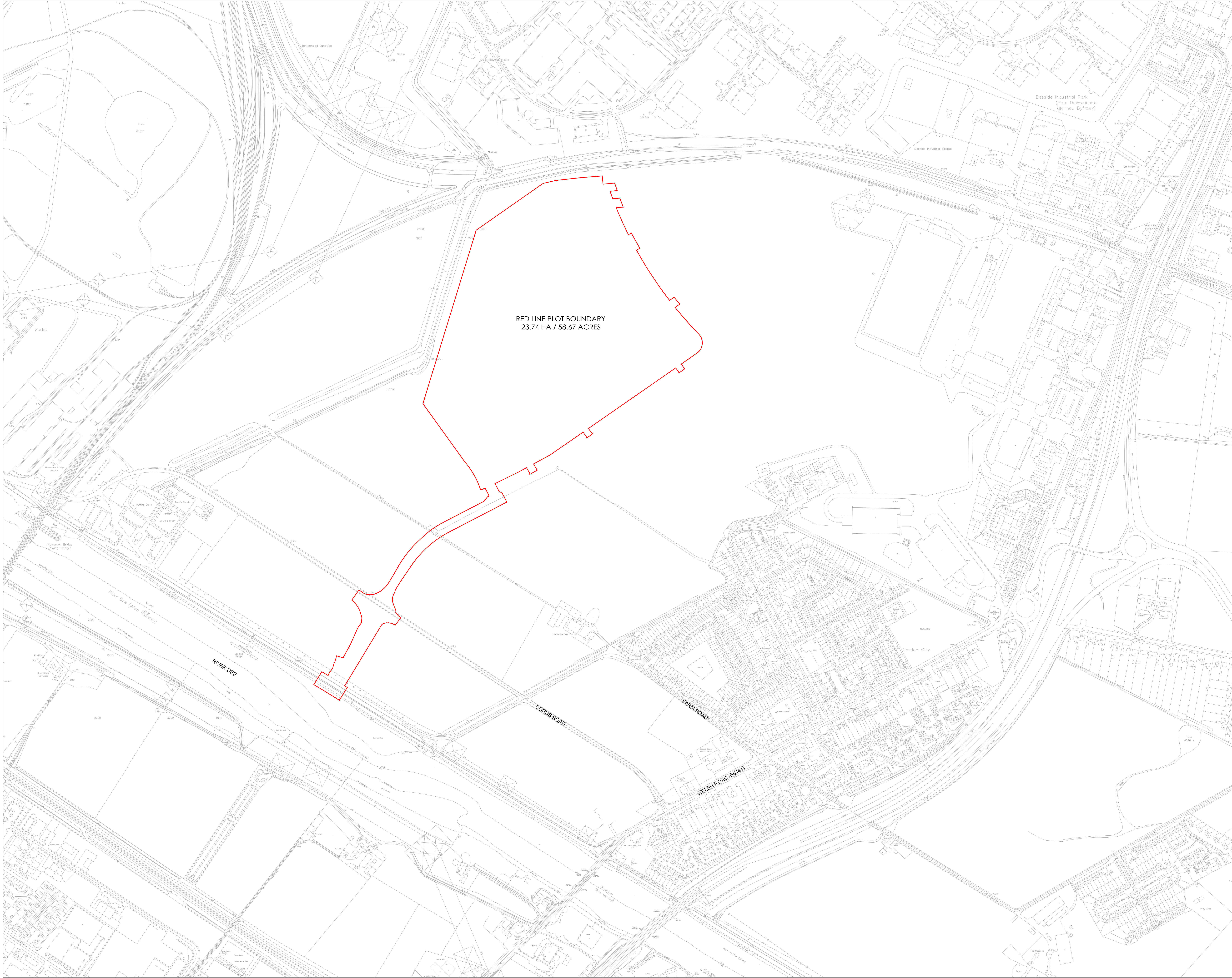
12500-AEW-SI-XX-DR-A-0001_P1_Location Plan

12500-AEW-SI-XX-DR-A-0501_P2_Location Plan

ICT_phase 1_2_3

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Phase 2B Plots C & D Swale Provisions



- NOTES
- All dimensions and levels are to be checked on site

• Any discrepancies are to be reported to the architect before any work commences

• This drawing shall not be scaled to ascertain any dimensions. Work to ground dimensions only.

• This drawing shall not be reproduced without express written permission from AEW.

• Title overlay drawings and ownership boundaries are produced using all reasonable endeavours. AEW cannot be responsible for the accuracy or scale discrepancy of base plans supplied to them.

• All works are to be undertaken in accordance with Building Regulations and the latest British Standards.

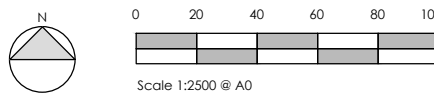
• All proprietary materials and products are to be used strictly in accordance with the manufacturers recommendations.

CDM 2015

Client method of duties: Aug 2019

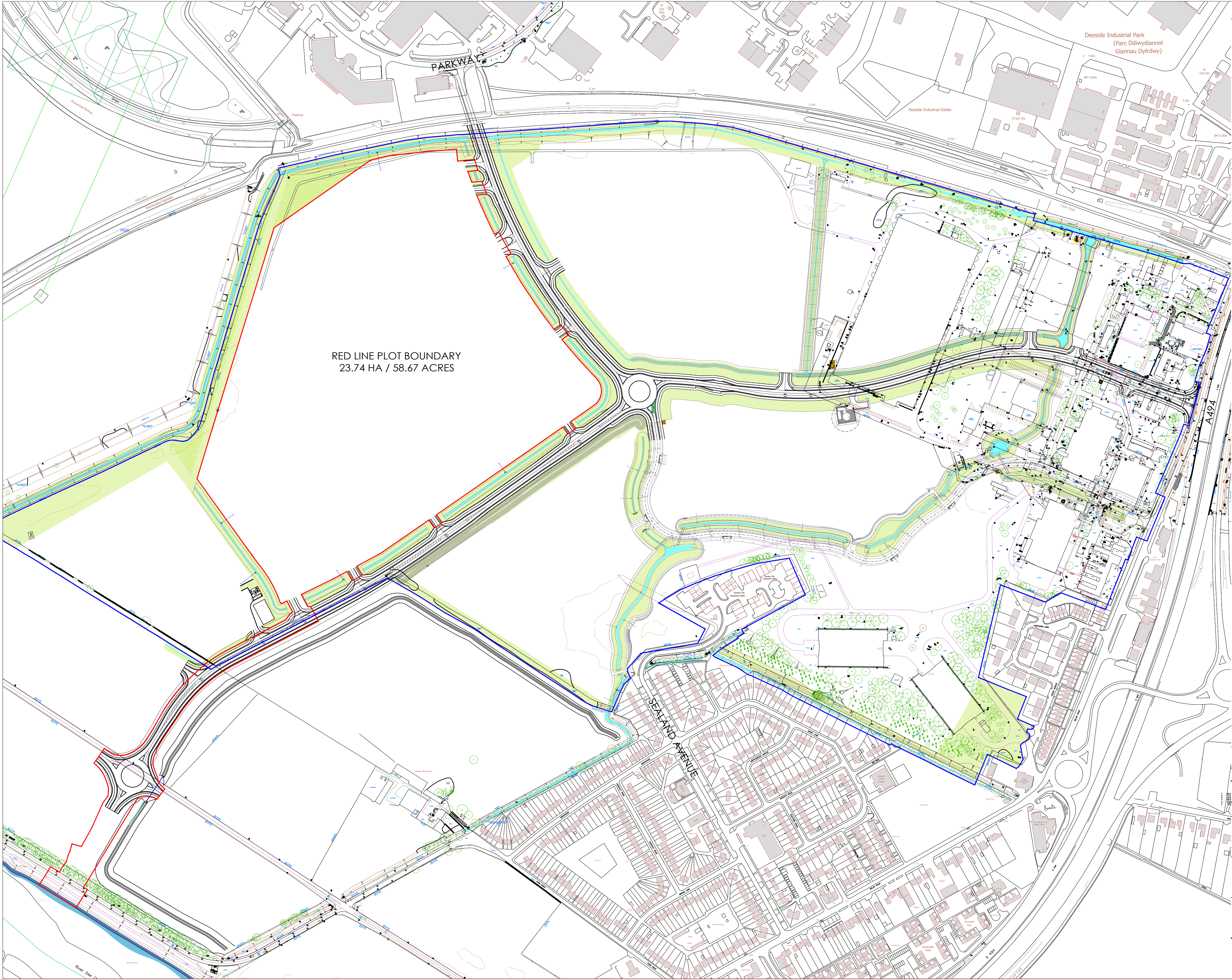
Principal Designer: ICT

Unless noted below, all known hazards have been highlighted on the drawing:



- Red line boundary partially based on plot demise line given on Fletcher Plan drawing ref. 13061_3K222_Plot C Boundary Plan - Additional Land - Option 1.

P1	02/07/2021	MB	DOH
Planning Issue			
REV	Date	Drawn by -	Checked by -
S4		For Comment	
drawing stage	RIBA Stage 2 Concept Design		
client	Industrie Cartarie Tronchetti UK Ltd.		
project	Paper Mill Facility Plot C The Airfields Deeside		
drawing title	Location Plan		
date	02/07/2021	drawn	MB
scale@A3	1:2500	checked	DOH



RED LINE PLOT BOUNDARY
23.74 HA / 58.67 ACRES

- NOTES**
- All dimensions and levels are to be checked on site.
 - Any discrepancies are to be reported to the architect before any work commences
 - This drawing shall not be scaled to ascertain any dimensions. Work to figured dimensions only.
 - This drawing shall not be reproduced without express written permission from AEW.
 - Title overlay drawings and ownership boundaries are produced using all reasonable endeavors. AEW cannot be responsible for the accuracy or scale discrepancy of base plans supplied to them.
 - All works are to be undertaken in accordance with Building Regulations and the latest British Standards.
 - All proprietary materials and products are to be used strictly in accordance with the manufacturers recommendations.

CDM 2015

Client notified of duties:
Principal Designer:
Unless noted below, all known hazards have been highlighted on the drawing:

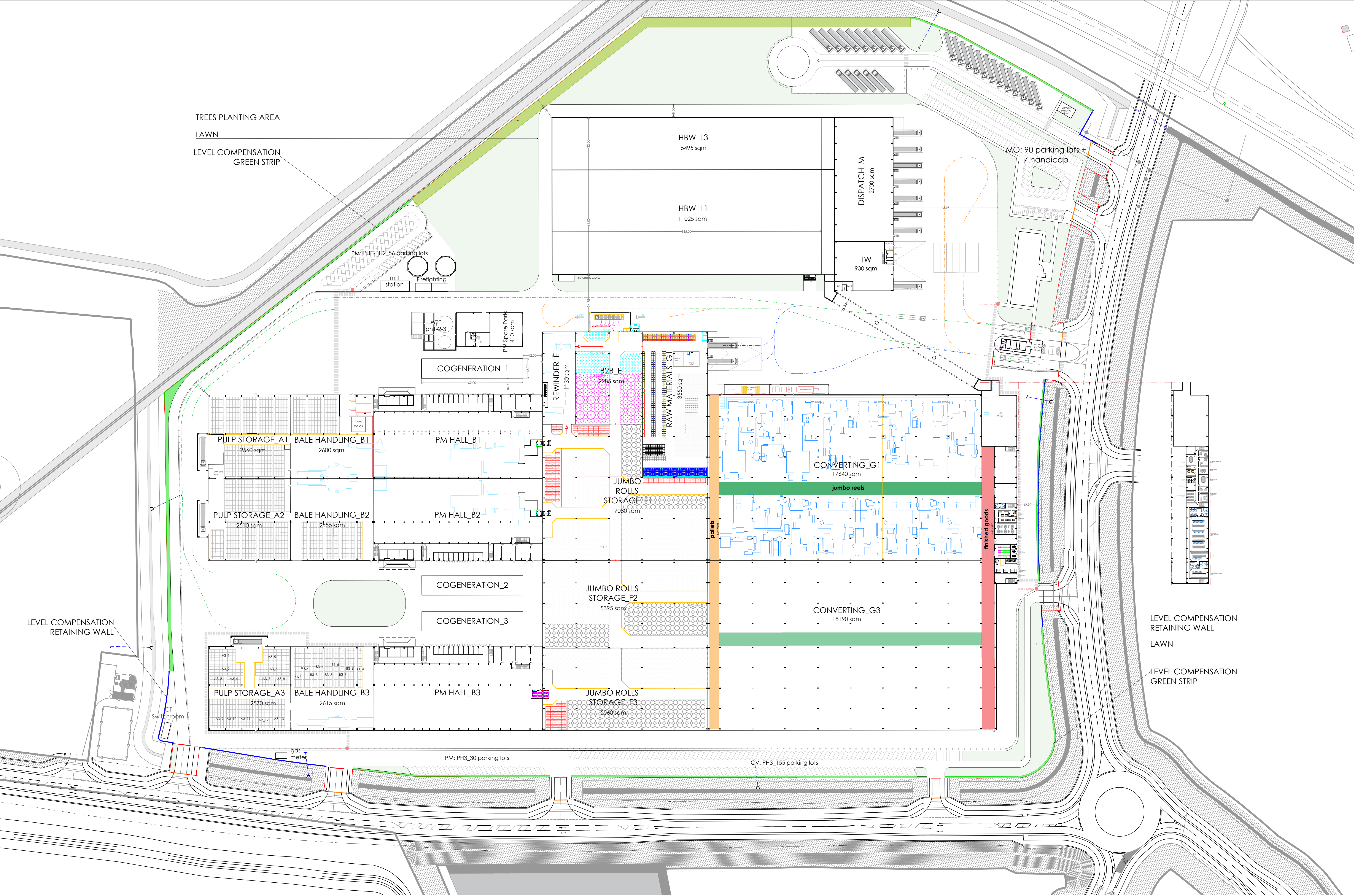
N

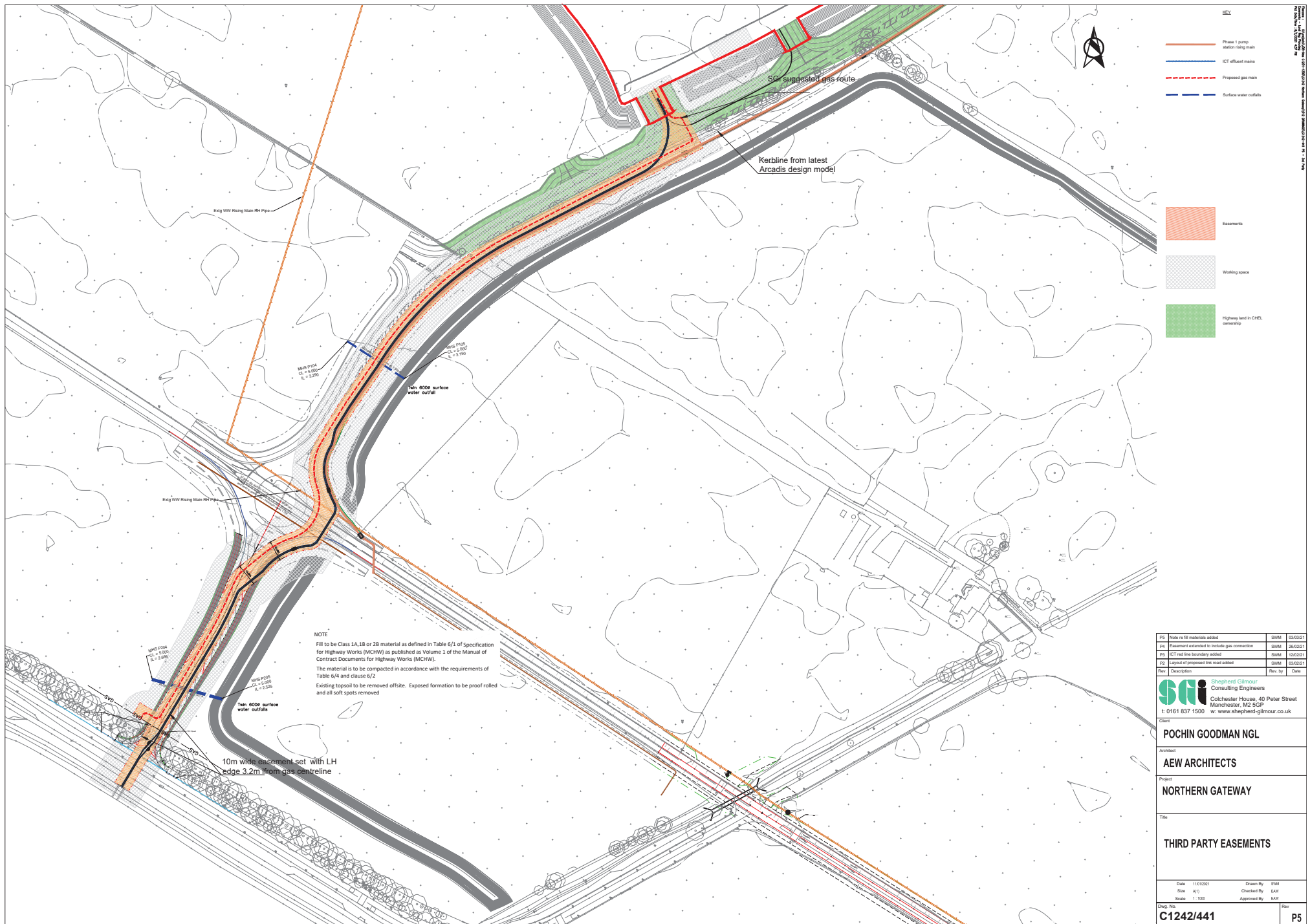
0 20 40 60 80 100m
Scale 1:2500 @ A1

Fletcher Rae Plot boundary and infrastructure underlay taken from drawing ref: 13001_SK222_Plot C Boundary Plan - Additional Land - Option 1.

Enabling works to be implemented separately by Craig Hill Estates Ltd and the road reserved matters application submitted separately by Welsh Government in June 2021

P1	02/07/21	MB	DOH
Red Line Updated. Note identifying green areas added			
P1	17/06/21	TF	DOH
Initial issue			
REV	Date	Drawn by: -	Checked by: -
Status	Purpose of issue		
S2	For Information		
drawing stage	Stage 3		
client	Industrie Cartarie Tronchetti SpA		
project	ICT Paper Mill Deeside		
drawing title	Location Plan		
date	17/06/21	drawn	TF
scale@A1	1:2500	checked	DOH





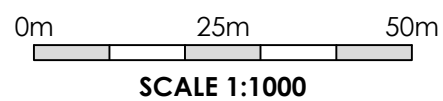
PS	Note re 19 materials added	BMM	03/02/21
PS	Easement extended to include gas connection	BMM	26/02/21
PS	ICT red line boundary added	BMM	12/02/21
PS	Layout of proposed line road added	BMM	03/02/21
Rev	Characteristics	Rev	Rev
 Shepherd Gilmour Consulting Engineers Colchester House, 40 Peter Street Manchester, M2 5GP t: 0161 837 1500 w: www.shepherd-gilmour.co.uk			
Client: POCHIN GOODMAN NGL			
Architect: AEW ARCHITECTS			
Project: NORTHERN GATEWAY			
Title: THIRD PARTY EASEMENTS			
Date	11/01/2021	Drawn By	BMM
Size	A1)	Checked By	EXR
Scale	1:100	Approved By	EXR
Drawn By			
C1242/441			P5



DO NOT SCALE

NOTES

LEGEND	
—	DENOTES PLOT BOUNDARIES.
—	DENOTES SITE DEVELOPMENT BOUNDARY.



PLOT
AREA = 109847.189m

PLOT C
AREA = 218180.067m² / 21.818Ha / 53.913Ac
MIN. PLATFORM LEVEL=4.830m
FFL=4.980m

PLOT D
AREA = 49953.848m² / 4.995Ha / 12.343Ac
MIN. PLATFORM LEVEL=4.830m
FFL=4.980m

PLOT H5
AREA = 31968.502m² / 3.197Ha

PLOT H4
AREA = 29659.033m² / 2.966Ha

REV	DESCRIPTION	DATE	BY
C	GENERAL UPDATE.	13/10/20	JAC
B	UPDATED TO SUIT COMMENTS.	29/09/20	JAC
A	FIRST ISSUE.	24/09/20	JAC

Job Title
THE AIRFIELDS

Drawing Title
PHASE 2B
PLOTS C & D
SWALE PROVISIONS

Architect



Checked RE	Date SEPT 20	Scale 1:1000	A0	Drawn JAC
Drawing No		4671-2B-01		C

Appendix B

Weetwood 2020 Flood Consequences Assessment Addendum

THE AIRFIELDS, DEESIDE
PLOTS C/D DRAINAGE &
LANDSCAPING DETAILS
FLOOD CONSEQUENCES ASSESSMENT ADDENDUM
Final Report v1.0

October 2020

Report Title: **The Airfields, Deeside – Plots C/D Drainage & Landscaping Details**
Flood Consequences Assessment Addendum Final Report v1.0

Client: Crag Hill Estates Ltd

Date of Issue: 23 October 2020

Prepared by: James Aldridge BEng (Hons) MSc MCIWEM
Technical Director

Checked and
Approved by: Adam Edgerley BSc (Hons)
Technical Director

This document has been prepared solely as a Flood Consequences Assessment Addendum for Crag Hill Estates Ltd. This report is confidential to Crag Hill Estates Ltd and Weetwood Services Ltd accepts no responsibility or liability for any use that is made of this document other than by Crag Hill Estates Ltd for the purposes for which it was originally commissioned and prepared.

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1 INTRODUCTION

1.1 BACKGROUND

The Northern Gateway is a large strategic development site located in north-east Wales. The former RAF Sealand site, owned by Crag Hill Estates Ltd, forms part of the larger land allocation and is hereafter referred to as 'The Airfields'.

Outline planning permission for redevelopment of The Airfields was granted in January 2013¹. It was envisaged that the proposed development would be brought forward through a series of reserved matters applications relating to specific phases.

Condition 6 of the Decision Notice stated:

"Prior to the approval of reserved matters applications a Development Brief for the site comprising an illustrative land use Master Plan, green infrastructure plan and flood mitigation plan for built development and a Design Statement shall be submitted to the Local Planning Authority for approval and the development shall be carried out in accordance with the approved details, unless otherwise agreed in writing by the Local Planning Authority."

A Flood Consequences Assessment (FCA) was prepared by Weetwood Services Ltd ('Weetwood') in November 2013² in support of the site wide Flood Mitigation Plan submitted as part of the Design Statement accompanying the application to discharge Condition 6³.

The FCA detailed the existing flood risk to the site and provided the overarching flood risk mitigation scheme to which future reserved matters applications should relate. The assessment of flood risk and the proposed flood risk mitigation scheme were informed by 1D-2D hydraulic modelling of the site and surrounding land.

The FCA was approved by Natural Resources Wales (NRW) and Flintshire County Council (FCC) and Condition 6 of the outline planning permission was subsequently discharged in November 2013.

Welsh Government and Crag Hill Estates Ltd submitted a reserved matters application⁴ for Phase 1 of the Employment Spine Road and associated infrastructure in October 2015. The application was accompanied by a FCA⁵ prepared by Weetwood in November 2015 and was approved by FCC in March 2016.

Approval for the Phase 1 Enabling Works was subsequently sought via a second reserved matters application⁶ in August 2017. Weetwood prepared a FCA⁷ in October 2017 to accompany the reserved matters application based on the understanding that the Sealand Bank Farm culvert, located within the adjoining Northern Gateway development site owned by Pochin Goodman Northern Gateway Ltd, would be upgraded in accordance with the approved site wide Flood Mitigation Plan.

Pochin Goodman Northern Gateway Ltd agreed in principle to Crag Hill Estates Ltd upgrading the Sealand Bank Farm culvert. However, NRW raised a concern that the culvert may not be upgraded within an appropriate timeframe, owing to the culvert being located outside of the land controlled by Crag Hill Estates Ltd.

¹ Planning Ref: 049320

² Flood Consequences Assessment; The Airfields, Deeside, Final Report, 8 November 2013, Ref: 2097/FCA_v1.5

³ Planning Ref: 051025

⁴ Planning Ref: 054488

⁵ Flood Consequences Assessment; Northern Gateway – Phase 1 Infrastructure Works, Final Report v1.0, 19 November 2015, Ref: 2097/FCA (Phase 1 Infrastructure Works) v1.0

⁶ Planning Ref: 057404

⁷ Flood Consequences Assessment; The Airfields, Deeside – Phase 1 Enabling Works, Final Report v1.5, 30 October 2017, Ref: 2097/FCA(P1)/Final/v1.5/2017-10-30

Weetwood undertook additional hydraulic modelling to investigate a temporary flood mitigation strategy in the event that the Sealand Bank Farm culvert could not be upgraded. The results of the hydraulic modelling were presented in a letter⁸ to FCC dated 14 November 2017.

The Phase 1 Enabling Works reserved matters application was subsequently approved subject to Conditions 2 and 3, which state the following:

Condition 2: "Prior to the connection of Northern Drain to Garden City Drain West via a new open channel, a scheme for temporary flood storage shall be submitted for the approval of the Local Planning Authority and thereafter shall be implemented in accordance with an agreed programme. The scheme shall remain in place until such time that the Sealand Bank Farm culvert has been replaced as shown on drawing number 4671-1-D21-C."

Condition 3: "In the event that Sealand Bank Farm culvert has not been replaced prior to the commencement of Phase 2 of the development, a further Flood Consequences Assessment shall be undertaken and submitted in writing for approval to the Local Planning Authority. This shall assess the likely impacts of climate change on a site wide basis and shall include a flood mitigation scheme to be implemented in accordance with an agreed programme."

A planning application⁹ was submitted in September 2017 for an amended version of the approved Illustrative Land Use Masterplan and Design Statement to reallocate the proposed residential plot on the Welsh Road frontage to provide a district centre, commercial and social uses.

Weetwood prepared a FCA Addendum¹⁰ and Amended Flood Mitigation Plan in support of the above, which encompassed the information submitted with the Phase 1 Enabling Works application. NRW confirmed in its letter dated 21 December 2017¹¹ that it had removed its objection to the application, following submission of a supplementary letter by Weetwood dated 13 December 2017¹².

For completeness, the previously approved October 2017 FCA Addendum was updated¹³ to reflect the information contained within the supplementary letter prepared by Weetwood and was submitted in support of the application¹⁴ to discharge Condition 6, which was subsequently approved by FCC in August 2018.

A Section 73 application¹⁵ was submitted in September 2018 to remove Conditions 7, 15, 16 and 17 of the original outline planning permission. Approval was granted by FCC in October 2018.

Approval to extend the Phase 1 Enabling Works to include Plot B was sought via a reserved matters application¹⁶ in April 2019. Weetwood prepared a FCA Addendum¹⁷ to accompany the reserved matters application and planning permission was subsequently granted by FCC in August 2019.

A reserved matters application¹⁸ for the Phase 2 Enabling Works was submitted to FCC in July 2019. Weetwood prepared a FCA Addendum¹⁹ to accompany the application and planning permission was granted by FCC in February 2020.

⁸ Weetwood Ref: 2097/2017-11-14/RMu/01

⁹ Planning Ref: 057547

¹⁰ Flood Consequences Assessment Addendum; The Airfields, Deeside – Discharge of Condition 6 Amendment, Final Report v1.4, 30 October 2017, Ref: 2097/FCA Addendum/Final/v1.4/2017-10-30

¹¹ NRW Ref: CAS-47096

¹² Weetwood Ref: 2097/2017-12-13/RMu/02

¹³ Flood Consequences Assessment Addendum; The Airfield's, Deeside – Discharge of Condition 6, Final Report v1.6, 17 May 2018, Ref: 2097/FCA Addendum/Final/v1.6/2018-05-17

¹⁴ Planning Ref: 058514

¹⁵ Planning Ref: 058990

¹⁶ Planning Ref: 059938

¹⁷ Flood Consequences Assessment Addendum; The Airfields, Deeside – Plot B Enabling Works, Final Report v1.0, 24 April 2019, Ref: 2097/PB/FCA Addendum/Final/v1.0/2019-04-24

¹⁸ Planning Ref: 060311

¹⁹ Flood Consequences Assessment Addendum; The Airfields, Deeside – Phase 2 Enabling Works, Final Report v1.0, 24 July 2019, Ref: 2097/P2/FCA Addendum/Final/v1.0/2019-07-24

Weetwood prepared a Technical Note²⁰ to accompany an application²¹ to discharge Condition 2 of the Phase 1 Enabling Works application in July 2019 because the Sealand Bank Farm culvert had not yet been upgraded and the Phase 1 Enabling Works were nearing completion. A supplementary letter²² was issued to NRW in October 2019 and the application was subsequently approved by FCC in February 2020.

Weetwood prepared a FCA Addendum²³ to accompany an application²⁴ to discharge Condition 3 in December 2019. This presented an Alternative Flood Mitigation Plan to which future reserved matters applications should relate, until such time that the Sealand Bank Farm culvert has been upgraded. FCC approved the application to discharge Condition 3 in February 2020.

A reserved matters application²⁵ for the Phase 3 Enabling Works was submitted to FCC in February 2020. Weetwood prepared a FCA Addendum²⁶ to accompany the application based upon the Alternative Flood Mitigation Plan and planning permission was granted by FCC in May 2020.

A Section 73 application²⁷ was submitted in March 2020 to remove Conditions 26, 28, 30, 34 and 44 of the revised outline planning permission. Approval was granted by FCC in October 2020.

1.2 PURPOSE OF THE REPORT

This FCA Addendum has been prepared to accompany the Plots C/D application comprising drainage and landscaping details to discharge (in part) Conditions 7, 15, 17, 18 and 19 of the outline planning permission.

It is understood that the Plots C/D Enabling Works will be brought forward concurrently with the Phase 2/3 Employment Spine Road and that approval of these works will enable the Sealand Bank Farm culvert to be upgraded. This report considers these works holistically and has therefore been prepared in accordance with the October 2017 FCA Addendum and associated Amended Flood Mitigation Plan.

1.3 STRUCTURE OF THE REPORT

The report is structured as follows:

Section 1	Introduction and report structure
Section 2	Provides background information relating to the development site, the waterbodies in the vicinity of the site and the proposals
Section 3	Assesses the potential sources of flooding
Section 4	Presents flood risk mitigation measures based on the findings of the assessment
Section 5	Addresses the effect of the proposals on surface water runoff
Section 6	Presents a summary of key findings
Section 7	Presents the recommendations

²⁰ The Airfields, Deeside – Temporary Flood Mitigation Strategy, Technical Note: Planning Condition 2, 26 July 2019, Ref: 2097/C2/TN/Final/v1.0/2019-07-26

²¹ Planning Ref: 060330

²² Weetwood Ref: 2097-10-08/2097/C2-L1

²³ The Airfields, Deeside – Alternative Flood Mitigation Strategy, Condition 3: Flood Consequences Assessment Addendum, 10 December 2019, Ref: 2097/C3/TN/v1.3/2019-12-10

²⁴ Planning Ref: 060575

²⁵ Planning Ref: 061018

²⁶ Flood Consequences Assessment Addendum; The Airfields, Deeside – Plots H3/H5 Enabling Works, Final Report v1.0, 11 February 2020, Ref: 2097/H3-5/FCA_Addendum/Final/v1.0/2020-02-11

²⁷ Planning Ref: 061125

2 SITE DETAILS AND PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The Airfields site is located at Ordnance Survey National Grid Reference SJ 325 696, as shown in **Figure 1**. The site is approximately 100.0 hectares (ha) in area. Plots C and D are located adjacent to the western boundary of the site and have a combined area of approximately 26.8 ha.

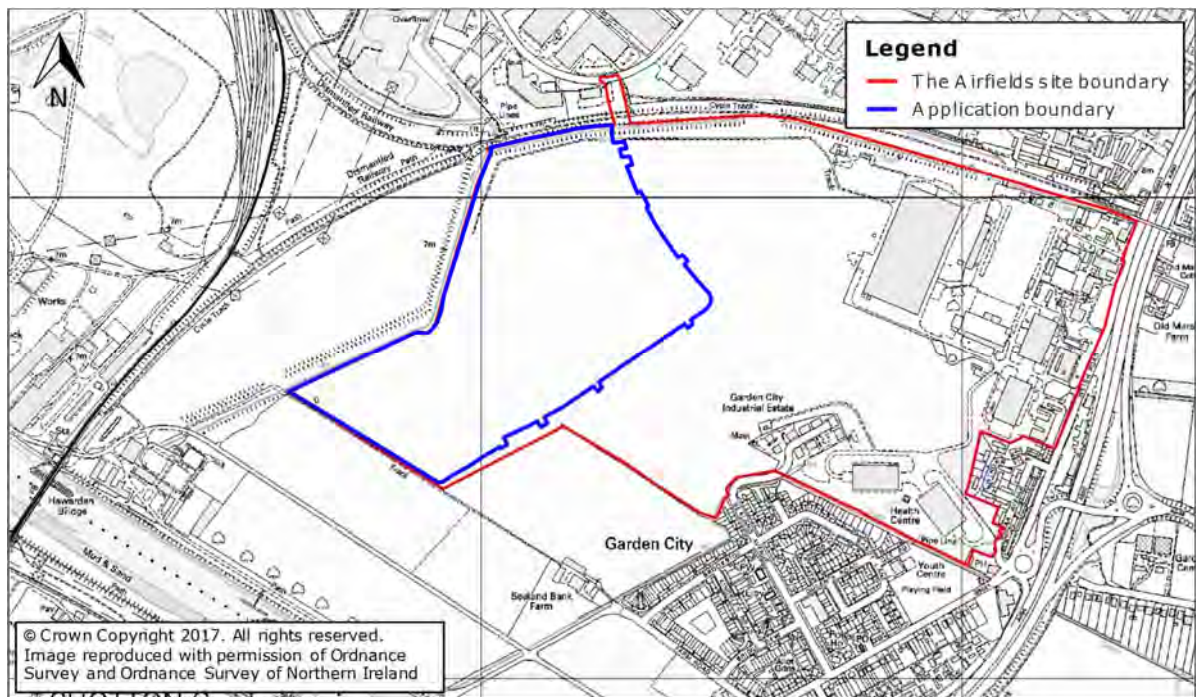


Figure 1: Site Location

2.2 EXISTING AND PROPOSED DEVELOPMENT

The site previously comprised approximately 30.0 ha of developed land in the north-east corner, with the remainder of the site comprising grassland and scrub. The developed land was associated with former RAF Sealand and comprised military buildings with associated hardstanding and landscaped areas.

Outline planning permission was granted for a mixed-use regeneration scheme comprising the following:

- Up to 205,000 m² of storage and distribution floorspace;
- Up to 31,000 m² of other employment uses (offices, shops, etc);
- Up to 725 residential dwellings; and
- Public open space and landscaping.

The Phase 1 Employment Spine Road and associated infrastructure, including the swale along its northern edge and the eastern connection to Northern Drain, were constructed in 2017. The Phase 1 Employment Spine Road extends from Welsh Road to the central roundabout within the site.

The new Garden City Drain channel, associated connection to the Phase 1 Employment Spine Road swale and the Phase 1 Residential Spine Road were constructed in 2019 as part of the Phase 1 Enabling Works. The Phase 1 Residential Spine Road extends from Welsh Road to the boundary between Plots H2 and H3.

The Phase 1 Enabling Works also included the removal of two culverts along Northern Drain, widening of the Northern Drain channel and ground raising to create development platforms within Plots A, 01, 02, 03, H1, H2 and H8.

Construction of an Amazon distribution centre was recently completed on Plot A and Countryside Properties is currently developing Plots H1, H2 and H8 for residential use.

The Plot B Enabling Works, comprising the extension of the Phase 1 Employment Spine Road swale to provide two additional connections to Northern Drain, the removal of the existing culvert located along the northern boundary of Plot B and widening of the Northern Drain channel have commenced and are expected to be complete in 2020.

A temporary flood storage area has also been constructed at the site within Plots H4, H5 and the footprint of the southern arm of the Phase 3 Employment Spine Road. The basin will soon be reconfigured so that it is wholly located within Plot H4 (application ref: 061629).

The Phase 2 Enabling Works, comprising the extension of the Residential Spine Road to provide a connection to the central roundabout, the construction of a swale adjacent to the western extent of the spine road and ground raising to create development platforms within Plots H6 and H7, are expected to commence in 2020.

The Plots H3/H5 Enabling Works, comprising engineering works to create the Plot H3 and H5 development platforms, the creation of a screening bund adjacent to Plot H5 and the provision of footpath/cycleway connections from the The Airfields to Sealand Avenue, are expected to commence in 2021.

The Plots C/D Works comprise drainage and landscaping works to facilitate development of Plots C and D and includes channel widening works along Northern Drain and Shotwick Brook and the creation of a swale between Plots C and D. The Swale Provision and Site Clearance drawings are provided in **Appendix A**.

2.3 WATERBODIES IN THE VICINITY OF THE SITE

There are a number of existing waterbodies in the vicinity of the site, as detailed below.

River Dee	The River Dee is located approximately 0.4 km to the south of the site. This section of the River Dee is tidally dominated and benefits from flood defence infrastructure, which comprises raised earth embankments. The River Dee is designated a main river.
Shotwick Brook	Shotwick Brook is culverted under the disused railway via a 2500 mm wide arch culvert in the north-west corner of the site before flowing in open channel in a predominately south-westerly direction along the western boundary of the site. Shotwick Brook ultimately outfalls to the River Dee via a flapped outfall after being culverted under the existing John Summers buildings to the south-west. Shotwick Brook is designated a main river.
Garden City Drain	Garden City Drain enters the site via a 900 mm culvert in the north-east corner of the site. The watercourse remains in open channel flowing in a westerly and then south-westerly direction, outfalling to Garden City Drain West. Garden City Drain is designated main river.
Manor Drain	Manor Drain enters the site via a 1200 mm diameter culvert under the A494 before flowing in open channel in a north-westerly direction along the south-east boundary of the site to its confluence with Garden City Drain West. Manor Drain is designated a main river.
Garden City Drain West	Garden City Drain West is located to the south of the site. The watercourse remains in open channel, flowing in a south-westerly direction and ultimately outfalling to the River Dee via four flapped outfalls. Garden City Drain West is designated a main river.
Northern Drain	Northern Drain is culverted under the disused railway in the north-east corner of the site. The watercourse subsequently flows in open channel in a predominately westerly direction along the northern boundary of the site to its confluence with Shotwick Brook. A swale connects Northern Drain with Garden City Drain via a culvert through the Phase 1 Employment Spine Road. Northern Drain is designated an ordinary watercourse.
East Camp	An existing 975 mm diameter culvert enters the site in the north-east corner and takes surface water flows from the RAF Sealand East Camp. The culvert has been diverted and outfalls to the new Garden City Drain open channel.

2.4 SITE LEVELS

A topographic survey of the site was undertaken by Green Hatch Group prior to development commencing on site. This information has been used to develop a digital elevation model as illustrated in **Figure 2**.

Levels at The Airfields generally range between 2.3 and 12.5 metres Above Ordnance Datum (m AOD), with an average level of 4.7 m AOD.

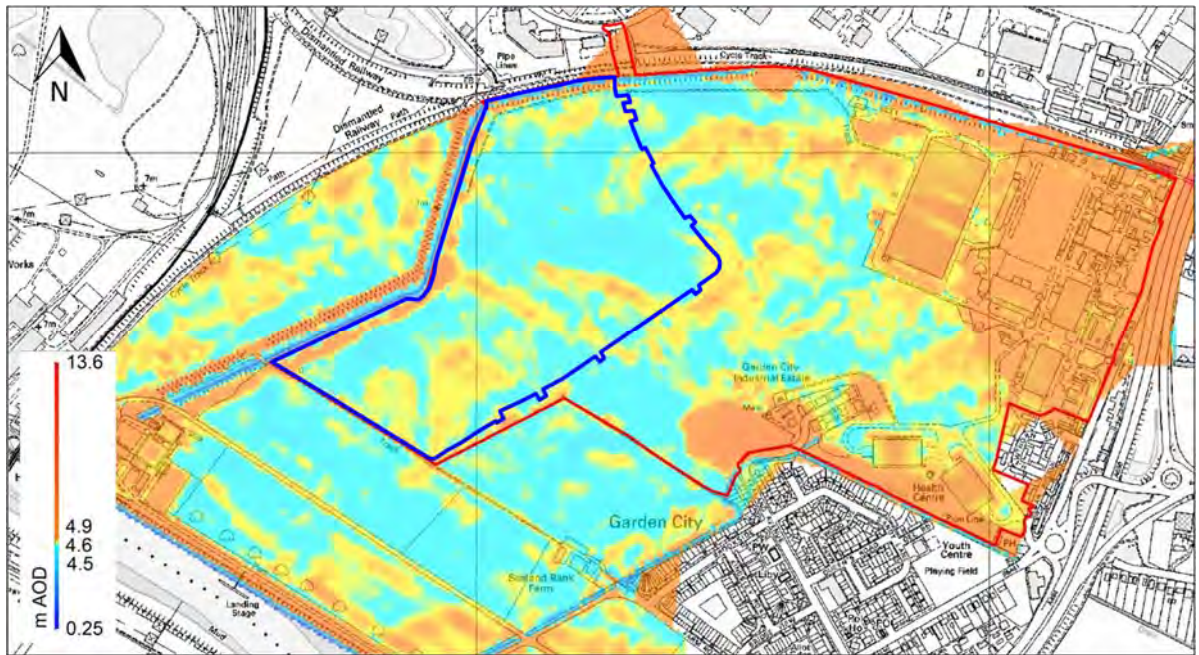


Figure 2: Digital Elevation Model

3 REVIEW OF FLOOD RISK

3.1 FLOOD ZONE DESIGNATION

Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. TAN15 defines flood zones as follows:

- **Zone A.** Considered to be at little or no risk of fluvial or tidal/coastal flooding.
- **Zone B.** Areas known to have been flooded in the past evidenced by sedimentary deposits.
- **Zone C.** Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal). Zone C is subdivided into the following two zones:
 - **Zone C1.** Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
 - **Zone C2.** Areas of the floodplain without significant flood defence infrastructure.

The Flood Zones are currently shown on the NRW Flood Risk Map and do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.

3.1.1 Development Advice Map

According to the latest Development Advice Map The Airfields is located within Zone C1 (**Figure 3**).

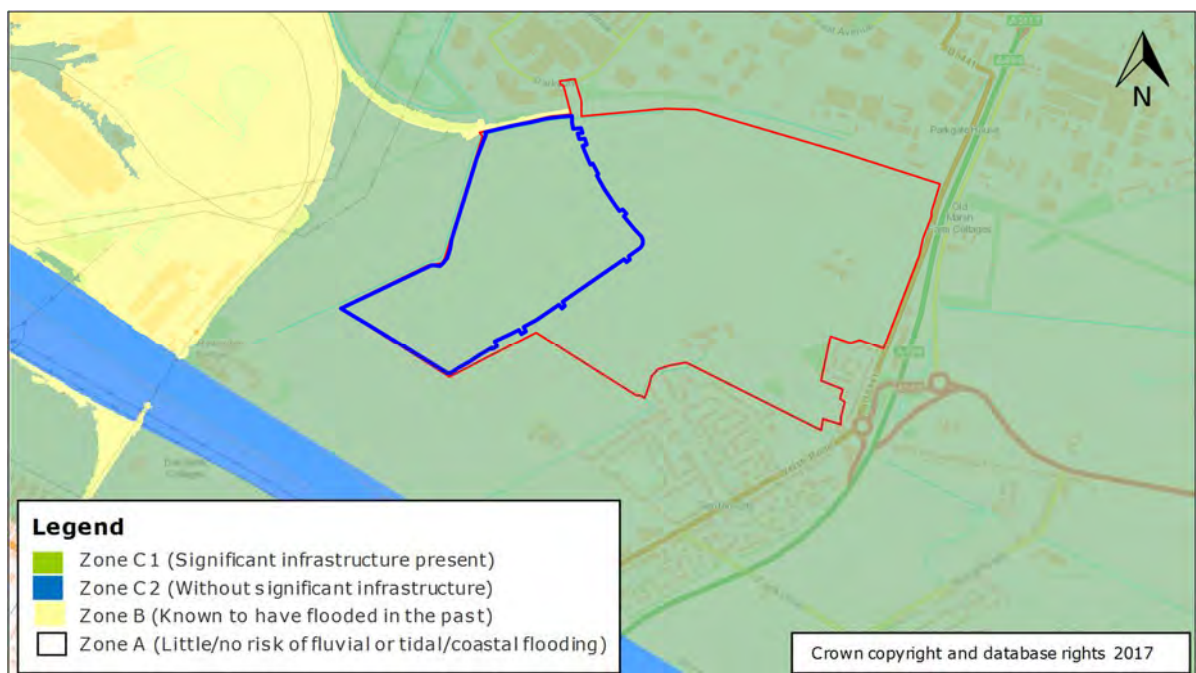


Figure 3: Development Advice Map
(Source: NRW website)

3.1.2 Natural Resources Wales Flood Map

According to the NRW Flood Risk Map (**Figure 4**) The Airfields is located in the defended 1.0% annual exceedance probability (AEP) fluvial / 0.5% AEP tidal flood outline.

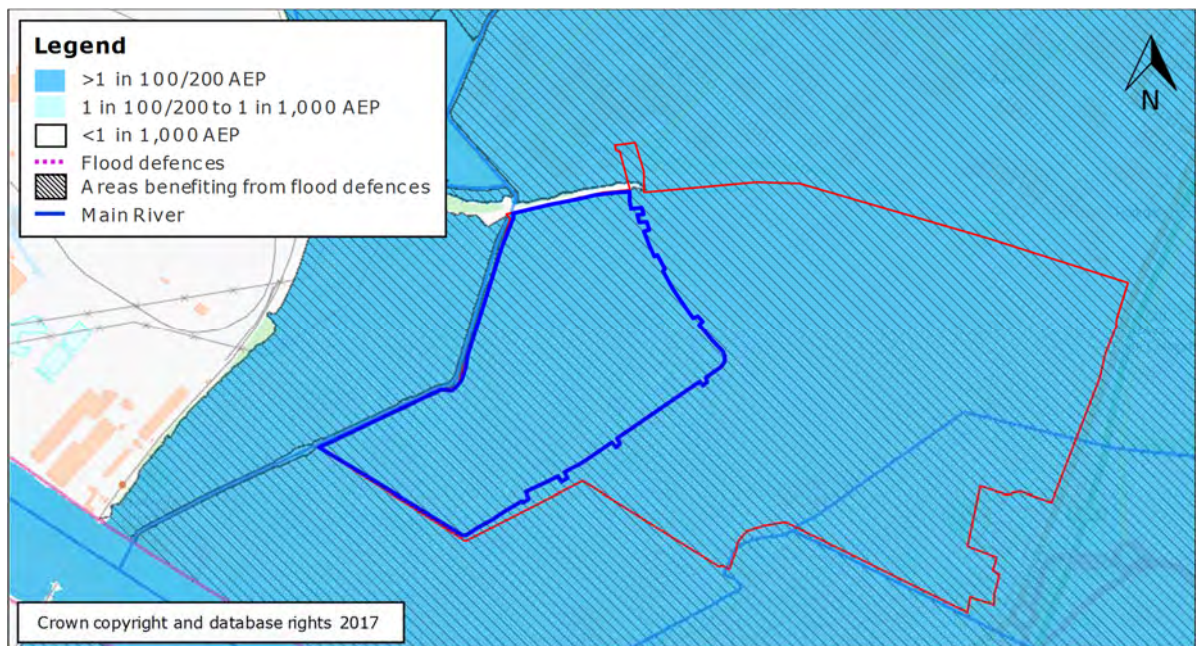


Figure 4: Natural Resources Wales Flood Risk Map
(Source: NRW website)

3.2 TIDAL FLOOD RISK

As detailed in **Section 2.3** the River Dee is located approximately 0.4 km to the south of The Airfields site.

3.2.1 Flood Defences

The River Dee benefits from existing flood defence infrastructure, comprising earth embankments.

Condition 7 of the original outline planning permission for The Airfields stated:

"No built development (being above ground other than necessary infrastructure works and ground preparatory works) authorised by this permission shall commence until such time as:

- a. A scheme to strengthen the River Dee defences has been submitted to and approved in writing by the Local Planning Authority in consultation with [Environment Agency Wales (EAW)] (or such other body as shall succeed it)*

And

- b. The approved scheme has been completed in accordance with the approved details and has been certified in writing as complete by the Local Planning Authority, in consultation with EAW (or such other body as shall succeed it)."*

The above works have now been completed by Welsh Government. The works extend between the A494 road bridge and the railway line, with the defence crest height set at a minimum of 7.2 m AOD (i.e. the design height as previously agreed with NRW).

3.2.2 Modelled Flood Levels & Extents - Baseline

In order to identify and assess the level of flood risk to the site from the River Dee a 2D TUFLOW model was developed by Weetwood as part of the November 2013 site wide FCA for The Airfields. The model development process is detailed within the Weetwood report entitled *Fluvial and Tidal Modelling Study; The Airfields, Deeside* dated 8 November 2013.

FCC has previously confirmed²⁸ that the flood risk criteria agreed as part of the November 2013 Weetwood FCA should be applied in relation to works undertaken under the outline planning permission.

Table 1 details the design model runs that have been undertaken in order to assess the tidal flood risk at the existing site under the consented baseline²⁹ scenario. Model output plots are provided in **Appendix B**.

Table 1: Tidal Model Runs - Baseline

Flood Event (AEP)	Scenario	Drawing No.
0.5% (2013)	Overtopping	n/a – No overtopping expected
0.1% (2013)	Overtopping	n/a – No overtopping expected
0.5% (2088)	Overtopping	2097_159_200yr_75yrCC_d_overtopping_consentd_baseline
0.5% (2113)	Overtopping	2097_159_200yr_100yrCC_d_overtopping_consentd_baseline
0.5% (2088)	Upstream breach	2097_160_200yr_75yrCC_d_U/S_breach_consentd_baseline
0.5% (2113)	Upstream breach	2097_160_200yr_100yrCC_d_U/S_breach_consentd_baseline
0.5% (2088)	Downstream breach	2097_161_200yr_75yrCC_d_D/S_breach_consentd_baseline
0.5% (2113)	Downstream breach	2097_161_200yr_100yrCC_d_D/S_breach_consentd_baseline

Table 2 summarises the maximum and average level, depth and velocity of floodwaters expected on site during all modelled events.

Table 2: Modelled Tidal Flood Level, Depth & Velocity - Baseline

Flood Event (AEP)	Scenario	Level (m AOD)		Depth (m)		Velocity (m/s)	
		Max	Ave Max	Max	Ave Max	Max	Ave Max
0.5% (2088)	Overtopping	n/a	n/a	n/a	n/a	n/a	n/a
0.5% (2113)	Overtopping	4.65	4.56	1.79	0.12	4.93	0.10
0.5% (2088)	Upstream breach	5.09	4.69	2.03	0.11	5.78	0.04
0.5% (2113)	Upstream breach	5.13	4.70	2.13	0.14	6.51	0.06
0.5% (2088)	Downstream breach	n/a	n/a	n/a	n/a	n/a	n/a
0.5% (2113)	Downstream breach	4.65	4.57	1.79	0.12	4.93	0.10

The tidal flood risk to the site will be mitigated through the implementation of the measures proposed in **Section 4.2** of this report.

3.2.3 Modelled Flood Levels & Extents – Baseline Sensitivity

Within the November 2013 Weetwood FCA, sensitivity analysis was also undertaken using the following two parameters:

1. NRW/JBA tidal levels (95% confidence bound)
2. The downstream breach location specified by Hyder Consulting
A downstream breach location was previously specified by Hyder Consulting immediately to the west of Hawarden Railway Bridge. An assessment of the propensity of the River Dee embankment to breach at this location was undertaken by Weetwood in October 2013. This included a condition assessment, walkover survey, review of site investigation data and supplementary topographic survey. This concluded that the probability of a breach at the location specified by Hyder Consulting was negligible. This scenario was subsequently modelled as a sensitivity analysis for the proposed flood risk mitigation strategy (as opposed to a design event).

Table 3 details the sensitivity analysis model runs that have been undertaken. Model output plots are provided in **Appendix C**.

²⁸ Email from Flintshire County Council to Weetwood dated 20 October 2015

²⁹ This included a minimum defence crest height of 7.20 m AOD as detailed in **Section 3.2.1**

Table 3: Tidal Model Runs - Baseline Sensitivity Analysis

Flood Event (AEP)	Scenario	Drawing No.
1. NRW tidal levels		
0.5% (2088)	Overtopping	2097_162_200yr_75yrCC_d_overtopping_consented_baseline
0.5% (2113)	Overtopping	2097_162_200yr_100yrCC_d_overtopping_consented_baseline
0.5% (2088)	Upstream breach	2097_155_200yr_75yrCC_d_U/S_breach_consented_baseline
0.5% (2113)	Upstream breach	2097_155_200yr_100yrCC_d_U/S_breach_consented_baseline
0.5% (2088)	Downstream breach	2097_163_200yr_75yrCC_d_D/S_breach_consented_baseline
0.5% (2113)	Downstream breach	2097_163_200yr_100yrCC_d_D/S_breach_consented_baseline
2. Downstream breach location		
0.5% (2088)	Downstream breach	2097_164_200yr_75yrCC_d_D/S_breach(Hyder)_consented_baseline
0.5% (2113)	Downstream breach	2097_164_200yr_100yrCC_d_D/S_breach(Hyder)_consented_baseline

Table 4 summarises the maximum and average level, depth and velocity of floodwaters expected on site during all modelled sensitivity analysis events.

Table 4: Modelled Tidal Flood Level, Depth & Velocity – Baseline Sensitivity

Flood Event (AEP)	Scenario	Level (m AOD)		Depth (m)		Velocity (m/s)	
		Max	Ave Max	Max	Ave Max	Max	Ave Max
1. NRW tidal levels							
0.5% (2088)	Overtopping	4.69	4.57	1.80	0.11	6.35	0.08
0.5% (2113)	Overtopping	5.28	5.05	2.89	0.45	7.02	0.36
0.5% (2088)	Upstream breach	5.13	4.69	2.16	0.13	7.83	0.06
0.5% (2113)	Upstream breach	5.28	5.09	2.96	0.47	7.05	0.35
0.5% (2088)	Downstream breach	4.69	4.57	1.81	0.11	5.87	0.08
0.5% (2113)	Downstream breach	5.28	5.05	2.89	0.45	7.02	0.36
2. Downstream breach location							
0.5% (2088)	Downstream breach	4.64	4.58	0.43	0.07	0.22	0.01
0.5% (2113)	Downstream breach	4.74	4.61	1.96	0.13	6.04	0.08

Section Error! Reference source not found. demonstrates how the proposed flood risk mitigation measures will ensure that the site will remain safe for the sensitivity analysis scenarios.

3.3 FLUVIAL FLOOD RISK

As detailed in **Section 2.3** Shotwick Brook, Garden City Drain, Manor Drain, Garden City Drain West, Northern Drain and East Camp drainage network, flow in open channels and culverts through/adjacent to The Airfields site (**Figure 5**).



Figure 5: Fluvial Watercourses

3.3.1 Modelled Flood Levels & Extents - Baseline

In order to identify and assess the level of fluvial flood risk to the site a 1D-2D ISIS-TUFLOW model was developed by Weetwood as part of the November 2013 site wide FCA for The Airfields. The model development process is detailed within the Weetwood report entitled *Fluvial and Tidal Modelling Study; The Airfields, Deeside* dated 8 November 2013.

As detailed previously, FCC has confirmed that the flood risk criteria agreed as part of the November 2013 Weetwood FCA should be applied in relation to works undertaken under the outline planning permission.

Table 5 details the model runs that have been undertaken in order to assess the fluvial flood risk at the existing site under the baseline scenario. Model output plots are provided in **Appendix D**.

Table 5: Fluvial Model Runs - Baseline

Flood Event (AEP)	Drawing No.
1.0% (2013)	2097_064_100yr_d_fluvial_consented_baseline
1.0% (2088)	2097_064_100yr_75yrCC_d_fluvial_consented_baseline
1.0% (2113)	2097_064_100yr_100yrCC_d_fluvial_consented_baseline
0.1% (2013)	2097_064_1000yr_d_fluvial_consented_baseline

Table 6 summarises the maximum and average level, depth and velocity of floodwaters expected on site during all modelled events.

Table 6: Modelled Fluvial Flood Level, Depth & Velocity - Baseline

Flood Event (AEP)	Level (m AOD)		Depth (m)		Velocity (m/s)	
	Max	Ave Max	Max	Ave Max	Max	Ave Max
1.0% (2013)	4.61	4.51	1.34	0.14	3.49	0.05
1.0% (2088)	4.69	4.62	1.44	0.13	4.22	0.04
1.0% (2113)	4.71	4.64	1.46	0.14	5.04	0.04
0.1% (2013)	4.80	4.58	1.39	0.12	4.82	0.03

The fluvial flood risk to the site will be mitigated through the implementation of the measures proposed in **Section 4.2** of this report.

3.4 OTHER SOURCES OF FLOOD RISK

3.4.1 Flood Risk from Reservoirs, Canals and Other Artificial Sources

There are no canals or other impoundments located within the immediate vicinity of the site. The NRW Reservoir Flood Risk Map indicates that the site is not at risk of flooding from such sources. The site is therefore not considered to be at risk of flooding from reservoirs, canals or other artificial sources.

3.4.2 Flood Risk from Groundwater

The Capita Symonds *Phase 1 Geo-Environmental Appraisal* dated July 2013 states that groundwater entries were recorded frequently across The Airfields during exploratory hole formation, at depths of between 1.1 and 2.7 metres below ground level (m bgl).

During subsequent monitoring of installed standpipes, groundwater levels were recorded at depths of between 0.9 m and 3.9 m bgl, but typically in the order of 1.0 to 2.0 m bgl. Due to the site's location, geology and regional topography, the shallow groundwater was inferred to be in hydraulic continuity with, and upgradient of the River Dee.

The extensive network of drainage channels within the vicinity of the site are expected to significantly reduce the risk of flooding from this source. However, any residual risk of flooding will be mitigated through the implementation of the measures proposed in **Section 4.2** of this report.

3.4.3 Flood Risk from Surface Water

The NRW Surface Water Flood Risk Map indicates that The Airfields is generally at a very low³⁰ risk of flooding from this source. There are some isolated areas, which are defined as low³¹ risk; however, these appear to be within depressions in the site topography and as such are not considered to pose a significant risk.

³⁰ Very Low Risk; Chance of flooding of less than 1 in 1,000 in each year

³¹ Low Risk; Chance of flooding of between 1 in 1,000 and 1 in 100 in each year

4 FLOOD RISK MITIGATION STRATEGY

4.1 APPROVED FLOOD RISK MITIGATION CRITERIA

The Amended Flood Mitigation Plan (**Appendix E**) was derived based upon the agreed flood risk mitigation criteria as summarised in **Table 7**. These criteria have been used to inform the flood risk mitigation measures for development at The Airfields.

Table 7: Flood Risk Mitigation Criteria

Platform	Employment	Set at the highest of the following: <ul style="list-style-type: none"> ➤ 150 mm above 1% AEP (2088) fluvial flood level; or ➤ at the 0.5% AEP (2088) tidal upstream breach flood level (<i>utilising Hyder Consulting River Dee in-channel tidal levels</i>); or ➤ at the 0.5% AEP (2088) tidal downstream (Weetwood) breach flood level (<i>utilising Hyder Consulting River Dee in-channel tidal levels</i>)
	Residential	Set at the highest of the following: <ul style="list-style-type: none"> ➤ 150 mm above 1% AEP (2113) fluvial flood level; or ➤ at the 0.5% AEP (2113) tidal upstream breach flood level (<i>utilising Hyder Consulting River Dee in-channel tidal levels</i>); or ➤ at the 0.5% AEP (2113) tidal downstream (Weetwood) breach flood level (<i>utilising Hyder Consulting River Dee in-channel tidal levels</i>)
Finished Floor	Employment	Set at the highest of the following: <ul style="list-style-type: none"> ➤ 300 mm above 1% AEP (2088) fluvial flood level; or ➤ at the 0.5% AEP (2088) tidal upstream breach flood level (<i>utilising NRW/JBA Consulting River Dee in-channel tidal levels plus 95% confidence bound</i>); or ➤ at the 0.5% AEP (2088) tidal downstream (Weetwood) breach flood level (<i>utilising NRW/JBA Consulting River Dee in-channel tidal levels plus 95% confidence bound</i>); or ➤ at the 0.5% AEP (2088) tidal downstream (Hyder Consulting) breach flood level (<i>utilising Hyder Consulting River Dee in-channel tidal levels</i>)
	Residential	Set at the highest of the following: <ul style="list-style-type: none"> ➤ 300 mm above 1% AEP (2113) fluvial flood level; or ➤ at the 0.5% AEP (2113) tidal upstream breach flood level (<i>utilising NRW/JBA Consulting River Dee in-channel tidal levels plus 95% confidence bound</i>); or ➤ at the 0.5% AEP (2113) tidal downstream (Weetwood) breach flood level (<i>utilising NRW/JBA Consulting River Dee in-channel tidal levels plus 95% confidence bound</i>); or ➤ at the 0.5% AEP (2113) tidal downstream (Hyder Consulting) breach flood level (<i>utilising Hyder Consulting River Dee in-channel tidal levels</i>)
Access	Employment & Residential	Set at the highest of the following: <ul style="list-style-type: none"> ➤ 300 mm above 1% AEP (2113) fluvial flood level; or ➤ at the 0.5% AEP (2113) tidal upstream breach flood level (<i>utilising NRW/JBA Consulting River Dee in-channel tidal levels plus 95% confidence bound</i>); or ➤ at the 0.5% AEP (2113) tidal downstream (Weetwood) breach flood level (<i>utilising NRW/JBA Consulting River Dee in-channel tidal levels plus 95% confidence bound</i>); or ➤ at the 0.5% AEP (2113) tidal downstream (Hyder Consulting) breach flood level (<i>utilising Hyder Consulting River Dee in-channel tidal levels</i>)

4.2 APPROVED FLOOD MITIGATION MEASURES

To facilitate development at the site, a number flood mitigation measures and modifications to existing watercourses are proposed.

Table 8 provides a summary of the approved mitigation measures and watercourse modifications, identifying the completed works, works that are underway and those that have not yet commenced.

Table 8: Flood Mitigation Measures

Watercourse	Description	Status
River Dee	<ul style="list-style-type: none"> Defence crest between the A494 road bridge and the railway line, set at a minimum height of 7.20 m AOD. 	Completed
Garden City Drain	<ul style="list-style-type: none"> Existing 1200 mm diameter culvert extending from the A494 to Garden City Drain West removed. Culvert beneath A494 to remain up to first manhole on-site, outfalling to an approximately 21.18 m length of 900 mm diameter pipe. Open channel constructed in place of the removed culvert with its course re-aligned. The invert level at the upstream and downstream ends of the re-aligned channel fall from 2.76 m AOD to 2.40 m AOD at its confluence with Garden City Drain West. 	Completed
	<ul style="list-style-type: none"> Concrete box culverts of 2.00 m width by 1.25 m height incorporated to facilitate the vehicular and pedestrian crossings required along the length of the new channel. Natural bed material to a depth of 0.25 m provided in the base of the culverts. 	Partially Completed
	<ul style="list-style-type: none"> Sealand Bank Farm culvert upgraded to provide a 2.00 m wide by 1.25 m high box culvert with natural bed material to a depth of 0.25 m provided in the base of the culvert. 	Not Commenced
East Camp	<ul style="list-style-type: none"> 975 mm diameter surface water culvert retained and re-routed in order to connect into the new open section of Garden City Drain channel. 	Completed
Northern Drain	<ul style="list-style-type: none"> Removal of 600 mm to 975 mm diameter culvert that connects Northern Drain to Garden City Drain. Removal of 1070 mm diameter culvert that connects Northern Drain to Garden City Drain West. Concrete box culvert of dimension 2.00 m width by 1.25 m height provided beneath the first phase of the Welsh Government Commercial Spine Road to allow new connection between Northern Drain and Garden City Drain open channel. Natural bed material to a depth of 0.25 m provided in the base of the culvert. Removal of all culverts along the sites northern boundary (3 in total). 	Completed
	<ul style="list-style-type: none"> Left (south) bank of channel widened to create a 2-stage channel. Bed level of the second-stage set at 4.20 m AOD. 	Partially Completed
	<ul style="list-style-type: none"> Concrete box culverts of 2.50 m width by 1.25 m height incorporated to facilitate DCWW pipe crossing and access to the Deeside Industrial Estate. Natural bed material to a depth of 0.25 m provided in the base of the culverts. 	Not Commenced
Manor Drain	<ul style="list-style-type: none"> Top of bank to be set no lower than existing level. 	Ongoing
Landscape Strategy	<ul style="list-style-type: none"> Creation of series of swales through the site to provide flood storage and facilitate drainage of surface water from the proposed development platforms. Create temporary flood storage area within Plot H4 with a maximum bed level of 4.00 m AOD until such time that the Sealand Bank Farm culvert has been upgraded. Raise proposed development platforms and finished floor levels. 	Partially Completed

4.3 PLOTS C/D FLOOD MITIGATION MEASURES

The Plots C/D Enabling Works include implementation of the following flood risk mitigation measures:

- Lowering ground levels along the left (south) bank of Northern Drain to 4.20 m AOD.
- Lowering ground levels along the left (east) bank of Shotwick Brook to 4.20 m AOD.
- Creation of a swale between Plots C and D that will connect to the swale constructed as part of the works associated with the Phase 2/3 Welsh Government spine road.
- Lowering ground levels over the existing DCWW rising main to 4.38 m AOD to allow water to spill from Shotwick Brook and into the proposed swale between Plots C and D.

It should be noted that the above mitigation measures are not specifically required to facilitate the Plots C/D Enabling Works because the proposals do not entail creation of raised development platforms and therefore do not reduce flood storage.

4.3.1 Environmental Permits and Ordinary Watercourse Consents

An environmental permit for flood risk activities will be required from NRW for the landscaping works along Shotwick Brook and ordinary watercourse consent will be required from FCC for the landscaping works along Northern Drain.

4.4 PROPOSED SCENARIO FLOOD RISK MODELLING

The flood risk mitigation measures detailed in **Section 4.2** and **Section 4.3** have been incorporated into the approved Weetwood tidal and fluvial hydraulic models. The following features have also been incorporated into the proposed scenario hydraulic models to allow flood risk to be considered holistically:

- Phase 2/3 Employment Spine Road and associated swale and plot access points. Box culverts of dimension 2.00 m width by 1.00 m height have been incorporated in the location of the Plot B and C access points. It is therefore assumed that 1.25 m height concrete box culverts will be installed to provide natural bed material to a depth of 0.25 m within the base of the culverts.
- Plot C and D development platforms.
- Box culvert of dimension 2.00 m width by 1.00 m height in the location of the proposed pipe crossing at the junction between the western Plot B swale and Northern Drain (**Appendix F**). It is again assumed that a 1.25 m height concrete box culvert will be installed to provide natural bed material to a depth of 0.25 m within the base of the culvert.

Table 9 details the model runs that have been undertaken for the proposed scenario and model output plots are provided in **Appendix G**. The model outputs indicate that the development plots would remain dry during the design events.

Table 9: Tidal and Fluvial Model Runs – Proposed

	Flood Event (AEP)	Scenario
Tidal	0.5% (2088)	Overtopping*
	0.5% (2113)	Overtopping
	0.5% (2088)	Upstream breach
	0.5% (2113)	Upstream breach
	0.5% (2088)	Downstream breach*
	0.5% (2113)	Downstream breach
Fluvial	1% (2013)	
	1% (2088)	
	1% (2113)	

* The site is unaffected by flooding

Hydraulic modelling has also been undertaken to confirm that removal of the temporary flood storage area within Plot H4 does not result in the need for additional flood storage at the site. The tidal and fluvial model output plots are provided in **Appendix H**.

4.4.1 Development Platform and Finished Floor Levels

A comparison of the minimum development levels presented within the Plots H3/H5 FCA Addendum and those proposed based on the latest modelling is provided in **Table 10**.

Minimum development levels correspond with the higher of the flood levels assessed within this FCA Addendum and the Plots H3/H5 Enabling Works FCA Addendum, thereby ensuring that it is possible to revert to the previously approved scheme if the Sealand Bank Farm culvert is not ultimately replaced.

The Employment Spine Road between the roundabout and the Pochin Goodman site to the south should be set at a minimum of 5.37 m AOD and levels between the roundabout and the Deeside Industrial Estate to the north should be set at a minimum of 5.17 m AOD.

Table 10: Minimum Development Levels (m AOD) – The Airfields

Plot	Phase 2 FCA Addendum		Proposed	
	Platform	Finished Floor	Platform	Finished Floor
01	4.80	4.95	4.80	4.95
02	4.80	4.95	4.80	4.95
03	4.84	4.97	4.84	4.97
A	4.82	4.97	4.82	4.97
B	4.83	4.98	4.83	4.98
C	4.83	4.98	4.83	4.98
D	4.83	4.98	4.83	4.98
H1*	5.35	5.50	5.35	5.50
H2*	5.35	5.50	5.35	5.50
H3	4.80	5.35	4.80	5.37
H4	4.75	5.35	4.77	5.37
H5	4.76	5.35	4.77	5.37
H6	4.77	5.09	4.77	5.09
H7	4.79	5.09	4.79	5.09
H8*	5.35	5.50	5.35	5.50
H8a#	5.00	5.15	5.00	5.15

* Proposed levels in accordance with January 2019 Waterco FCA prepared for Countryside Properties³²

Proposed levels in accordance with plot survey

4.4.2 Proposed Sensitivity

As within the November 2013 Weetwood FCA, sensitivity analysis has been undertaken using the parameters as detailed in **Section 3.2.3**.

Table 11 details the sensitivity analysis model runs that have been undertaken for the proposed site and fully developed site scenarios. Model output plots are provided in **Appendix I**. The model outputs indicate that the maximum depths of flooding do not exceed the tolerable conditions outlined in A1.15 of TAN15. The flood depths are based upon the minimum development platform levels.

Table 11: Tidal Model Runs – Proposed Sensitivity

	Flood Event (AEP)	Scenario
NRW tidal levels	0.5% (2088)	Overtopping
	0.5% (2113)	Overtopping
	0.5% (2088)	Upstream breach
	0.5% (2113)	Upstream breach
	0.5% (2088)	Downstream breach
	0.5% (2113)	Downstream breach
Downstream breach location	0.5% (2088)	Downstream breach
	0.5% (2113)	Downstream breach

4.5 CULVERT BLOCKAGE

The impact of culvert blockage at the site is expected to be minimal given the interconnectivity of the channels (i.e. water is able to discharge from the site via Shotwick Brook and Garden City Drain West) and the additional storage provided within the channels and swales.

³² Application Ref: 059514

The risk of culvert blockage is also reduced through implementation of an appropriate Maintenance and Management Plan which will allow blockages to be identified and cleared prior to the onset of flooding.

4.6 FLOOD RISK ELSEWHERE

Any proposal to modify ground levels should demonstrate that there is no increase in flood risk to the development itself, or to any existing buildings which are known to, or are likely to flood.

Developers must ensure there will be no loss of flood flow or flood storage capacity for floods up to the severity of the 1.0% AEP fluvial event.

Compensatory storage is not generally required for the loss of floodplain storage or conveyance where the standard of protection of flood defences exceeds the 0.5% AEP tidal event. However, in such instances where overtopping of defences is expected by tidal floodwaters, and the predicted water level is not an extension of the water level within the estuary, then the developer should demonstrate no increase in flood risk elsewhere in a 0.5% AEP tidal event.

Whilst not specified by TAN15, NRW generally recommends that flood risk elsewhere should be assessed over the lifetime of development (i.e. should take into account climate change).

4.6.1 Modelling Tolerance

A modelling tolerance of +/- 0.03 m was previously agreed as part of the November 2013 Weetwood FCA for assessing the impact of the proposals on flood risk elsewhere. As detailed previously, FCC has confirmed that the flood risk criteria agreed as part of the November 2013 Weetwood FCA should be applied to the application.

Based upon the above, a modelling tolerance of +/- 0.03 m has been applied in respect of the above and is considered appropriate. However, NRW now recommends that a modelling tolerance of +/- 0.01 m is used and has therefore also been considered.

4.6.2 Tidal

As part of the November 2013 Weetwood FCA it was agreed with NRW³³ that the Hyder Consulting tidal levels should be used when considering flood risk elsewhere during tidally dominated events. Model plots comparing the baseline and proposed outputs for the tidally dominated events are provided in **Appendix J**.

It should be noted that flood depths are shown to increase by a maximum 31 mm in the proposed scenario 0.5% AEP (2113) tidal overtopping and downstream breach scenarios. The increases in flood depth occur across a small area within the adjacent Pochin Goodman Northern Gateway Ltd development site.

Given that the increases in flood depth only marginally exceed the agreed modelling tolerance, would not be realised until after the year 2088 and do not occur following development of Plot H4 and the associated depression along the southern plot boundary, the increases in flood depth are considered to be acceptable.

4.6.3 Fluvial

Model plots comparing the baseline and proposed outputs for the fluvially dominated events are provided in **Appendix K**.

It should be noted that an isolated area of increased flood risk is observed within residential gardens to the south-west of Sealand Avenue. The observed increases do not represent an increase in the depth of flooding expected in this located but result from a minor model instability.

A comparison of maximum flood levels directly upstream and downstream of this location in the pre and post development scenarios indicate that in-channel flood levels are expected to reduce following development. As such, the risk of flooding to the rear gardens to the south-west of Sealand Road is also expected to reduce.

³³ Meeting with NRW, Welsh Government, Weetwood and Hyder on 18 June 2012

5 SURFACE WATER MANAGEMENT

5.1 REQUIREMENTS FOR SURFACE WATER MANAGEMENT

TAN15 provides an overview of the requirements for the management of surface water to ensure that development does not increase flood risk at the site or elsewhere.

Paragraph 8.3 of TAN15 states that *‘the aim should be for new development not to create additional run-off when compared with the undeveloped situation, and for redevelopment to reduce runoff where possible. It is accepted that there may be practical difficulties in achieving this aim’*.

5.2 SURFACE WATER DRAINAGE CRITERIA

As outlined within the November 2013 FCA, the drainage networks serving the former RAF Sealand site discharged surface water to Garden City Drain and Northern Drain. Surface water runoff was subsequently discharged to the tidal River Dee via Shotwick Brook and Garden City Drain West.

Post development it is proposed to continue to discharge surface water runoff to the River Dee via the various watercourses within/adjacent to the site.

There would not normally be a requirement to attenuate surface water runoff from a development where discharges are direct to a tidal estuary. However, in this instance surface water storage is required to attenuate flows for the period over which tide locking of the outfalls to the River Dee occurs.

The surface water storage is provided by the network of swales and open channels that have been or are soon to be constructed. This enables surface water to be discharged unrestricted from the various development plots and the spine road, without a requirement for on plot attenuation.

As outlined within the October 2020 Weetwood Surface Water Drainage Assessment³⁴, the assumptions set out in **Table 12** have been made with respect to the anticipated post development impermeable areas at the site.

The Surface Water Drainage Assessment concluded that unrestricted discharge to the open drainage network on and within the vicinity of the site would be possible. The extensive fluvial and tidal flood storage areas proposed on site were also considered sufficient to accommodate surface water runoff from the development plots and highway for the period over which tide locking of the outfalls to the River Dee occurs.

Table 12: Estimated Post Development Site Areas

Plot	Land Use	Development Area (ha)	Impermeable Area (ha)	Permeable Area (ha)	Impermeable Area Used (ha)
1/2/8	Residential	8.485	4.407	4.078	4.407
H3	Residential	1.684	1.010	0.674	0
H4	Residential	2.969	1.781	1.188	0
H5	Residential	3.189	1.913	1.276	0
H6	Residential	2.810	1.686	1.124	0
H7	Residential	2.321	1.393	0.928	0
H8a	Residential	1.955	1.173	0.782	0
01	Commercial	2.354	2.236	0.118	0
02	Commercial	2.504	2.379	0.125	0
03	Commercial	3.060	2.907	0.153	0

³⁴ Surface Water Drainage Assessment; The Airfields, Deeside, Final Report v1.0, 15 October 2020, Ref: 2097/ SWDA/Final/v1.0/2020-10-15

Plot	Land Use	Development Area (ha)	Impermeable Area (ha)	Permeable Area (ha)	Impermeable Area Used (ha)
A	Industrial	7.140	6.105	1.035	6.105
B	Industrial	11.069	9.962	1.107	0
C	Industrial	21.641	19.477	2.164	0
D	Industrial	5.727	5.154	0.573	0
Spine Road		5.4	4.779	4.779	-
Green Space		0.0	17.046	-	17.046
Total		59.3	98.733	66.362	32.371

5.3 SURFACE WATER RUNOFF FROM PLOTS C/D

The proposals within Plot C and D do not include any new impermeable areas and formal surface water drainage arrangements are not required.

5.3.1 Management and Maintenance Plan

A management company has been created to maintain the network of swales and open channels at the site, as detailed by the Drainage Maintenance and Management Plan provided in **Appendix L**.

6 SUMMARY

This FCA Addendum has been prepared to accompany the Plots C/D drainage and landscaping details application to discharge (in part) Conditions 7, 15, 17, 18 and 19 of the outline planning permission.

It is understood that the Plots C/D Works will be brought forward concurrently with the Phase 2/3 Employment Spine Road and that approval of these works will enable the Sealand Bank Farm culvert to be upgraded. This report considers these works holistically and has therefore been prepared in accordance with the October 2017 FCA Addendum and associated Amended Flood Mitigation Plan.

The Plots C/D Works comprise drainage and landscaping works to facilitate development of Plots C and D and includes channel widening works along Northern Drain and Shotwick Brook the creation of a swale between Plots C and D.

According to the NRW Flood Map The Airfields site is located in the defended 1% AEP fluvial / 0.5% AEP tidal flood outline and is therefore defined by TAN15 as being situated within Zone C1.

The approved Weetwood tidal and fluvial hydraulic models have been utilised in order to inform the proposed flood mitigation. FCC has previously confirmed that the flood risk criteria agreed as part of the November 2013 Weetwood FCA should be applied in relation to works undertaken under the outline planning permission.

The mitigation measures as detailed in **Section 4.2** and **Section 4.3** have been incorporated within the approved Weetwood tidal and fluvial hydraulic models. The model outputs indicate that the site would remain dry during all of the modelled design events. The impact of the proposals on flood risk elsewhere has also been assessed.

Surface water runoff from the site may be sustainably managed in accordance with TAN15.

7 RECOMMENDATIONS

This FCA Addendum has demonstrated that the Plots C/D drainage and landscaping works may be completed without conflicting with the requirements of TAN15, providing that the mitigation measures detailed in **Section 4.2** and **Section 4.3** are incorporated.

Conditions 7, 15, 17, 18 and 19 of the outline planning permission may therefore be discharged in respect of the Plots C/D drainage and landscaping works.

APPENDIX A:

Development Proposals

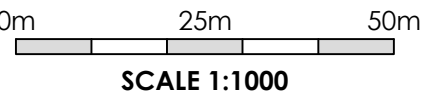


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NOTES

LEGEND
DENOTES PLOT BOUNDARIES.
DENOTES SITE DEVELOPMENT BOUNDARY.



PLOT
AREA = 109847.189m

PLOT C
AREA = 218180.067m² / 21.818Ha / 53.913Ac
MIN. PLATFORM LEVEL=4.830m
FFL=4.980m

PLOT H5
AREA = 31968.502m² / 3.197Ha

PLOT H4
AREA = 29659.033m² / 2.966Ha

PLOT D
AREA = 49953.848m² / 4.995Ha / 12.343Ac
MIN. PLATFORM LEVEL=4.830m
FFL=4.980m

C	GENERAL UPDATE.	13/10/20	JAC
B	UPDATED TO SUIT COMMENTS.	29/09/20	JAC
A	FIRST ISSUE.	24/09/20	JAC
REV	DESCRIPTION	DATE	BY

Job Title
THE AIRFIELDS

Drawing Title
PHASE 2B.
PLOTS C & D
SWALE PROVISIONS

Architect



Checked RE	Date SEPT 20	Scale 1:1000	A0	Drawn JAC
Drawing No			4671-2B-01	C

Appendix C

Natural Resources Wales Pre-application Advice



**Cyfoeth
Naturiol
Cymru
Natural
Resources
Wales**

Ein cyf/Our ref: CAS-163567-V5Z7
Eich cyf/Your ref: CH4 0DF

Maes Y Ffynnon,
Penrhosgarnedd,
Bangor,
Gwynedd
LL572DW

Valerio Casillo and Gavin Winter
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Gavin.winter@spawforths.co.uk

ebost/email:
northplanning@cyfoethnaturiolcymru.gov.uk

02/09/2021

Dear Sir/Madam,

DISCRETIONARY PLANNING ADVICE SERVICE

FLOOD CONSEQUENCES ASSESSMENT SCOPE

PROPOSAL: FULL PLANNING APPLICATION FOR ERECTION OF PAPER PROCESSING MILL TO PRODUCE AND MANUFACTURE TISSUE PAPER (B2, B8 USE CLASS) WITH ANCILLARY B1A OFFICE SPACE; ASSOCIATED SERVICING AND INFRASTRUCTURE INCLUDING CAR PARKING, HGV PARKING AND VEHICLE AND PEDESTRIAN CIRCULATION; NOISE MITIGATION FEATURES; EARTHWORKS TO CREATE DEVELOPMENT PLATFORMS; CREATION OF DRAINAGE FEATURES INCLUDING A NEW OUTFALL TO THE RIVER DEE; WATER TREATMENT PLANT; AND LANDSCAPING

LOCATION: PLOT C, THE AIRFIELDS, NORTHERN GATEWAY, FLINTSHIRE

Thank you for your request for discretionary planning advice. We received your signed quotation on 16/08/2021.

Flood Risk

We have reviewed the information submitted in support of this charged pre-planning application request relating to Plot C at the Airfields.

As you are aware, there has recently been a planning application for works at Plot C (planning reference 061986). This application related to some enabling works at the site but was limited solely to the lowering of ground levels along Northern Drain and Shotwick Brook and creation of swales.

The proposal is for the development of a paper processing mill with ancillary office use. This would include the creation of development platforms, construction of the buildings and creation of a new outfall into the River Dee.

We would expect any Flood Consequences Assessment (FCA) for this proposal to be based upon the previous work that has been undertaken for the wider Airfields site. The proposed mitigation measures (development platform levels, finished floor levels, and flood storage requirements) have previously been agreed; the FCA will therefore need to demonstrate that the proposal satisfies these agreed parameters and will need to be supported by detailed information to demonstrate that the proposed mitigation can be delivered.

The FCA prepared in support of the original outline planning application included the upgrading of the Sealand Bank Farm culvert as one of the mitigation measures required to develop the Airfields site. The most recent iteration of the mitigation scheme which relies upon the Sealand Bank Farm culvert upgrade is referred to as the 'Amended Flood Mitigation Plan' (submitted under application 057547). We have previously raised concerns that this upgrade would not be undertaken prior to subsequent phases of the development coming forward, because the culvert lies within land outside the applicant's control. This led to a planning condition being included on the Phase 1 enabling works consent, stipulating that if the upgrade works had not been completed prior to commencement of Phase 2, an additional FCA would need to be prepared, based on the upgrade works not being undertaken. This FCA was submitted under application 060575 and resulted in the alternative mitigation strategy (along with the Alternative Flood Mitigation Plan). This mitigation strategy is based on a scenario where the Sealand Bank Farm upgrade has not been undertaken. It was agreed that this strategy should be referred to for any subsequent applications on the Airfields site, until the upgrade works have been completed.

The upgrade works to the Sealand Bank Farm culvert have not yet been completed (and have not commenced at the time of writing). Therefore, we would expect the FCA for this proposal to refer to the Alternative Flood Mitigation Plan when assessing the flood risk mitigation requirements (unless the upgrade works have been completed prior to this application being submitted). It should be noted that under the Alternative Flood Mitigation Plan, the northern portion of Plot C is allocated as green space and provides a flood storage function. The proposed plan indicates that this area would form part of the development platform. As this would require this area of land to be raised, the FCA would need to assess the impacts of the loss of this flood storage area and propose alternative mitigation to manage any identified increases in flood risk elsewhere.

We would expect the FCA to include the following:

- An assessment of flood risk from both tidal and fluvial sources, including overtopping and breach for the tidal River Dee. This should be based on the work undertaken in previous FCAs. The previously agreed lifetime of development (i.e. to the year 2088) can be adopted for the FCA.
- The FCA will need to refer to the approved flood risk mitigation measures and demonstrate that the specific flood risk mitigation measures proposed for Plot C are

in accordance with the agreed measures, including specification of development platform and finished floor levels. To reiterate, this needs to be based on the Alternative Flood Mitigation Plan.

- We would expect detailed proposed level information to be submitted in support of the application. This should include proposed level plans which show the development platform and finished floor levels and proposed cross sections showing the transition in levels from the flood storage areas to the development platform and finished floor levels.
- As outlined above, an assessment of the development proposals on flood risk elsewhere will need to be undertaken, to demonstrate that the proposal would not result in an adverse impact on flood risk to third party land or property. This needs to include the impact of the loss of the flood storage area in the northern section of Plot C as a result of this area forming part of the raised development platform.
- We will require an 8-metre access easement to be provided along Shotwick Brook to allow access for our maintenance activities along this Main River. We would expect a plan to be submitted showing this easement. We would also request that gated access is provided off the road network.
- We would also expect the application to be supported by detailed design drawings for the proposed outfall through the River Dee defence. This will need to address the concerns that we have been raised as part of the Flood Risk Activity (FRAP) pre-application discussions with the site's consulting engineers (Sheperd Gilmour).

We advise that you discuss the proposed surface water drainage arrangements with the SuDS Approving Body (SAB). We do not provide advice in this regard.

Please do not hesitate to contact us if you require further information or clarification of any of the above.

Yours faithfully,

Tristan Williams

Cynghorydd - Cynllunio Datblygu / Advisor - Development Planning
Cyfoeth Naturiol Cymru / Natural Resources Wales

Disclaimer

The applicant acknowledges that the content of any advice or assistance provided by NRW is advisory only and that it shall not be deemed to bind or in any other way restrict NRW in performing its statutory functions.

In particular, the recipient acknowledges that:

- any advice given or materials or documentation provided by NRW do not constrain or bind NRW in respect of its statutory functions or its role as a statutory consultee or any decision NRW may make in relation to any application for a licence or permit;
- any advice given by NRW does not bind NRW in respect of any future representations it may make as statutory consultee or any decision NRW may make in relation to any application for a licence or permit;
- any views or opinions expressed by NRW are without prejudice to the consideration NRW may be required to give to any application or any future representations as statutory consultee or any decision NRW may make in relation to any application for a licence or permit;
- the final decision as to any representations made by NRW as statutory consultee will be based on all the relevant information available to NRW at the time it makes such representations;
- NRW cannot and does not give any guarantee as to the representations it may make as statutory consultee; and
- any advice given by NRW may be overtaken by changes in available information, law, policy and guidance relevant to the subject matter of the advice.

Appendix D

Weetwood Surface Water Drainage Assessment Report

THE AIRFIELDS, DEESIDE

SURFACE WATER DRAINAGE ASSESSMENT

Final Report v1.0

October 2020

Weetwood Services Ltd
70 Cowcross Street
London
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Report Title: **The Airfields, Deeside**
Surface Water Drainage Assessment
Final Report v1.0

Client: Crag Hill Estates Ltd

Date of Issue: 15 October 2020

Prepared by: James Aldridge BEng (Hons) MSc MCIWEM
Technical Director

Checked and
Approved by: Kevin Tilford BSc MSc PhD MBA CEnv CWEM FCIWEM
Managing Director

This document has been prepared solely as a Surface Water Drainage Assessment for Crag Hill Estates Ltd. This report is confidential to Crag Hill Estates Ltd and Weetwood Services Ltd accepts no responsibility or liability for any use that is made of this document other than by Crag Hill Estates Ltd for the purposes for which it was originally commissioned and prepared.

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1 INTRODUCTION

1.1 BACKGROUND

The Northern Gateway is a large strategic development site located in north-east Wales. The former RAF Sealand site, owned by Crag Hill Estates Ltd, forms part of the larger land allocation and is hereafter referred to as 'The Airfields'.

Outline planning permission for redevelopment of The Airfields was granted in January 2013¹. It was envisaged that the proposed development would be brought forward through a series of reserved matters applications relating to specific phases.

Condition 6 of the Decision Notice stated:

"Prior to the approval of reserved matters applications a Development Brief for the site comprising an illustrative land use Master Plan, green infrastructure plan and flood mitigation plan for built development and a Design Statement shall be submitted to the Local Planning Authority for approval and the development shall be carried out in accordance with the approved details, unless otherwise agreed in writing by the Local Planning Authority."

A Flood Consequences Assessment (FCA) was prepared by Weetwood Services Ltd ('Weetwood') in November 2013² in support of the site wide Flood Mitigation Plan submitted as part of the Design Statement accompanying the application to discharge Condition 6³.

The FCA presented the overarching strategy for the management of surface water runoff at The Airfields. The strategy was informed by 1D-2D hydraulic modelling of the site and surrounding land to show that off-site flood risk was not increased as a result of the proposed development.

The FCA was approved by Natural Resources Wales (NRW) and Flintshire County Council (FCC) and Condition 6 of the outline planning permission was subsequently discharged in November 2013.

Welsh Government and Crag Hill Estates Ltd submitted a reserved matters application⁴ for Phase 1 of the Employment Spine Road and associated infrastructure in October 2015. The application was accompanied by a FCA⁵ prepared by Weetwood in November 2015 and was approved by FCC in March 2016.

Approval for the Phase 1 Enabling Works was subsequently sought via a second reserved matters application⁶ in August 2017. Weetwood prepared a FCA⁷ in October 2017 to accompany the reserved matters application based on the understanding that the Sealand Bank Farm culvert, located within the adjoining Northern Gateway development site owned by Pochin Goodman Northern Gateway Ltd, would be upgraded in accordance with the approved site wide Flood Mitigation Plan.

Pochin Goodman Northern Gateway Ltd agreed in principle to Crag Hill Estates Ltd upgrading the Sealand Bank Farm culvert. However, NRW raised a concern that the culvert may not be upgraded within an appropriate timeframe, owing to the culvert being located outside of the land controlled by Crag Hill Estates Ltd.

¹ Planning Ref: 049320

² Flood Consequences Assessment; The Airfields, Deeside, Final Report, 8 November 2013, Ref: 2097/FCA_v1.5

³ Planning Ref: 051025

⁴ Planning Ref: 054488

⁵ Flood Consequences Assessment; Northern Gateway – Phase 1 Infrastructure Works, Final Report v1.0, 19 November 2015, Ref: 2097/FCA (Phase 1 Infrastructure Works) v1.0

⁶ Planning Ref: 057404

⁷ Flood Consequences Assessment; The Airfields, Deeside – Phase 1 Enabling Works, Final Report v1.5, 30 October 2017, Ref: 2097/FCA(P1)/Final/v1.5/2017-10-30

Weetwood undertook additional hydraulic modelling to investigate a temporary flood mitigation strategy in the event that the Sealand Bank Farm culvert could not be upgraded. The results of the hydraulic modelling were presented in a letter⁸ to FCC dated 14 November 2017.

The Phase 1 Enabling Works reserved matters application was subsequently approved subject to Conditions 2 and 3, which state the following:

Condition 2: “Prior to the connection of Northern Drain to Garden City Drain West via a new open channel, a scheme for temporary flood storage shall be submitted for the approval of the Local Planning Authority and thereafter shall be implemented in accordance with an agreed programme. The scheme shall remain in place until such time that the Sealand Bank Farm culvert has been replaced as shown on drawing number 4671-1-D21-C.”

Condition 3: “In the event that Sealand Bank Farm culvert has not been replaced prior to the commencement of Phase 2 of the development, a further Flood Consequences Assessment shall be undertaken and submitted in writing for approval to the Local Planning Authority. This shall assess the likely impacts of climate change on a site wide basis and shall include a flood mitigation scheme to be implemented in accordance with an agreed programme.”

A planning application⁹ was submitted in September 2017 for an amended version of the approved Illustrative Land Use Masterplan and Design Statement to reallocate the proposed residential plot on the Welsh Road frontage to provide a district centre, commercial and social uses.

Weetwood prepared a FCA Addendum¹⁰ and Amended Flood Mitigation Plan in support of the above, which encompassed the information submitted with the Phase 1 Enabling Works application and revised percentage impermeable area calculations. NRW confirmed in its letter dated 21 December 2017¹¹ that it had removed its objection to the application, following submission of a supplementary letter by Weetwood dated 13 December 2017¹².

For completeness, the previously approved October 2017 FCA Addendum was updated¹³ to reflect the information contained within the supplementary letter prepared by Weetwood and was submitted in support of the application¹⁴ to discharge Condition 6, which was subsequently approved by FCC in August 2018.

A Section 73 application¹⁵ was submitted in September 2018 to remove Conditions 7, 15, 16 and 17 of the original outline planning permission. Approval was granted by FCC in October 2018.

Approval to extend the Phase 1 Enabling Works to include Plot B was sought via a reserved matters application¹⁶ in April 2019. Weetwood prepared a FCA Addendum¹⁷ to accompany the reserved matters application and planning permission was subsequently granted by FCC in August 2019.

A reserved matters application¹⁸ for the Phase 2 Enabling Works was submitted to FCC in July 2019. Weetwood prepared a FCA Addendum¹⁹ to accompany the application and planning permission was granted by FCC in February 2020.

⁸ Weetwood Ref: 2097/2017-11-14/RMu/01

⁹ Planning Ref: 057547

¹⁰ Flood Consequences Assessment Addendum; The Airfields, Deeside – Discharge of Condition 6 Amendment, Final Report v1.4, 30 October 2017, Ref: 2097/FCA Addendum/Final/v1.4/2017-10-30

¹¹ NRW Ref: CAS-47096

¹² Weetwood Ref: 2097/2017-12-13/RMu/02

¹³ Flood Consequences Assessment Addendum; The Airfield's, Deeside – Discharge of Condition 6, Final Report v1.6, 17 May 2018, Ref: 2097/FCA Addendum/Final/v1.6/2018-05-17

¹⁴ Planning Ref: 058514

¹⁵ Planning Ref: 058990

¹⁶ Planning Ref: 059938

¹⁷ Flood Consequences Assessment Addendum; The Airfields, Deeside – Plot B Enabling Works, Final Report v1.0, 24 April 2019, Ref: 2097/PB/FCA Addendum/Final/v1.0/2019-04-24

¹⁸ Planning Ref: 060311

¹⁹ Flood Consequences Assessment Addendum; The Airfields, Deeside – Phase 2 Enabling Works, Final Report v1.0, 24 July 2019, Ref: 2097/P2/FCA Addendum/Final/v1.0/2019-07-24

Weetwood prepared a Technical Note²⁰ to accompany an application²¹ to discharge Condition 2 of the Phase 1 Enabling Works application in July 2019 because the Sealand Bank Farm culvert had not yet been upgraded and the Phase 1 Enabling Works were nearing completion. A supplementary letter²² was issued to NRW in October 2019 and the application was subsequently approved by FCC in February 2020.

Weetwood prepared a FCA Addendum²³ to accompany an application²⁴ to discharge Condition 3 in December 2019. This presented an Alternative Flood Mitigation Plan to which future reserved matters applications should relate, until such time that the Sealand Bank Farm culvert had been upgraded. FCC approved the application to discharge Condition 3 in February 2020.

A reserved matters application²⁵ for the Phase 3 Enabling Works was submitted to FCC in February 2020. Weetwood prepared a FCA Addendum²⁶ to accompany the application based upon the Alternative Flood Mitigation Plan and planning permission was granted by FCC in May 2020.

A Section 73 application²⁷ was submitted in March 2020 to remove Conditions 26, 28, 30, 34 and 44 of the revised outline planning permission. Approval was granted by FCC in October 2020.

1.2 PURPOSE OF THE REPORT

This Surface Water Drainage Assessment report defines the overarching strategy for the management of surface water runoff at The Airfields, taking into account development that has been completed or approved.

The report has been prepared at the request of FCC following implementation of Schedule 3 of the Flood and Water Management Act 2010 and accords with the general principles set down within the November 2013 FCA and the May 2018 FCA Addendum.

Schedule 3 of the Flood and Water Management Act 2010 was implemented in Wales on 7 January 2019 and the transition period exempting reserved matters applications from requiring SAB approval expired on 7 January 2020. As such, future reserved matters applications at The Airfields will require SAB approval.

The design of surface water drainage infrastructure associated with future reserved matters applications at the site should accord with the principles set down within this report. It is understood that FCC will assess future SAB applications against these criteria and that significant deviation may require this assessment to be updated.

It should be noted that this report has been prepared in accordance with Amended Flood Mitigation Plan and therefore requires the Sealand Bank Farm culvert to be upgraded. It is understood that Pochin Goodman Northern Gateway Ltd has now agreed to these works being undertaken.

²⁰ The Airfields, Deeside – Temporary Flood Mitigation Strategy, Technical Note: Planning Condition 2, 26 July 2019, Ref: 2097/C2/TN/Final/v1.0/2019-07-26

²¹ Planning Ref: 060330

²² Weetwood Ref: 2097-10-08/2097/C2-L1

²³ The Airfields, Deeside – Alternative Flood Mitigation Strategy, Condition 3: Flood Consequences Assessment Addendum, 10 December 2019, Ref: 2097/C3/TN/v1.3/2019-12-10

²⁴ Planning Ref: 060575

²⁵ Planning Ref: 061018

²⁶ Flood Consequences Assessment Addendum; The Airfields, Deeside – Plots H3/H5 Enabling Works, Final Report v1.0, 11 February 2020, Ref: 2097/H3-5/FCA_Addendum/Final/v1.0/2020-02-11

²⁷ Planning Ref: 061125

1.3 STRUCTURE OF THE REPORT

The report is structured as follows:

- Section 1** Introduction and report structure
- Section 2** Provides information relating to the development site, the waterbodies in the vicinity of the site and the proposals
- Section 3** Presents the overarching strategy for the management of surface water runoff at the developed site
- Section 4** Presents a summary of key findings

2 SITE DETAILS AND PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The Airfields is located at Ordnance Survey National Grid Reference SJ 325 696, as shown in **Figure 1**. The site is approximately 98.7 hectares (ha) in area.

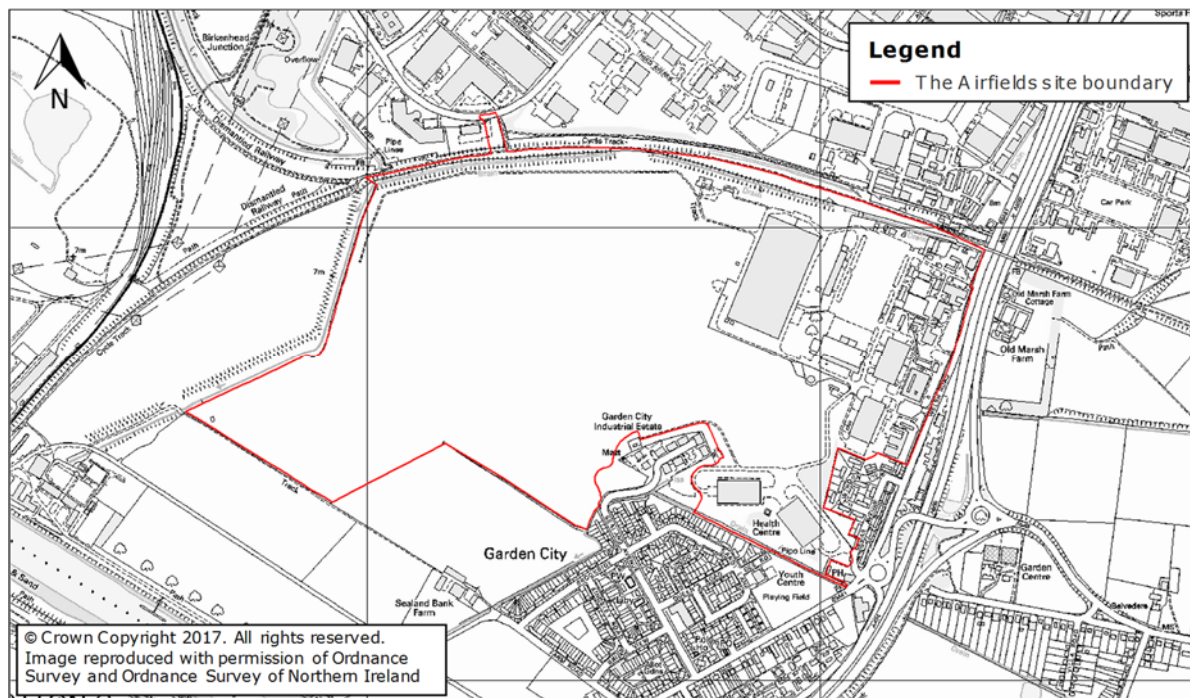


Figure 1: Site Location

2.2 EXISTING AND PROPOSED DEVELOPMENT

The site previously comprised approximately 30.0 ha of developed land in the north-east corner, with the remainder of the site comprising grassland and scrub. The developed land was associated with former RAF Sealand and comprised military buildings with associated hardstanding and landscaped areas.

Outline planning permission was granted for a mixed-use regeneration scheme comprising the following:

- Up to 205,000 m² of storage and distribution floorspace;
- Up to 31,000 m² of other employment uses (offices, shops, etc);
- Up to 725 residential dwellings; and
- Public open space and landscaping.

The Phase 1 Employment Spine Road and associated infrastructure, including the swale along its northern edge and the eastern connection to Northern Drain, were constructed in 2017. The Phase 1 Employment Spine Road extends from Welsh Road to the central roundabout within the site.

The new Garden City Drain channel, associated connection to the Phase 1 Employment Spine Road swale and the Phase 1 Residential Spine Road were constructed in 2019 as part of the Phase 1 Enabling Works. The Phase 1 Residential Spine Road extends from Welsh Road to the boundary between Plots H2 and H3.

The Phase 1 Enabling Works also included the removal of two culverts along Northern Drain, widening of the Northern Drain channel and ground raising to create development platforms within Plots A, 01, 02, 03, H1, H2, H8 and H8a.

The Plot B Enabling Works, comprising the extension of the Phase 1 Employment Spine Road swale to provide two additional connections to Northern Drain, the removal of the existing culvert located along the northern boundary of Plot B and widening of the Northern Drain channel have commenced and are expected to be complete in 2020.

The Phase 2 Enabling Works, comprising the extension of the Residential Spine Road to provide a connection to the central roundabout, the construction of a swale adjacent to the western extent of the spine road and ground raising to create development platforms within Plots H6 and H7, are expected to commence in 2020.

Construction of an Amazon distribution centre was recently completed on Plot A and Countryside Properties is currently developing Plots H1, H2 and H8 for residential use.

The Plot Boundaries Masterplan is presented in **Appendix A**.

2.3 WATERBODIES IN THE VICINITY OF THE SITE

There are a number of existing waterbodies in the vicinity of the site, as detailed below.

- River Dee: Located approximately 0.4 km to the south of the site. This section of the River Dee is tidally dominated and benefits from flood defence infrastructure, which comprises raised earth embankments. The River Dee is designated a main river.
- Shotwick Brook: Culverted under the disused railway via a 2500 mm wide arch culvert in the north-west corner of the site before flowing in open channel in a predominately south-westerly direction along the western boundary of the site. Shotwick Brook ultimately outfalls to the River Dee via a flapped outfall after being culverted under the existing John Summers buildings to the south-west. Shotwick Brook is designated a main river.
- Garden City Drain: Enters the site via a 900 mm culvert in the north-east corner of the site. The watercourse remains in open channel flowing in a westerly and then south-westerly direction, outfalling to Garden City Drain West. Garden City Drain is designated main river.
- Manor Drain: Enters the site via a 1200 mm diameter culvert under the A494 before flowing in open channel in a north-westerly direction along the south-east boundary of the site to its confluence with Garden City Drain West. Manor Drain is designated a main river.
- Garden City Drain West: Located to the south of the site. The watercourse remains in open channel, flowing in a south-westerly direction and ultimately outfalling to the River Dee via four flapped outfalls. Garden City Drain West is designated a main river.
- Northern Drain: Culverted under the disused railway in the north-east corner of the site. The watercourse subsequently flows in open channel in a predominately westerly direction along the northern boundary of the site to its confluence with Shotwick Brook. A swale connects Northern Drain with Garden City Drain via a culvert through the Phase 1 Employment Spine Road. Northern Drain is designated an ordinary watercourse.
- East Camp: An existing 975 mm diameter culvert enters the site in the north-east corner and takes surface water flows from the RAF Sealand East Camp. The culvert has been diverted and outfalls to the new Garden City Drain open channel.

2.4 SITE LEVELS

A topographic survey of the site was undertaken by Green Hatch Group prior to development commencing on site. This information has been used to develop a digital elevation model as illustrated in **Figure 2**.

Levels at the site generally ranged between 2.3 and 12.5 metres Above Ordnance Datum (m AOD), with an average level of 4.7 m AOD.



3 SURFACE WATER DRAINAGE STRATEGY

3.1 DISPOSAL OF SURFACE WATER

As outlined within the November 2013 FCA, the drainage networks serving the former RAF Sealand site discharged surface water to Garden City Drain and Northern Drain. Surface water runoff was subsequently discharged to the tidal River Dee via Shotwick Brook and Garden City Drain West.

Post development it is proposed to continue to discharge surface water runoff to the River Dee via the various watercourses within/adjacent to the site.

3.2 POST DEVELOPMENT IMPERMEABLE AREAS

As outlined within the May 2018 FCA Addendum, the following percentage impermeable areas have been considered for the development plots at the site:

- Residential 60%
- Commercial 95%
- Industrial 90%

These have been used to estimate the impermeable area for each development plot, as set out in **Table 1**. However, the impermeable area for Plots H1, H2 and H8 is based upon the Countryside Properties site layout, the impermeable area for Plot A is based upon the Amazon site layout and the impermeable area for the spine road is based upon detailed design drawings.

Table 1: Estimated Post Development Impermeable Areas

Plot	Land Use	Development Area (ha)	Impermeable Area (ha)	Permeable Area (ha)
H1/2/8	Residential	8.485	4.407	4.078
H3	Residential	1.684	1.010	0.674
H4	Residential	2.969	1.781	1.188
H5	Residential	3.189	1.913	1.276
H6	Residential	2.810	1.686	1.124
H7	Residential	2.321	1.393	0.928
H8a	Residential	1.955	1.173	0.782
01	Commercial	2.354	2.236	0.118
02	Commercial	2.504	2.379	0.125
03	Commercial	3.060	2.907	0.153
A	Industrial	7.140	6.105	1.035
B	Industrial	11.069	9.962	1.107
C	Industrial	21.641	19.477	2.164
D	Industrial	5.727	5.154	0.573
Spine Road		4.779	4.779	-
Green Space		17.046	-	17.046
Total		98.733	66.362	32.371

3.3 ATTENUATION STORAGE AND PROPOSED DISCHARGE RATES

There would not normally be a requirement to attenuate surface water runoff from a development where discharges are direct to a tidal estuary. However, in this instance surface water storage is required to attenuate flows for the period over which tide locking of the outfalls to the River Dee occurs.

The surface water storage is provided by the network of swales and open channels that have been or are soon to be constructed. This enables surface water to be discharged unrestricted from the various development plots and the spine road, without a requirement for on plot attenuation.

The surface water discharges from the development plots and the spine road have been estimated using MicroDrainage for the 1.0% annual exceedance probability (AEP) event, including a 40% increase in peak rainfall intensity to account for climate change.

The 360 minute duration storm has been assessed because it coincides with the critical storm duration for the fluvial watercourses at the site (6.25 hours). The 15 minute duration storm has also been assessed to estimate peak flows from the proposed development plots.

The surface water hydrographs for the 15 minute and 360 minute duration storms are presented by **Figure 3** and **Figure 4** respectively. It should be noted that the surface water hydrographs have been translated to commence at 6.25 hours to correspond with the fluvial hydrographs.

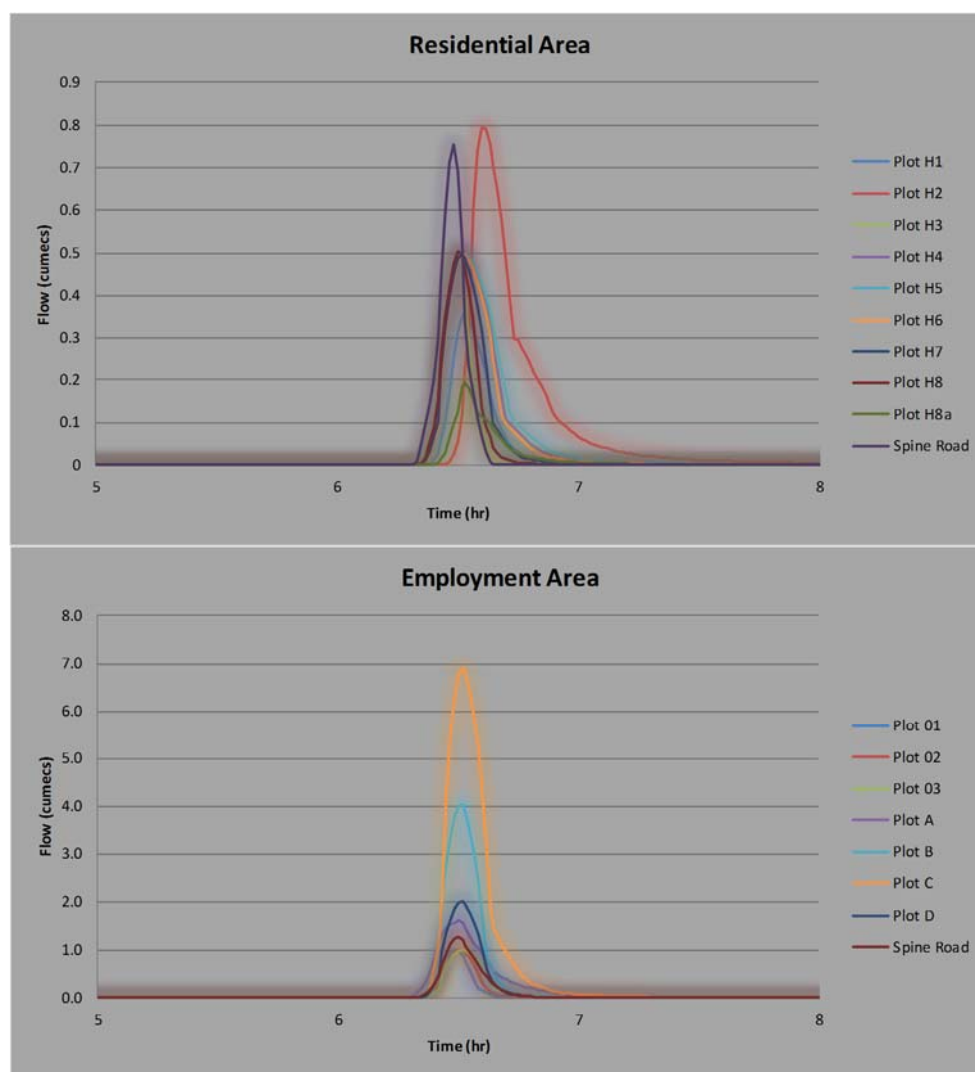


Figure 3: Surface Water Hydrographs – 15 Minute Duration

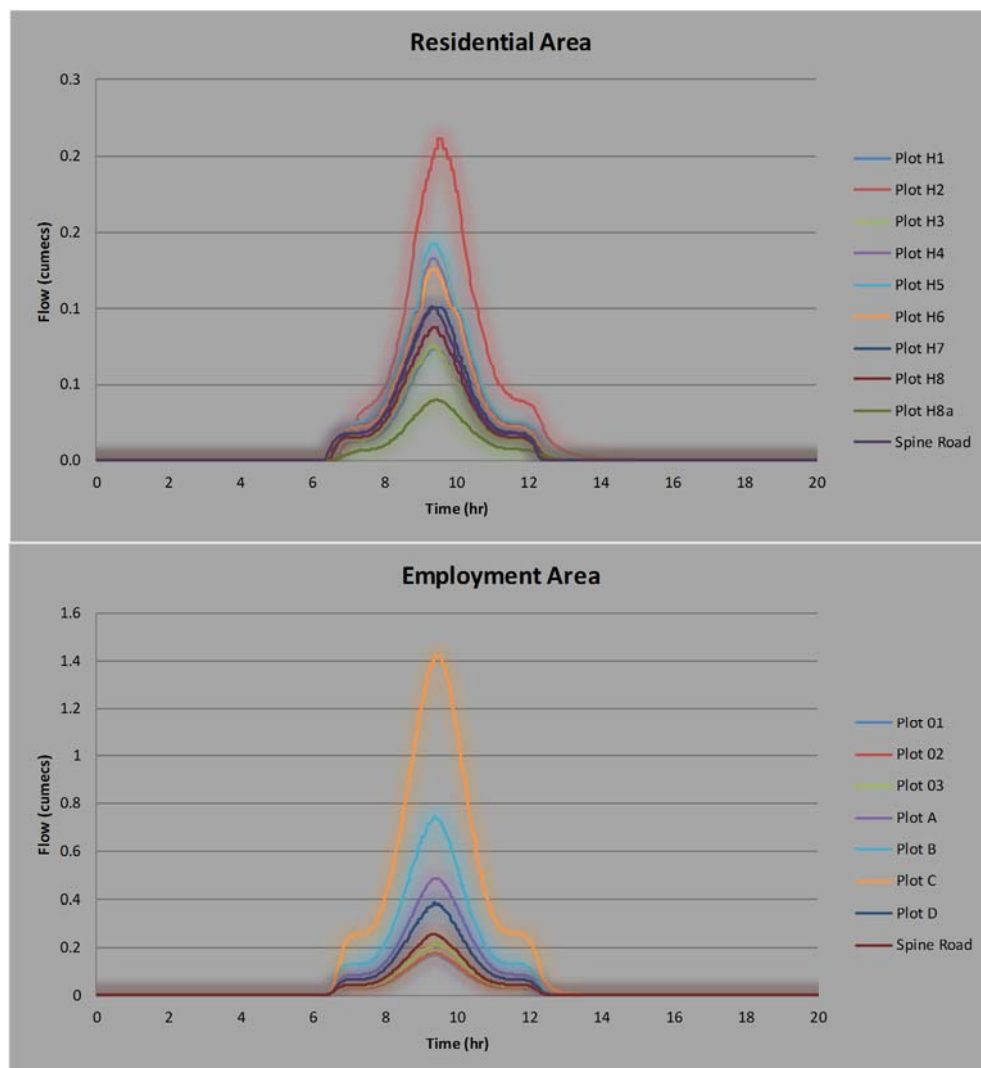


Figure 4: Surface Water Hydrographs – 360 Minute Duration

3.4 FLOOD RISK ELSEWHERE

The approved Weetwood fluvial hydraulic model has been updated to include the surface water hydrographs for the development plots and spine road. Peak flows for the fluvial hydrographs for Northern Drain and Shotwick Brook have also been reduced by 0.287 cumecs and 0.068 cumecs respectively in the 1.0% AEP (2113) event, to ensure that runoff from the proposed impermeable area is not double-counted.

The hydraulic model has been used to assess the impact of the proposed development and associated surface water discharges on flood risk elsewhere. The hydraulic model has been run for the 1.0% AEP (2113) event including both the 15 minute and 360 minute duration surface water hydrographs.

The simulation including the 15 minute duration surface water hydrographs generates lower peak flood levels than the simulation including the 360 minute duration surface water hydrographs. This is because peak surface water flows coincide with peak fluvial flows more closely in the 360 minute duration storm and total runoff volumes are greater.

Model results plots presenting flood depths and extents are provided in **Appendix B** and a comparison of pre and post development flood risk is provided in **Appendix C**.

The model results indicate that the proposed development generally reduces flood risk elsewhere, with no change in flood risk depicted where flood depths do not reduce. It should be noted that a hydraulic modelling tolerance of ± 0.03 m has been used to identify areas of 'no change', as was agreed with FCC in October 2015²⁸.

3.5 PLOT DRAINAGE DESIGN PRINCIPLES

The hydraulic modelling has shown that surface water can be discharged unrestricted from the proposed development plots using traditional drainage systems, without increasing flood risk elsewhere.

To ensure that the results remain valid for the purposes of future SAB applications, plot drainage designs should generally accord with the criteria presented by **Table 2**.

Significant deviation from the plot drainage design principles, such as a substantial increase in the proposed impermeable area at the site, may require the impact of development on flood risk elsewhere to be reassessed. Alternatively, additional attenuation storage could be provided within the development plots.

Table 2: Plot Drainage Design Principles

Plot	No. of Discharge Points	Estimated Impermeable Area (ha)	Impermeable Area Used to Date (ha)	Remaining Impermeable Area (ha)
H1/2/8	3	4.407	4.407	0
H3	1	1.010	0	1.010
H4	1	1.781	0	1.781
H5	1	1.913	0	1.913
H6	1	1.686	0	1.686
H7	1	1.393	0	1.393
H8a	1	1.173	0	1.173
01	2	2.236	0	2.236
02	2	2.379	0	2.379
03	2	2.907	0	2.907
A	4	6.105	6.105	0
B	4	9.962	0	9.962
C	4	19.477	0	19.477
D	2	5.154	0	5.154
Spine Road	-	4.779	2.937	1.842
Total		66.362	13.449	52.913

3.6 WATER QUALITY TREATMENT

The network of swales and open channels at the site will provide water quality benefits by removing pollutants via filtration and sedimentation. Additional treatment stages should be introduced across the commercial and industrial plots, in the form of by-pass separators to treat the first flush at the commencement of a storm event.

Catch-pit manholes should be incorporated into the drainage systems serving the residential plots and proprietary treatment systems, such as vortex separators, may also be considered.

²⁸ Email from Flintshire County Council to Weetwood dated 20 October 2015

3.7 MANAGEMENT AND MAINTENANCE

It is expected that each premises within the commercial and industrial plots will be served by independent surface water drainage systems, with maintenance responsibilities resting with the occupier of the premises.

Under the requirements of Schedule 3 of the Flood and Water Management Act 2010, it is expected that the drainage systems serving the residential plots will be offered for adoption by FCC as the SAB.

A management company has been created to maintain the network of swales and open channels at the site, as detailed by the Drainage Maintenance and Management Plan provided in **Appendix D**.

4 SUMMARY

This Surface Water Drainage Assessment report has been prepared to define the overarching strategy for the management of surface water runoff at The Airfields, taking into account development that has been completed or approved.

The design of surface water drainage infrastructure associated with future reserved matters applications at the site should accord with the principles set down within this report. It is understood that FCC will assess future SAB applications against these criteria and that significant deviation may require this assessment to be updated.

Impermeable areas at the site have been estimated based upon the proposed development types, with more precise calculations provided where detailed layouts have been developed. The total proposed impermeable area is estimated to be 66.4 ha.

It is proposed discharge surface water runoff generated by the proposed impermeable areas unrestricted to the network of swales and open channel that have been or are soon to be constructed. These features will provide the attenuation storage that is required to ensure that flood risk elsewhere does not increase as a result of the proposals.

The approved Weetwood fluvial hydraulic model has been updated to include the surface water hydrographs associated with the proposed development. The hydraulic model has been used to assess the 1.0% AEP (2113) event including both the 15 minute and 360 minute duration surface water hydrographs.

The model results indicate that the proposed development generally reduces flood risk elsewhere, with no change in flood risk depicted where flood depths do not reduce.

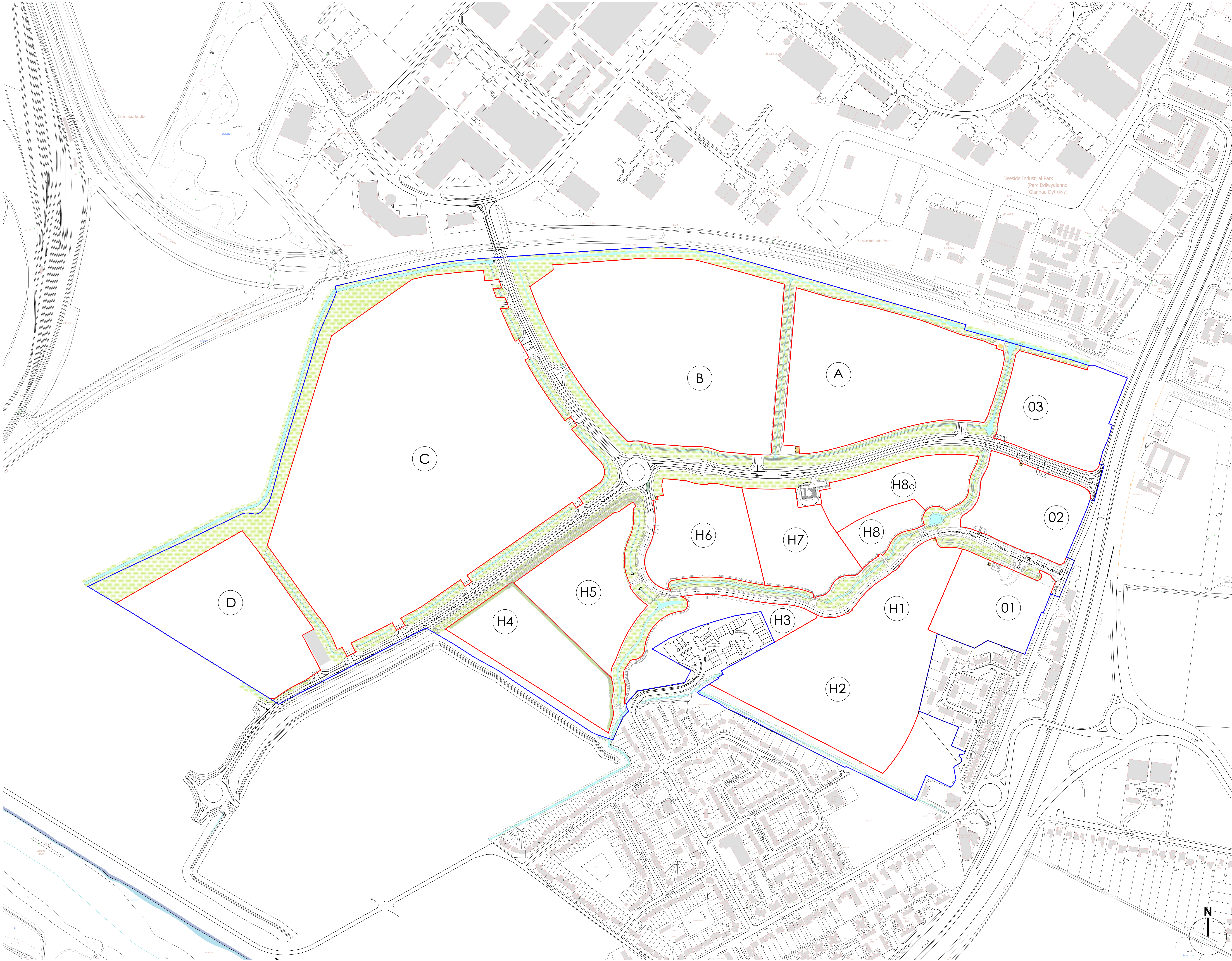
The network of swales and open channels at the site will also provide water quality benefits by removing pollutants via filtration and sedimentation. Additional treatment stages should be introduced, in the form of by-pass separators, catch-pit manholes and vortex separators may also be considered.

It is expected that each premises within the commercial and industrial plots will be served by an independent surface water drainage system, with maintenance responsibilities resting with the owner or occupier of the premises.

It is expected that the drainage systems serving the residential plots will be offered for adoption by FCC as the SAB, whilst the network of swales and open channels at the site will continue to be maintained by a management company.

APPENDIX A:

Plot Boundaries Masterplan



General Notes

All site dimensions shall be verified by the Contractor on site prior to commencing any works.

Do not scale from this drawing.

Only work to written dimensions.

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Note

This drawing is for information purposes only and is not to be used as a contract drawing

SCHEDULE OF AREAS		
Plot 1	23,560 sqm	5.82 Acres
Plot 2	25,036 sqm	6.19 Acres
Plot 3	30,560 sqm	7.55 Acres
Plot A	71,402 sqm	17.64 Acres
Plot B	110,650 sqm	27.34 Acres
Plot C	218,180 sqm	53.91 Acres
Plot D	49,954 sqm	12.34 Acres
Plot H1 & H2	76,465 sqm	18.89 Acres
Plot H3	16,843 sqm	4.16 Acres
Plot H4	29,689 sqm	7.34 Acres
Plot H5	31,863 sqm	7.87 Acres
Plot H6	27,969 sqm	6.91 Acres
Plot H7	23,212 sqm	5.74 Acres
Plot H8	8,380 sqm	2.07 Acres
Plot H8a	19,553 sqm	4.83 Acres
TOTAL PLOT AREA	763,316 sqm	188.62 Acres
OWNERSHIP AREA	987,370 sqm	243.98 Acres

Revision

Scale1:2000@A0

StatusSKETCH

Drawn byAE

Date13.10.2020

ClientCRAG HILL ESTATES LTD

ProjectTHE AIRFIELDS, DEESIDE

Drawing DescriptionBOUNDARIES MASTERPLAN

Drawing No.13001-SK245Rev. /

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Architects | Master Planners | Designers

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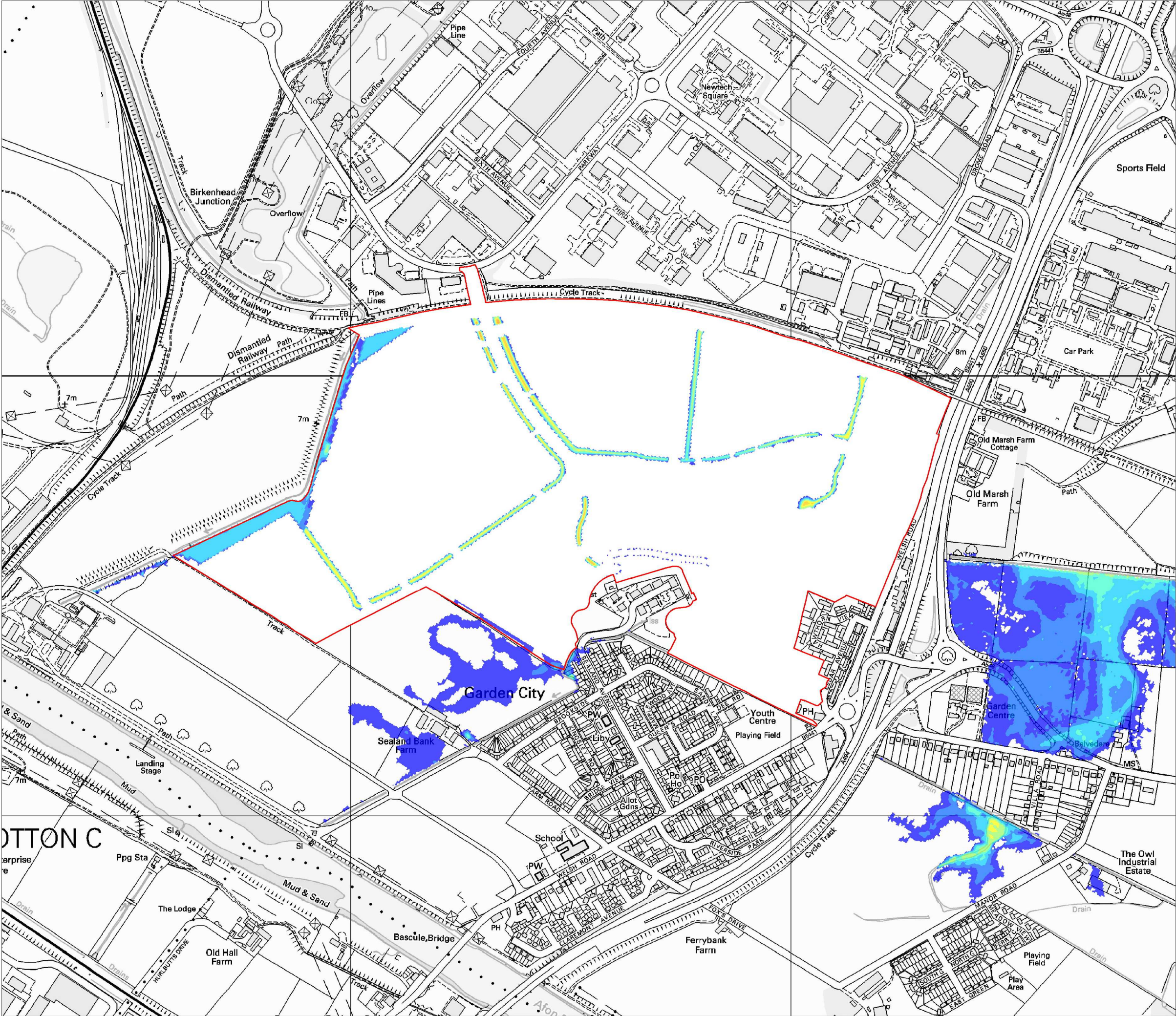
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APPENDIX B:

Model Output Plots – Flood Depths



- Notes:
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KEY:

— Site Location

- Depth (metres)
- 0.00 to 0.25
 - 0.25 to 0.50
 - 0.50 to 0.75
 - 0.75 to 1.00
 - 1.00 to 1.25
 - 1.25 to 1.50
 - 1.50 to 1.75
 - 1.75 to 2.00
 - 2.00 to 2.25
 - 2.25 to 2.50
 - > 2.50

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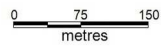
70 Cowcross Street
London
EC1M 6EJ

Tel: 0203 757 5444
Email: info@weetwood.net

Client:
Crag Hill Estates Ltd

Project Title:
The Airfields, Deeside

Drawing Title:
**Site Wide Scheme
SW (360 min) - 1.0% AEP (2113)**

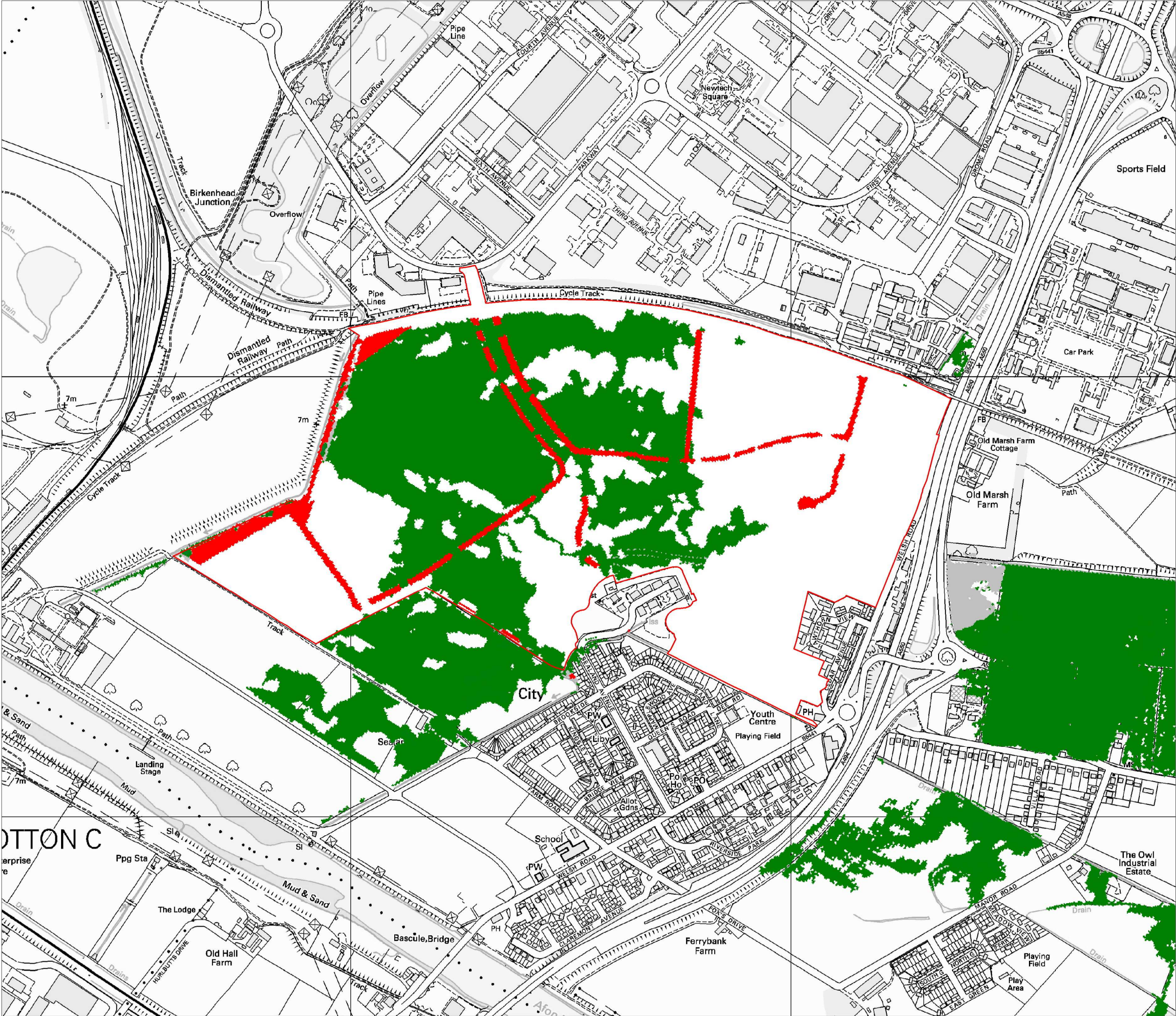
Map Orientation:
 Scale:


Drawn: JA	Checked: KT	Date: 14 October 2020
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APPENDIX C:

Model Output Plots – Flood Risk Comparison



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KEY:

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Change in Depth

- Decrease (> 0.03m)
- No Change (+/- 0.03m)
- Increase (> 0.03m)

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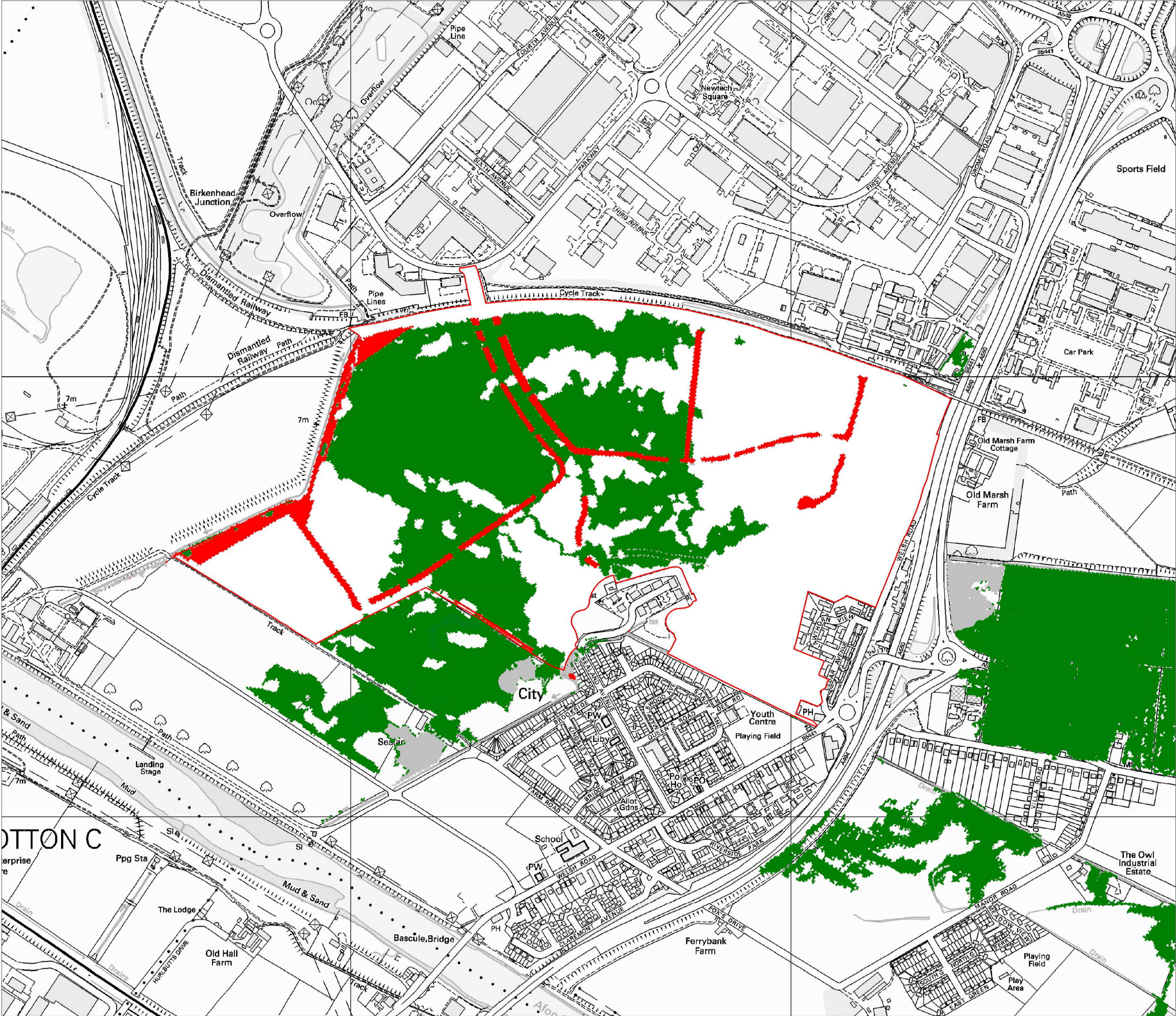
Project Title:
The Airfields, Deeside

Drawing Title:
**Comparison of Flood Risk
Site Wide Scheme
SW (15 min) - 1.0% AEP (2113)**

Map Orientation:  Scale: 

Drawn: JA	Checked: KT	Date: 14 October 2020
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Drawing No: 2097_416-064_1.0%(2113)_d	Rev: A
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Change in Depth

- Decrease (> 0.03m)
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- Increase (> 0.03m)

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Project Title:
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Drawing Title:
**Comparison of Flood Risk
Site Wide Scheme
SW (360 min) - 1.0% AEP (2113)**

Map Orientation:  Scale: 

Drawn: JA	Checked: KT	Date: 14 October 2020
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Drawing No: 2097_417-064_1.0%(2113)_d	Rev: A
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APPENDIX D:

Drainage Maintenance and Management Plan



DRAINAGE MAINTENANCE AND MANAGEMENT PLAN

Attenuation Swale and Culverts The Airfields Deeside

Reference

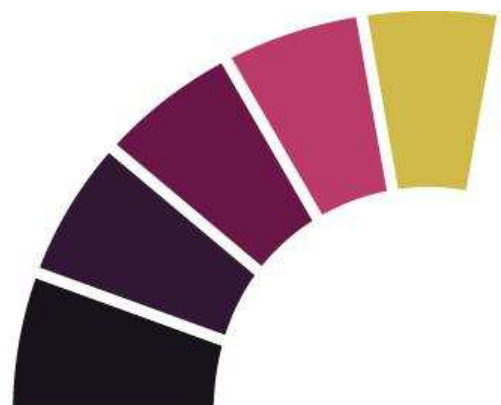
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Date

13 December 2018

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3.0	Swale Culverts and Headwalls	3
4.0	Consents and Licenses	4
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6.0	Record History	4



1.0 INTRODUCTION

The surface water attenuation swale system proposed as part of the works is shown on JPG drawings 3759.1-D1 to -D6 Inc. (copies attached). Regular maintenance and inspections are required to ensure the long-term efficiency of the swale system.

All works should be undertaken by suitably qualified personnel and waste should be treated and removed by an appropriately registered company.

The following document provides details of maintenance of the fluvial channel and new culvert structures for details of maintenance of the landscaping reference should be made to the following Barnes Walker Limited documents:

- Phase 1 Enabling Works Landscape Management Plan.
- Phase 1 Enabling Works Landscape Management Schedules.

The following party is responsible for the management and maintenance of the surface water attenuation swale system:

The Airfields Management Company Limited
c/o Praxis Real Estate Management Limited
13 Police Street
MANCHESTER
M2 7LQ

Telephone: 0161 839 9454

The Airfields Management Company Limited is owned by the landowner, as each plot of land is sold off the plot owners become a shareholder in the management company whilst the landowner retains the majority share. Each plot owner will pay a service charge for the maintenance and management of the site. The management company will employ a facilities management company to act on its behalf ensuring maintenance is undertaken.



2.0 SWALE CHANNEL

Regular inspection and maintenance is important for the effective operation of the attenuation swale. CIRIA's SUDS manual C753 Table 17.1 recommends the following maintenance regime for swales:

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut Grass – to retain grass height within specific design range.	Monthly (during growing season), or as required.
	Manage other vegetation and remove nuisance plants.	Monthly at start, then as required.
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly.
	Inspect vegetation coverage.	Monthly for 6 months, quarterly for 2 years, then half yearly.
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.	Half Yearly.
Occasional maintenance	Resend areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more of the swale treatment area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeding.	As required.
	Relevel uneven surfaces and reinstate design levels.	As required.
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	As required.
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required.
	Remove and dispose of oils or petrol residues using safe standard practices.	As required.

This regime can be tailored to suit the swale dependant on final landscaping details and many of the maintenance activities may be undertaken as landscaping maintenance.



3.0 SWALE CULVERTS AND HEADWALLS

Regular inspection of the culverts and headwalls is important to obtain snapshots of conditions and performance related information about the culverts and their associated systems.

Inspection should be undertaken by suitably qualified personnel with experience in such work. Risk Assessment and Method Statements shall be prepared by the specialist prior to undertaking works.

CIRIA's Culvert Design and Operation Guide C689 Table 17.1 recommends the following inspection regime for culverts:

Inspection type	Details of inspection
Superficial inspection	The purpose of a superficial inspection is to identify and report obvious defects, which if ignored might lead to collapse, blockage, accidents or high maintenance and repair costs. The inspection will normally be carried out without entry. (Recommended frequency – Every 3 months for the first 12 months following construction, followed by every 6 months thereafter).
General inspection	This inspection requires the examination of all parts of the structure that can be inspected without the use of access or specialist inspection equipment. Visual aids such as binoculars can be used where necessary. General inspections will normally be carried out without entry. (Recommended frequency – Every 2 years)
Principal inspection	This inspection comprises a close examination, within touching distance, of all accessible parts of a structure. This should include adjacent earthworks and waterways where relevant to the performance of the structure. A principal inspection should use as necessary suitable inspection techniques, access and/or traffic management works. Suitable inspection techniques for a principal inspection include hammer tapping to detect loose concrete cover and brickwork and paint thickness measurements. Testing is not a requirement for a principal inspection. The inspection should be undertaken with man-entry with the qualified engineer accompanied by a confined spaces team where appropriate. If culverts that cannot be safely inspected by man-entry, the inspection could be undertaken remotely by CCTV and the findings recorded by a suitably competent operator (Recommended frequency – Every 6 years)
Special inspection	Any other inspection required from those not listed here, usually as a recommendation following one of the above inspections or, for example, after very high flows or loading or an earthquake.

Following inspection remedial works may be required, the following lists culvert/headwall remedial actions;

Required Action	Frequency
Remove litter and debris	As required.
Inspect headwall and culvert base for silt accumulation, establish appropriate silt removal frequencies. Particular attention should be taken not to remove the natural bed formed on the base of the headwall/culvert.	Half Yearly.
Repair erosion or other damage to gabion mattress.	As required.
Repair damage to handrail to headwall.	As required.
Structural defects/assessment of scour – Remedial actions/repairs to be advised by a specialist.	As required.



4.0 CONSENTS AND LICENSES

Garden City Drain is a watercourse designated as a 'main river' as such certain maintenance activities will require a bespoke Flood Risk Activity Permit under the Environmental Permitting Regulations (England & Wales, 2016). Further information and guidance about this is available on our website at: <http://www.naturalresources.wales/permits-and-permissions/flood-risk-activities/guidance/?lang=en>

5.0 HEALTH AND SAFETY

Employers shall, so far as is reasonably practical, provide and maintain systems of work that are safe and without risks to health. The systems of work shall cover all aspects of the works including above-ground operations, access to the culverts including all operations in the confined spaces.

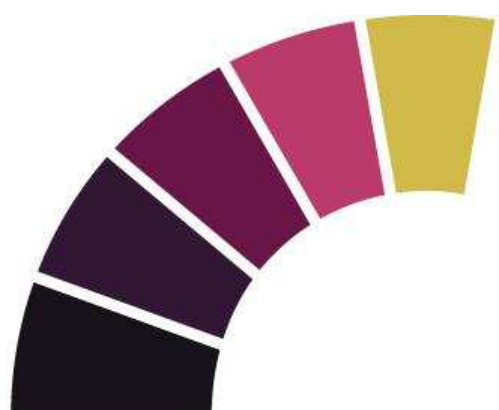
6.0 RECORD HISTORY

The Airfields Management Company will be responsible for recording and updating details of prior maintenance and operations, which can be made available for future reference.

The Airfields Management Company will also be responsible for scheduling future maintenance in accordance with the necessary requirements of each component, create a fixed timetable of routine checks and ensure that the maintenance is undertaken appropriately.

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Sequential, Justification and Exception Tests
Utility Assessments
Expert Witness and Planning Appeals
Discharge of Planning Conditions

Appendix 3.2 – Marine Discharges Assessment



Paper Mill Facility, Plot C Airfields, Northern Gateway

Industrie Cartarie Tronchetti (ICT) UK Limited and Crag
Hill Estates Limited (CHEL)

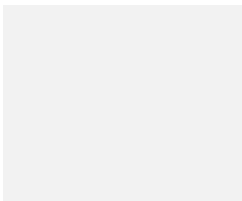
Marine Discharges Assessment

Document Ref: Appendix 3.2

Revision: 02

SEPTEMBER 2021

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Paper Mill Facility, Plot C Airfields, Northern Gateway

Marine Discharges Assessment

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Checker	Hywel Roberts
Reviewer	Russell Green
Approver	Gavin Winter
Document Ref.	Appendix 3.2
Date	SEPTEMBER 2021

Version Control

Version	Date	Author	Checker	Reviewer	Approver	Changes
01	19/08/21	LD	HR	RG		
02	16/09/21	LD				Updates to address review comments

This report dated 16 September 2021 has been prepared for Industrie Cartarie Tronchetti (ICT) UK Limited and Crag Hill Estates Limited (CHEL) (the "Client") in accordance with the terms and conditions of appointment (the "Appointment") between the Client and Arcadis UK ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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APPENDIX A

Water Quality Data for Proxy Paper Mill Site

APPENDIX B

H1 Screening Test Results

1 Introduction

1.1 Background

Arcadis Consulting (UK) Limited ('Arcadis') has been commissioned by Industrie Cartarie Tronchetti UK Limited (ICT) to undertake a preliminary discharge impact assessment. The assessment informs an application for consent to trade effluent to the Dee estuary from a proposed tissue paper processing and production facility at the Airfield Site, part of the Northern Gateway in Queensferry, Flintshire.

1.2 Aims and Objectives

The aims of this desk study were to:

- Define the expected water quality of the proposed paper mill trade discharge.
- Characterise the existing water quality of the Dee estuary local to the proposed site of the paper mill discharge and determine its current Water Framework Directive (WFD) status.
- Apply the Natural Resource Wales (NRW) H1 surface water pollution risk assessment screening tests for estuaries and coastal waters¹.
- Produce a technical note detailing the findings of the study to support the environmental permit application.

¹ <https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit>

2 Site Overview

2.1 Site Description

The proposed paper mill site is located approximately 0.4km from the northern bank of the River Dee at approximate National Grid Reference (NGR) 332163, 369962. Adjacent to the site, the river is canalised between substantial earth embankments and its flow regime is tidally dominated. The Dee estuary is a designated nature conservation site comprising a Special Area of Conservation (SAC) and Site of Specific Scientific Interest (SSSI).

The effluent from the paper mill would be treated on site and discharged from a single outfall to the Dee estuary. The location for the discharge to the Dee estuary currently being considered is understood to be at National Grid Reference (NGR): 331835, 368995, as shown in Figure 2-1.



Figure 2-1 Proposed Paper Mill Discharge Location (red dot)

The tidal range in the Dee estuary is detailed in Table 2-1 for Connah's Quay, which is the closest secondary port to the site.

Table 2-1 Tidal Water Levels in the Dee Estuary at Connah's Quay Secondary Port²

Tidal State	Water Level (mAOD*)
Lowest Astronomical Tide (LAT)	-0.75
Mean Low Water Spring (MLWS)	-0.75
Mean Low Water Neap (MLWN)	-0.75
Mean Sea Level (MSL)	-0.75
Mean High Water Neap (MHWN)	2.25

² Sefton Council, December 2013 North West Estuaries Processes Reports, Dee Estuary.

Mean High Water Spring (MHWS)	3.95
Highest Astronomical Tide (HAT)	4.85

*meters above Ordnance Survey Datum (mAOD)

Bathymetry data that Arcadis hold (original source unknown) for the river reach adjacent to the proposed paper mill show that bed levels range from approximately 0.1 mAOD to 0.2 mAOD.

The tidal water level data detailed in Table 2-1 shows that for much of the tidal cycle, the water levels in the area of the proposed discharge are below the riverbed levels, therefore, the depth of water would be determined by the river flow during these tidal conditions.

The peak water depths along the section of the Dee estuary that the discharge would be located range from 2.05 to 2.15m during MHWN and from 3.75 to 3.85 m during MHWS tidal conditions.

2.2 River Dee Flow Data

River Dee flows have been estimated at the tidal limit at Chester using Wallingford Hydrosolutions LowFlows software. Results were cross checked against the river flow record at Chester Suspension Bridge gauging station, located just upstream. The flow statistics from the gauging station data record provide confidence in the flow statistics produced by the LowFlows software.

The key flow data are summarised below:

- Annual mean flow – 38.7m³/s.
- Mean winter flow (October to March inclusive) – 58.9 m³/s.
- Mean summer flow (April to September inclusive) – 18.7m³/s.
- 95 percentile (Q95) low flow – 3.7m³/s.

2.3 Water Framework Directive Status for the Dee Estuary

Standards for the Dee (transitional waters) waterbody (ID GB531106708200: Dee N. Wales) are recorded in the Dee River Basin Management Plan (RBMP)³. The Dee is classified as a Heavily Modified Waterbody (HMWB).

Its current Water Framework Directive (WFD) Status is reported in the WFD River Basin District Cycle 2 Rivers and Waterbodies dataset. The WFD Overall Status of the River Dee Transitional waterbody is Moderate. The Chemical Status of the River Dee is characterised as a Fail. The target water body status is to achieve 'Good' by 2021.

2.4 Water Quality Data for the Dee Estuary

Water quality data for the Dee estuary recorded at Queensferry Blue Bridge (NGR: 332200, 368700) over the period 2000 to 2014 were obtained from NRW for use in the current study (NRW data reference ATI 17938a).

These data have been used to define the background parameter concentrations in the screening tests (see Section 3).

2.5 Water Quality Data for the Proposed Paper Mill Discharge

There are no data available to characterise the paper mills operational discharge as the facility has not been constructed. Therefore, it was agreed in discussion with NRW, that data from a proxy site could be used. This was on condition that the proxy site selected was similar in its operational capacity and manufacturing process and processed a similar quality of raw materials.

Data for the proxy was supplied by ICT for a site in France that is understood to be a similar type plant as the one proposed in Queensferry. Water quality samples were obtained monthly over a 12 month

³ <https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3127>

period in 2018. The discharge data has been reviewed and the key water quality parameters are summarised in Table 2-2. Additional analysis was undertaken quarterly, including analysis for a range of metals, and the results are summarised in Table 2-3. The original laboratory certificates are given in Appendix A.

The results of the additional metal analysis (Table 2-3) show that the concentrations were generally below the limit of detection (LOD), therefore, an accurate assessment of the impact of these parameters on the receiving water is not possible. In order to obtain an indication of the potential risk to the Dee estuary that the discharge may pose, the maximum recorded metal concentrations have been adopted in the screening tests and, where the maximum measurements are below the LOD, the LOD values have been adopted. This provides a worst-case approach.

The measured values of adsorbable organic halogens (AOX) have also been given in Table 2-2 for information purposes. However, as no environmental quality standard (EQS) has been identified for this parameter, it has not been included in the screening tests.

Table 2-2 Paper Mill Discharge Data – Monthly Sample Results for the Proxy Site

Sample Date	Temperature (°C)	pH	Total Ammonia (mg N/l)	Unionised Ammonia ^a (mg N/l)	NO ₂ (mg N/l)	NO ₃ (mg N/l)	Dissolved Inorganic Nitrogen (DIN) ^b (mg N/l)	Phosphorous (mg P/l)	BOD (mg/l)	Adsorbable Organic Halogens (AOX) (µg/l)
10/01/2018	23.9	7.8	< 0.389	< 0.013	0.021	1.45	< 1.860	< 0.1	< 3	170
07/02/2018	13.1	7.8	< 0.389	< 0.006	0.022	2.9	< 3.311	< 0.1	< 3	360
14/03/2018	20.3	7.7	0.702	0.014	0.02	3.09	3.812	0.154	< 3	410
04/04/2018	23.4	7.5	< 0.389	< 0.006	0.343	3.49	< 4.222	< 0.01	36	500
02/05/2018	7.9	7.9	< 0.389	< 0.005	0.023	0.81	< 1.222	0.156	3.7	480
06/06/2018	10.1	7.7	< 0.389	< 0.004	0.082	1.72	< 2.191	< 0.1	7.73	290
04/07/2018	NR	6.7	< 0.389	NR	0.037	1.47	< 1.901	< 0.1	< 3	510
08/08/2018	9.4	7.3	< 0.389	< 0.001	0.031	1.76	< 2.180	< 0.1	3.1	340
05/09/2018	9.6	7.4	< 0.389	< 0.002	0.03	1.4	< 1.819	0.127	3	320
03/10/2018	8.7	6.8	0.702	0.001	0.028	0.98	1.710	0.275	10	820
07/11/2018	8.3	7.3	< 0.389	< 0.001	0.137	6.15	< 6.676	< 0.1	7	790
12/12/2018	7.2	8.2	1.21	0.028	0.031	0.94	2.181	0.136	4	600
Mean	12.9	7.5	< 0.510	< 0.007	0.07	2.18	< 2.757	< 0.122	< 7.21	466
Maximum	23.9	8.2	1.21	0.028	0.343	6.15	6.676	0.275	36	820

^a Unionised ammonia has been calculated from measured values of total ammonia, temperature and pH.

^b DIN has been calculated by summing the measured values of total ammonia, NO₂ and NO₃. NR – No result

Table 2-3 Paper Mill Discharge Data – Quarterly Results for Total Metals Recorded at the Proxy Site

Sample Date	Specific Pollutants					Priority Substances			
	Iron (mg/l)	Arsenic (mg/l)	Zinc (mg/l)	Chrome (mg/l)	Copper (mg/l)	Cadmiun (mg/l)	Mercury (mg/l)	Lead (mg/l)	Nickel (mg/l)
10/01/2018	< 0.02	< 0.01	< 0.01	< 0.005	< 0.005	< 0.002	< 0.0005	< 0.01	< 0.01
04/04/2018	< 0.02	< 0.01	< 0.01	< 0.005	< 0.005	< 0.002	< 0.0005	< 0.01	< 0.01
04/07/2018	< 0.02	< 0.01	< 0.01	< 0.005	< 0.005	< 0.002	< 0.0005	< 0.01	< 0.01
03/10/2018	0.02	< 0.01	0.01	< 0.005	< 0.005	0.003	< 0.0005	0.02	< 0.01

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Mean	< 0.02	< 0.01	< 0.01	< 0.005	< 0.005	< 0.00225	< 0.0005	< 0.0125	< 0.01
Maximum	0.02	< 0.01	0.01	< 0.005	< 0.005	0.003	< 0.0005	0.02	< 0.01

Note: Results are believed to be measures of total metal concentration rather than dissolved (i.e. bioavailable) concentrations.

2.6 Target Water Quality Standards for the Dee Estuary

The current study has been undertaken to assess the impact of the proposed discharge against water quality standards for both estuaries and rivers.

The water quality data for the proxy paper mill site were reviewed to determine what pollutants it may contain that could be a potential risk to the receiving waters. The corresponding EQS's for 'Good' status (i.e. the WFD target for the Dee estuary) for these pollutants in estuaries and rivers have been listed in Table 2-4. These standards have been derived from the Water Framework Directive (Standards and Classification) 2015⁴.

It stated in the H1 Annex D2⁵, there are no temperature standards defined for estuaries. However, there are assessment criteria for predicting the mixing zone for thermal discharges in estuaries. NRW should be consulted to confirm any requirements for assessing the extent of the thermal mixing zone.

⁴ http://www.legislation.gov.uk/uksi/2015/1623/pdfs/ukiod_20151623_en_auto.pdf

⁵ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/489146/H1_annex_D2.pdf

Table 2-4 *Environmental Quality Standards Adopted in Current Study for 'Good' Status*

Parameter	'Good' Threshold Value	Comment
Temperature (°C)	23	Temperature standards for a salmonid river ⁶ . Maximum allowable temperature as an annual 98 percentile.
	3	Maximum allowable change in temperature in relation to the ambient river temperature as an annual 98 percentile standard.
Ammonia (mg N/l)	0.6	Standard for rivers of Type 7 (i.e. low altitude and high alkalinity) – 90 percentile.
BOD (mg/l)	5	BOD standard for rivers – 90 percentile.
Phosphorous (mg P/l)	0.094	Annual Average (AA) reactive phosphorous standard for rivers. Threshold calculated based on altitude and alkalinity.
DIN (mg N/l)	2.522	Standard for estuaries that are classed as 'Turbid'. 99 percentile for the period 1 st November to 28 th February. The standard is given as 180 micromoles per litre - this has been converted to mg/l based on molecular weight of nitrogen.
Unionised Ammonia (mg N/l)	0.021	Long term mean standard for saltwater.
pH	≥6 to ≤9	Standard for all rivers. 5 and 95 percentile standard.
Lead (mg/l)	0.0012	AA standard. Dissolved bioavailable.
Mercury (mg/l)	0.00007	Maximum Allowable Concentration (MAC) standard for total mercury.
Copper (mg/l)	0.00376	Long term mean standard for saltwater. Dissolved bioavailable. The lowest concentration has been adopted as a worst case as there is insufficient data to define the dissolved organic carbon (DOC) concentrations.
Zinc (mg/l)	0.0079	Long term mean standard for saltwater. Dissolved concentration. Standard is 0.0068 mg/l plus ambient background concentration with a recommended value for saltwater of 0.0011mg/l.
Nickel (mg/l)	0.004	AA standard. Dissolved bioavailable.
Chromium (mg/l)	0.0006	Long term mean standard for saltwater. Dissolved concentration.

⁶ <https://naturalresources.wales/guidance-and-advice/business-sectors/fisheries/know-your-rivers-salmon-and-sea-trout-catchmentsummaries/?lang=en>

Arsenic (mg/l)	0.025	Long term mean standard for saltwater. Dissolved concentration.
Cadmium (mg/l)	0.000025	AA standard for total cadmium. River Class 5 (i.e. ≥ 200 mg CaCO ₃ /l) assumed as no data.
Iron (mg/l)	1	Long term mean standard for saltwater. Dissolved concentration.

3 Surface water pollution risk assessment

The H1 screening tests that have been undertaken for the proposed discharge to the Dee estuary are detailed in this Section. The assessment has been done for those parameters that are likely to be contained within the proposed discharge, as identified from the proxy site data, and for which EQS have been identified for the receiving water.

Given the tidal nature of the Dee, the impact of the paper mill discharge on receiving water quality would vary significantly depending on tidal conditions. In order to assess a likely worst-case, the screening tests have been undertaken assuming low tide conditions and a Q95 river flow, as this combination provides the minimum level of dilution of the discharge effluent.

The values adopted in the screening tests are given in Table 3-1 and 3-2 for the paper mill discharge and receiving water, respectively.

Table 3-1 *Paper Mill Discharge Values Adopted in the Screening Tests*

Parameter	Value	Comment
Discharge flow (l/s)	60	Maximum expected flow rate for the two development phases operating in parallel i.e. worstcase flow rates.
Temperature (°C)	30.0	Maximum expected temperature as confirmed by ICT. Note: this is higher than the 23.9 °C maximum temperature recorded at the proxy site.
Dissolved Inorganic Nitrogen (DIN) (mg/l)	2.757	Average values from the 12-month sample data recorded at the proxy paper mill site.
Unionised Ammonia (mg/l)	0.007	
Ammonia (mg/l)	0.510	
BOD (mg/l)	7.21	
Phosphorous (mg/l)	0.122	
Lead (mg/l)	0.0125	Average values recorded for each metal in the quarterly measurements made at the proxy paper mill site. N.B. Most of the measurements were above the LOD and therefore the vales adopted are an overestimate of the average metal concentrations.
Mercury (mg/l)	0.0005	
Copper (mg/l)	0.005	
Zinc (mg/l)	0.01	
Nickel (mg/l)	0.01	
Chromium (mg/l)	0.005	

Arsenic (mg/l)	0.01
Cadmium (mg/l)	0.00225
Iron (mg/l)	0.02

Table 3-2 River Dee values adopted in the screening tests

Parameter	Value	Comment
River Dee flow (l/s)	3,700	Q95 flow rate.
Temperature (°C)	12.73	Annual average temp recorded by NRW at Queensferry Blue Bridge.
DIN (mg/l)	2.061	Average DIN recorded by NRW for the months November to February.
Unionised Ammonia (mg/l)	0.015	Unionised ammonia has been calculated from the NRW measured total ammonia and temperature data. Note: pH measurements were not obtained by NRW during each total ammonia measurement therefore the average pH value of 8.6 was adopted for the unionised ammonia calculations.
Ammonia (mg/l)	0.182	Annual average ammonia recorded by NRW at Queensferry Blue Bridge.
BOD (mg/l)	4.62	Average BOD recorded by NRW at Queensferry Blue Bridge - N.B only 4 samples taken.
Phosphorous (mg/l)	0.101	Annual average orthophosphate recorded by NRW at Queensferry Blue Bridge.
Lead (mg/l)	0.0131	The NRW dataset only included two samples for total metals at Queensferry Blue Bridge. The maximum values have been adopted.
Mercury (mg/l)	0.000008	
Copper (mg/l)	0.00545	
Zinc (mg/l)	0.0402	
Nickel (mg/l)	0.00202	
Chromium (mg/l)	0.000422	The NRW dataset did not have any measurements of total cadmium therefore 50% of the EQS (which is for total cadmium rather than dissolved) has been adopted in the screening test, as per guidance.
Arsenic (mg/l)	0.001	
Cadmium (mg/l)	0.000125	
Iron (mg/l)	0.732	

3.1 Screening Test 1

Appendix B provides the screening test results that are summarised and discussed below.

The first screening test checks whether the concentration of the pollutant in the discharge is more than 10% of the EQS. If it's less than 10% there is no requirement to undertake the remaining three tests as the pollutant is not considered to pose a risk to the receiving water environment. If the level of pollutant in the proposed discharge is more than 10% of the EQS then Test 2 must be carried out.

The results of Screening Test 1 are given in Table 3-3. This shows that the level of pollutants in the discharge, with the exception of iron, all exceed 10% of the EQS and, therefore, Screening Test 2 should be undertaken.

Table 3-3 Screening Test 1 Results

Parameter	Release Concentration [RC]	Environmental Quality Standard [EQS] 'Good' Status	10% of EQS
Temperature (°C)	30.0	23.0	2.3
DIN (mg/l)	2.757	2.522	0.252
Unionised Ammonia (mg/l)	0.007	0.021	0.0021
Ammonia (mg/l)	0.51	0.6	0.06
BOD (mg/l)	7.21	5.0	0.5
Phosphorous (mg/l)	0.122	0.094	0.0094
Lead (mg/l)	0.0125	0.0012	0.00012
Mercury (mg/l)	0.0005	0.00007	0.000007
Copper (mg/l)	0.005	0.00376	0.000376
Zinc (mg/l)	0.010	0.0079	0.00079
Nickel (mg/l)	0.010	0.004	0.0004
Chromium (mg/l)	0.005	0.0006	0.00006
Arsenic (mg/l)	0.010	0.025	0.0025
Cadmium (mg/l)	0.0023	0.00025	0.000025
Iron (mg/l)	0.020	1.00	0.10

3.2 Screening Test 2

This test introduces the dilution available in the receiving water, using river flow and daily discharge volume data. The test checks whether the process contribution (PC) of the pollutant is more than 4% of the EQS (PC is the concentration of a discharged pollutant in the water after it's been diluted). The following steps are required to work out the PC:

- Multiply the effluent flow rate (EFR) by the release concentration of the pollutant in the effluent (RC).
- Add your value for the EFR to the river flow rate (RFR).
- Divide the result of step 1 by the result of step 2.

If the value for PC is 4% or less of the EQS there is no requirement to carry out Screening Test 3. However, if the PC is more than 4% of the EQS then Screening Test 3 is required.

The results of Screening Test 2 are given in Table 3-4. This shows that, with the exception of lead, mercury, chromium and cadmium, the discharge water quality is predicted to be within acceptable limits and, therefore, all other parameters are screened out of further assessment.

Table 3-4 Screening Test 2 Results

Parameter	EFR (l/day) x RC	EFR + RFR (l/day)	PC	4% of EQS
Temperature (°C)	155,520,000	324,864,000	0.48	0.92
DIN (mg/l)	14,292,288		0.044	0.10
Unionised Ammonia (mg/l)	36,288		0.0001	0.0008
Ammonia (mg/l)	2,643,840		0.008	0.024
BOD (mg/l)	37,376,640		0.115	0.20
Phosphorous (mg/l)	632,448		0.002	0.005
Lead (mg/l)	64,800		0.0002	0.000048
Mercury (mg/l)	2,592		0.00001	0.000003
Copper (mg/l)	25,920		0.00008	0.00015
Zinc (mg/l)	51,840		0.00016	0.000316
Nickel (mg/l)	51,840		0.00016	0.00016
Chromium (mg/l)	25,920		0.00008	0.000024
Arsenic (mg/l)	51,840		0.00016	0.001
Cadmium (mg/l)	11,664		0.00004	0.00001

3.3 Screening Test 3

Screening Test 3 has been undertaken to determine whether the discharge would be likely to increase the concentrations of lead, mercury, chromium and cadmium in the River Dee downstream of the discharge by more than 10% of their respective EQS values.

The predicted environmental concentration (PEC) in the water downstream of the discharge is a combination of the PC and background concentration. The steps to the H1 Screening Test 3 are as follows:

- Multiply EFR by RC.
- Multiply RFR by BC.
- Add the results of step 1 and 2 together.
- Add EFR to RFR.
- Divide the result from step 3 by the result from step 4.

The results of Screening Test 3 for the four parameters that failed Screening Test 2 are given in Table 3-5.

Table 3-5 Screening Test 3 for Lead, Mercury, Chromium and Cadmium

Parameter	EFR x RC	RFR x BC	Step 1 + Step 2	EFR+RFR	PEC	BC + 10% of EQS
Lead	0.75	48.47	49.22	3,760	0.01309	0.01322
Mercury	0.03	0.0296	0.06		0.000016	0.000015
Chromium	0.3	1.5614	1.861		0.000495	0.00048
Cadmium	0.135	0.4625	0.6		0.000159	0.00015

Whilst lead is screened out, the PEC's for the other three metals shown in Table 3-5 very slightly exceed the background concentration plus 10% of the EQS. It should be noted that the EQS standard for chromium and lead are the dissolved concentrations whereas the PEC's are for total chromium/lead.

As the results for these three metals only very slightly exceed the BC plus 10% EQS thresholds, together with the fact that most of the measured discharge concentrations were below the LOD (i.e. the values adopted are an overestimation of the likely average discharge concentrations) and the assessment has been undertaken for Q95 river flow rates, the proposed paper mill discharge is not considered a risk to the Dee estuary water quality.

In order to assess the potential impact of the discharge on the receiving waters during more typical river flow conditions, a further screening test was undertaken using the average summer river flow of 18.7 m³/s rather than the Q95. The results show that all parameters are screened out during these river flow conditions which supports the conclusion above.

It is considered that the parameters tested are screened out and, therefore, no further tests are required as part of the H1 risk assessment procedure.

3.4 Additional Temperature Assessment Tests

In order to provide information on the potential seasonal impact of the proposed discharge on the temperature of the receiving water, further analysis has been undertaken.

The largest temperature differential between the discharge and the receiving water would be expected to occur during winter, therefore, the conditions for river flow and temperature for winter have been assessed to ensure that the discharge would not cause the temperature of the receiving water to increase by more than the allowable 3 °C 'Good' status threshold.

As with the previous screening tests, the assessment has been undertaken assuming low tide conditions as this gives a worst case.

The parameter values adopted in this assessment are:

- Discharge temperature = 30 °C
- Discharge flow = 60 l/s
- Average winter River Dee flow (October to March inclusive) = 58,882 l/s
- Average winter River Dee temperature (October to March inclusive) = 8.1 °C

The mass balance H1 screening Test 3, as detailed in Section 3.3, has been used for this assessment and the results are given in Table 3-6.

Table 3-6 *Screening Test 3 - Winter Temperature Assessment*

Parameter	EFR x RC	RFR x BC	Step 1 + Step 2	EFR+RFR	PEC (°C)	Temperature increase downstream of discharge (°C)
Temperature (°C)	1,800	476,944	478,744	58,942	8.12	0.02

The results given in Table 3-6 show that the proposed discharge is predicted to result in only a small increase in the Dee estuary temperature downstream of the discharge, and well within the 3°C maximum allowable increase for the 'Good' standard for salmonid rivers.

4 Conclusion and Recommendations

Consultation with NRW has confirmed that there are no specific additional conditions on a discharge that would be applied due to the environmental designations and sensitivities of the River Dee.

Following the three stages of H1 screening tests, the majority of parameters in the proposed discharge are screened out.

Three metals are not screened out at Test 3. However, there are only very marginal exceedances of the BC plus 10% EQS thresholds. Most of the measured discharge concentrations of these metals at the proxy site were below the LOD, therefore the values applied in the tests are an overestimation of their likely average discharge concentrations. Also, the assessment has been undertaken for a Q95 river flow condition.

When taking these factors into account, it is concluded that, even during low tide and low river flow conditions, the proposed paper mill discharge would not result in unacceptable water quality impacts within the receiving water.

APPENDIX A

Water Quality Data for Proxy Paper Mill Site

APPENDIX B

H1 Screening Test Results

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