Outline Surface Water Drainage Strategy (Tracked Change)

HyNet Carbon Dioxide Pipeline DCO

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulations 8(1)(c)

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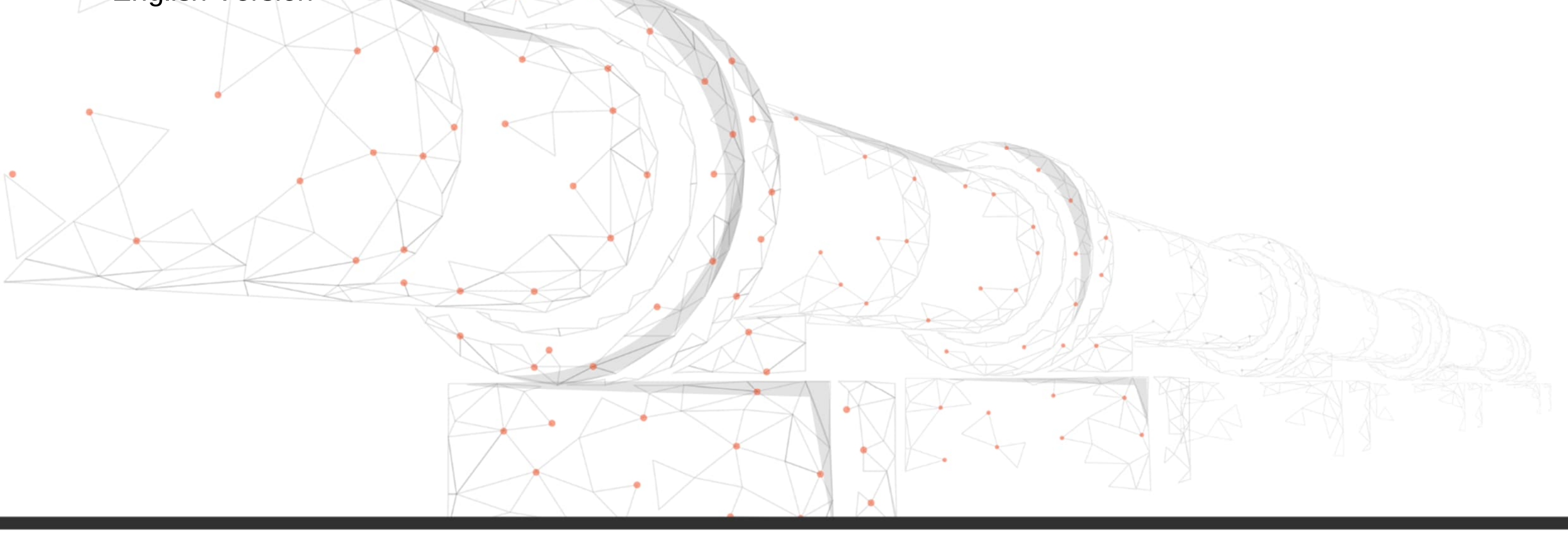

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TABLE OF CONTENTS

FIGURES

TABLES

ANNEXES

1. EXECUTIVE SUMMARY

1.1.1. The Development Consent Order (DCO) Proposed Development will form part of the HyNet North West Project (the Project) with the aim to reduce Carbon Dioxide (CO_2) emissions from the industry, homes and transport and support economic growth in the North West of England and North Wales.

1.1.2. This Report was developed to support the DCO Application covering four Above Ground Installations (AGIs) developments along Ince Above Ground Installation (AGI) to Flint AGI Pipeline and six Block Valve Stations (BVSs); three located along the Stanlow AGI to Flint AGI Pipeline and three located along the Flint Connection to Point of Ayr (PoA) Terminal Pipeline.

1.1.3. This Report outlines the key surface water principles for the DCO Proposed Development as well as providing monitoring, management, operation, and maintenance plan.

1.1.4. All proposed drainages have been designed in accordance with local policy, local Sustainable Drainage System (SuDS) guidance and national standards.

1.1.5. Four development sites are in England and fall under Cheshire West and Chester council. Six development sites are in Wales and fall under Flintshire County Council.

1.1.6. England development sites have followed Lead Local Flood Authority (LLFA) requirements and Welsh development sites have followed SuDS Approval Body (SAB) requirements. The SuDS options proposed for each development site are presented in this Report.

1.1.7. Drainage strategies will be subject to further intrusive site surveys to confirm the topographies, condition of the development sites and feasibility of connections at detailed design stage.

2. INTRODUCTION

2.1. APPOINTMENT AND BRIEF

2.1.1. The Applicant intends to build and operate a new underground CO_2 pipeline from Cheshire, England to Flintshire, Wales with necessary AGIs and BVSs. It is classed as a Nationally Significant Infrastructure Project (NSIP) and will require a DCO under the Planning Act 2008 (‘PA2008’) granted by the Secretary of State for the Department of Energy Security and Net Zero (DESNZ) via the Planning Inspectorate (the Inspectorate).

2.1.2. The DCO Proposed Development will form part of HyNet North West (‘the Project’), which is a hydrogen supply and Carbon Capture and Storage (‘CCS’) project. The goal of the Project is to reduce CO_2 emissions from industry, homes and transport and support economic growth in the North West of England and North Wales. The wider Project is based on the production of low carbon hydrogen from natural gas. It includes the development of a new hydrogen production plant, hydrogen distribution pipelines, hydrogen storage and the creation of CCS infrastructure. CCS prevents CO_2 entering the atmosphere by capturing it, compressing it and transporting it for safe, permanent storage.

2.1.3. The DCO Proposed Development is a critical component of HyNet North West which, by facilitating the transportation of carbon, enables the rest of the Project to be low carbon. The hydrogen production and CO_2 capture and storage elements of the Project do not form part of the DCO Proposed Development and will be delivered under separate consenting processes.

2.1.4. The DCO Application will seek consent for the construction, operation and maintenance of the following components which are part of the DCO Proposed Development, namely:

- **Ince AGI to Stanlow AGI Pipeline** – a section of new underground onshore pipeline (20” in diameter) to transport CO_2;
- **Stanlow AGI to Flint AGI Pipeline** – a section of new underground onshore pipeline (36” in diameter) to transport CO_2;
- **Flint AGI to Flint Connection Pipeline** – a section of new underground onshore pipeline (24” in diameter) to transport CO_2;
- **Flint Connection to PoA Terminal Pipeline** – a section of existing Connah’s Quay to PoA underground onshore pipeline (24” in diameter) which currently transports natural gas but would be repurposed and reused to transport CO_2;
- **Four AGIs -** Ince AGI, Stanlow AGI, Northop Hall AGI, and Flint AGI;
- **Six BVSs -** located along:
  - The new Stanlow AGI to Flint AGI Pipeline (three in total); and
  - The existing Flint Connection to PoA Terminal Pipeline (three in total);

- Other above ground infrastructure, including Cathodic Protection (CP) transformer rectifier cabinets and pipeline marker posts;
- Utility Connection infrastructure, including power utilities and Fibre Optic Cable (FOC); and
- Temporary ancillary works integral to the construction of the Carbon Dioxide Pipeline, including Construction Compounds and temporary access tracks.

2.1.5. Further details of each element of the DCO Proposed Development are set out in **Chapter 3 – Description of the DCO Proposed Development (Volume II).**

2.1.6. This **Outline Surface Water Drainage Strategy** (SWDS) was developed to support the DCO Application covering four AGIs and six BVSs facilities (the development sites).

2.1.7. This **Revision B** of the **Outline Surface Water Drainage Strategy** replaces and supersedes Revision A (**APP-241**). The **Outline Surface Water Drainage Strategy (Revision B)** has been updated in response to the proposed design changes as outlined in **Table i.i** of **Chapter I** of the **2023 ES Addendum Change Request 1**. In addition, **Revision A** of **Sheet 6 – Northop Hall AGI** and **Sheet 8 – Cornist Lane BVS** in **Annex A (APP-243)** and **Annex B (APP-242)** have been revised to **Revision B** as a result of the proposed design changes.

2.2. LIMITATIONS

2.2.1. This Report has been prepared using information that is publicly accessible, and from information received from Statutory Consultees and The Applicant. WSP assumes these sources of information are reliable and suitable for the purposes of this assessment.

2.2.2. This Outline SWDS has been presented to the SAB in presentation format as an introduction to the development, however further consultation beyond the presentation has been limited. Consultation responses from other relevant statutory authorities are also limited at the time of writing this Report. Any additional information which becomes available will be incorporated into the further detailed design. This Outline SWDS presents strategy and not the final design, as such a conservative approach has been adopted and detailed design by an elected skilled contractor will seek to refine the design within the parameters set.

2.2.3. The flood risk assessment from the development sites is outside of the scope of this SWDS Report and is addressed and included in the **Appendix 18.4 – Flood Risk Assessment (Volume III)** and **Appendix 18.5 – Flood Consequences Assessment (Volume III)**.

2.3. KEY STAKEHOLDERS

2.3.1. With regard to development planning and permissions, the following key stakeholders associated with drainage of the development sites have been considered:

- The Environment Agency (EA) is responsible, between other things, for management of 'Main Rivers' throughout England and advise on flood risk from fluvial and tidal sources;
- The LLFA manage local flood risk in their area and are a consultee for planning applications that impact on surface water, including approval of proposed drainage and SuDS strategies. They have powers to maintain and operate local watercourses, 'Ordinary Watercourses' and highways. For England sites, Cheshire West and Chester Council as LLFA and for Welsh sites Flintshire County Council as LLFA and SAB; and
- Natural Resources Wales (NRW).

2.3.2. Efforts have been made to engage in pre-application advice, however at the time of writing this Report limited responses have been received. Correspondences from stakeholders are included in **Annex D**.

2.4. OBJECTIVE OF STUDY AND METHODOLOGY

2.4.1. This Report outlines the SWDS for the ten above ground facilities which form part of the DCO Proposed Development and proposes how the facilities will manage and discharge surface water via the use of SuDS. Further detailed design work will commence at the post planning stage.

2.4.2. This Outline SWDS has been prepared in accordance with the relevant national, regional and local requirements and guidance of the following publications:

- National Planning Policy Framework, England (July 2021) (**Ref. 2.1**);
- National Planning Policy Framework Planning Practice Guidance for Flood Risk and Coastal Change website, England (Updated: 20 August 2021) (**Ref. 2.2**);
- The SuDS Manual, CIRIA (2015) (**Ref. 2.3**);
- Cheshire West and Chester Local Plan, England (2015) (**Ref. 2.4**);
- Cheshire West and Chester Sustainable Drainage Systems (SuDS) Guidance, England (2020) (**Ref. 2.5**);
- Non-Statutory Technical Standards for Sustainable Drainage Systems, England (TSSuDS) (Department for Environment, Food and Rural Affairs, March 2015) (**Ref. 2.6**);
- Flood and Water Management Act 2010 (**Ref. 2.7**);
- Planning Policy Wales (PPW) (Edition 11, February 2021) (**Ref. 2.8**);

- Technical Advice Note (TAN) 15: Development and Flood Risk (July 2004) Issued by Welsh Government (**Ref. 2.9**);
- Welsh Government Guidance: Statutory Standards for Sustainable Drainage Systems - Designing, Constructing, Operating and Maintaining Surface Water Drainage Systems (2018) (**Ref. 2.10**);
- Strategic Flood Consequence Assessment Flintshire, Wales (July 2018) (**Ref. 2.11**);
- Guidance for Pre-Application Approval and Full Application Approval of SuDS on new developments in accordance with The Sustainable Drainage (Approval and Adoption Procedure) (Wales) Regulations 2018 (**Ref. 2.12**);
- Sewer for Adoption 7th Edition, Wales (**Ref. 2.13**);
- Design and Construction Guidance (DCG) (2021), England (**Ref. 2.14**);
- Building Regulations 2010 (2015 Edition) (**Ref. 2.15**); and
- Overarching National Policy Statement for Energy (EN-1) (July 2011) (**Ref. 2.16**).

2.5. PLANNING POLICY

National Planning Policy Framework, England (July 2021) (Ref. 2.1)

2.5.1. The National Planning Policy Framework (NPPF) (**Ref. 2.1**) with the aim of protecting the environment and to promote sustainable growth. There is an overarching presumption in favour of sustainable development that should be the basis of every plan and every decision.

2.5.2. The following paragraphs/policies within the NPPF are considered relevant to this assessment:

2.5.3. Paragraph 159: Requires that "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere."

2.5.4. Paragraph 162: Explains that "the aim of the Sequential Test is to steer development to areas with the lowest probability of flooding"

2.5.5. Paragraph 167: Explains that "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere

2.5.6. Paragraph 169: Recommends that "major development should incorporate SuDS unless there is clear evidence that this would be inappropriate. The systems used should:

- Take account of advice from the lead local flood authority;

- Have appropriate proposed minimum operational standards;
- Have maintenance arrangements in place to ensure an acceptable;
- standard of operation for the lifetime of the development; and
- Where possible, provide multifunctional benefits.

National Planning Policy Framework Planning Practice Guidance for Flood Risk and Coastal Change, England (Updated: 20 August 2021) (Ref. 2.2)

2.5.7. The suitability of SuDS is assessed in accordance with:

2.5.8. Paragraph 051: SuDS are designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible. They provide opportunities to:

- Reduce the causes and impacts of flooding;
- Remove pollutants from urban runoff at source; and
- Combine water management with green space with benefits for amenity, recreation and wildlife.

2.5.9. Paragraph 080: Generally, the aim should be to discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

– Into the ground (infiltration);
– To a surface water body;
– To a surface water sewer, highway drain, or another drainage system; and
– To a combined sewer.

Cheshire West and Chester Local Plan, England (2015) (Ref. 2.4)

2.5.10. The Cheshire West and Chester Local Plan (**Ref. 2.4**) forms part of the statutory development plan for the Borough.

2.5.11. The following policies within the Local Plan are considered:

2.5.12. ENV 1 Flood risk and water management: The Local Plan will seek to reduce flood risk, promote water efficiency measures, and protect and enhance water quality through the following mechanisms:

- The drainage of new development shall be designed to reduce surface water runoff rates to include the implementation of SuDS unless it can be demonstrated that it is not technically feasible or viable.

2.5.13. DM41 SuDS: SuDS schemes will be required to satisfy technical standards and design requirements having regard to the Council's Draft SuDS Design and Technical Guidance.

On greenfield sites, restrictions on surface water runoff from new development should be incorporated into the development at the planning stage and must mimic or improve upon greenfield rates. On brownfield sites, site runoff rates should be reduced to the greenfield rates wherever possible.

2.5.14. DM43 Water quality, supply and treatment: Development proposals will be supported where it can be demonstrated that the proposal will not cause unacceptable deterioration to water quality or have an unacceptable impact on water quantity or wastewater infrastructure capacity by ensuring that:

- The proposal does not have a detrimental impact on the flow or quantity of groundwater;
- Development does not affect the water quality of surface or groundwater;
- Development does not cause unacceptable harm to biodiversity;
- Opportunities to improve water quality are used where possible; and
- Water efficiency methods are optimised.

Cheshire West and Chester Sustainable Drainage Systems (SuDS) Guidance, England (2020) (Ref. 2.5)

2.5.15. The SuDS Guidance (**Ref. 2.5**) provides design criteria based on local principles and local standards. The local standard requires that one designs for water quantity with requirements for runoff rate, runoff volume and storage volume.

2.5.16. Individual SuDS should be accounted for in the context of a 'Management Train' that reinforces and, where possible, follows the natural pattern of drainage. The 'Management Train' concept aims to highlight how a series of techniques may be employed in order to reduce the effect which the additional urban runoff from a development may have on the surrounding environment and watercourse as well as ensuring that pollutants and sediment are removed before water enters the watercourse.

2.5.17. The hierarchy is considered in terms of:

- Prevention (reducing the introduction of impermeable surfaces);
- Source control (restricting and reducing runoff to receptors within the catchment);
- Site control (managing surface water at the location of development); and
- Regional control (maintaining and establishing blue networks and storage).

2.5.18. **Figure 2.1** below summarises the SuDS components which have been categorised according to how they fit within the SuDS Management Train.

Figure 2.1 – SuDS Components (Source: Cheshire West and Chester Sustainable Drainage Systems (SuDS) Guidance 2020)

2.5.19. Urban runoff increases the volume of storm water runoff compared to greenfield runoff. To minimise the impact of this additional runoff, the use of infiltration systems is encouraged where appropriate. For example, infiltration could be provided using the following types of SuDS:

- Soakaways;
- Filter drains;
- Infiltration trenches / blankets;
- Filter strips;
- Swales (dry and conveyance);
- Bio-retention systems; and
- Pervious pavements.

2.5.20. Where infiltration does not provide sufficient reduction of runoff, the use of long-term storage to address the additional runoff volume should be provided. Further attenuation storage could be provided in the following types of SuDS:

- Ponds and wetlands;
- Detention basins; and
- Underground attenuation storage.

2.5.21. Discharging surface water runoff to the ground via infiltration SuDS is the preferred method. However, where it is not feasible, Figure **2.2** below shows other options of discharge method.

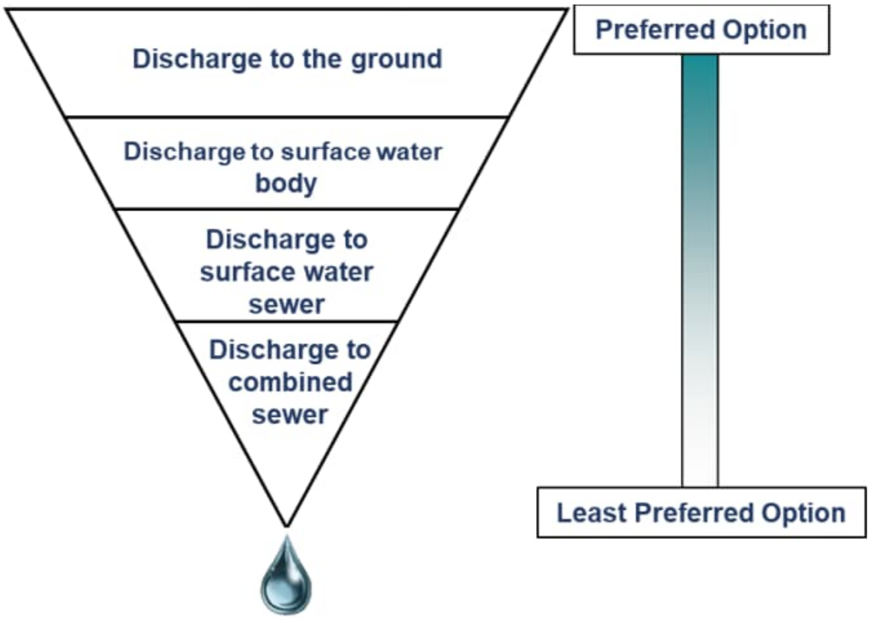

Figure 2.2 **– Discharge Hierarchy (Source: Cheshire West and Chester Sustainable Drainage Systems (SuDS) Guidance 2020)**

2.5.22. In order to manage surface water discharge under high rainfall, either of the two approaches below must be used:

2.5.23. Approach 1: Restricting both the peak flow rate and volume of runoff

2.5.24. The peak flow rates for the:

- 1 in 1 year rainfall event; and
- 1 in 100 years plus climate change (CC) rainfall event must not be greater than the equivalent greenfield runoff rates for these events. The critical duration rainfall event must be used to calculate the required storage volume for the 1 in 100 years plus CC rainfall event.

2.5.25. The volume of runoff must not be greater than the greenfield runoff volume from the site for the 1 in 100 years plus CC, 6-hour rainfall event.

2.5.26. Climate change should be considered in attenuation storage calculations.

2.5.27. Approach 2: Restricting the peak flow rate

2.5.28. The critical duration rainfall event must be used to calculate the required storage volume for the 1 in 100 years plus CC rainfall event. The flow rate discharged:

- For the 1 in 1 year event, must not be greater than either:
- The greenfield runoff rate from the site for the 1 in 1 year event; or

- 2 litres per second per hectare (l/s/ha).

2.5.29. And for the 1 in 100 years plus CC year event, must not be greater than either:

- The greenfield mean annual flood for the site; or
- 2 l/s/ha.

Flood and Water Management Act 2010 (Ref. 2.7)

2.5.30. Schedule 3 of the Flood and Water Management Act 2010 (**Ref. 2.7**) provides a framework for the approval and adoption of surface water systems serving new developments.

2.5.31. The Act requires new developments to include SuDS features that comply with national standards.

2.5.32. SuDS scheme applications for SAB approval are a statutory requirement in Wales.

2.5.33. "Sustainable drainage" means managing rainwater with the aim of:

- Reducing damage from flooding;
- Improving water quality;
- Protecting and improving the environment;
- Protecting health and safety; and
- Ensuring the stability and durability of drainage systems.

Planning Policy Wales (PPW) (Edition 11, Feb 2021) (Ref. 2.8)

2.5.34. The primary objective of PPW (**Ref. 2.8**) is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental, and cultural well-being of Wales.

2.5.35. Paragraph 6.6.17 states new developments of more than one dwelling or where the area covered by construction work equals or exceeds 100 square metres require approval from the SAB before construction can commence. Adoption and management arrangements, including the maintenance of SuDS infrastructure and all drainage elements are to be agreed by the SAB as part of the approval.

2.5.36. Development proposals should incorporate design for surface water management, based on principles which work with nature to facilitate the natural functioning of the water cycle, providing issues such as land contamination would not result in the mobilisation of contaminants which may have an impact over a wider area.

Technical Advice Note (TAN) 15: Development and Flood Risk (July 2004) Issued by Welsh Government (Ref. 2.9)

2.5.37. The TAN (**Ref. 2.9**) provides technical guidance which supplements the policy set out in PPW in relation to development and flooding. It advises on development and flood risk as this relates to sustainability principles 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.

2.5.38. Section 8 states built development tends to increase the surface area of impermeable ground. This has the effect of reducing the time it takes for precipitation to enter the watercourse and consequently increasing the peak discharge. SuDS can perform an important role in managing runoff from a site and should be implemented, irrespective of the zone in which they are located.

2.5.39. Development in one part of a catchment may increase runoff and hence flood risk elsewhere, therefore, the aim should be for new development not to create additional runoff when compared with the undeveloped situation, and for redevelopment to reduce runoff where possible.

2.5.40. Developers will need to give good reason why SuDS could not be implemented. If a conventional drainage system does not improve the status quo or has a negative impact, then this can be a valid reason for refusal of approval.

Welsh Government Guidance: Statutory Standards for Sustainable Drainage Systems - Designing, Constructing, Operating and Maintaining Surface Water Drainage Systems (2018) (Ref. 2.10)

2.5.41. The SuDS approach mimics natural drainage, managing surface runoff at or close to the surface and as close to its source as practicable, controlling the flow (volume and rate of runoff) and providing a range of additional benefits.

2.5.42. While pipes will often be used in SuDS drainage schemes, the construction of surface water drainage systems comprising solely of pipe sewers will be the exception. The most effective SuDS use a series of various drainage components, operating as close to the source of runoff as practicable. These should work as a SuDS management train as shown in **Figure 2.3** below to control flow rates and reduce volumes of runoff, providing treatment to protect water quality and opportunities to encourage biodiversity and amenity.

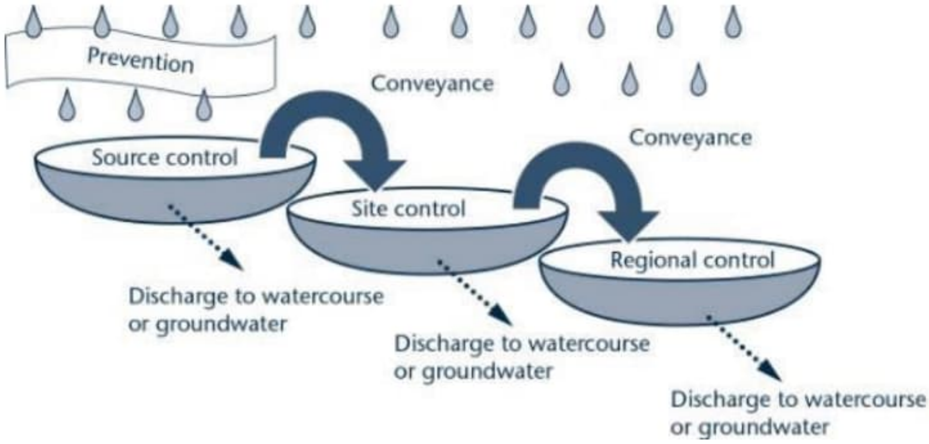

Figure 2.3 – SuDS Management Train Principle (Source: Strategic Flood Consequence Assessment Flintshire (July 2018))

2.5.43. The drainage design should follow the following 6 standards:

2.5.44. Standard S1 – Surface water runoff destination

- Priority Level 1: Runoff is collected for use;
- Priority Level 2: Runoff is infiltrated to ground;
- Priority Level 3: Runoff is discharged to a surface water body;
- Priority Level 4: Runoff is discharged to a surface water sewer highway drain, or another drainage system; and
- Priority Level 5: Runoff is discharged to a combined sewer.

2.5.45. Standard S2 – Surface water runoff hydraulic control

- The surface water runoff rate for the 1 in 1 year return period event should be controlled to help mitigate the negative impacts of the development runoff on the morphology and associated ecology of the receiving surface water bodies;
- Reducing the impact of surface water runoff from the development on flood risk associated with the receiving water body, is based on limiting the peak runoff rate and runoff volume for extreme events. The 1:100 year return period rainfall event is the criterion normally used;
- Where possible, the volume of runoff from the site area should not exceed the volume of runoff from the equivalent area in its natural undeveloped or "greenfield" state (for the same rainfall event);
- Where controlling runoff to greenfield volumes is considered unachievable, then the runoff volume should be reduced as much as possible, and any additional volume should be stored and released at a low rate which will not increase downstream flood risk, normally 2 l/s/ha is considered an appropriate rate;

- Unless specific off-site arrangements have been agreed, all runoff generated on the site should be managed on the site using attenuation or temporary storage which discharges through defined points of exit from the site; and
- Consideration should be given to likely future pressures on the site drainage system, such as climate change.

2.5.46. Standard S3 - Water Quality

- Treatment for surface water runoff should be provided to prevent negative impacts on the receiving water quality and protect downstream drainage systems;
- Surface water runoff should be managed using Interception, sedimentation and treatment components close to its source; and
- The generic design process for pollution control is set out in **Figure 2.4** below.

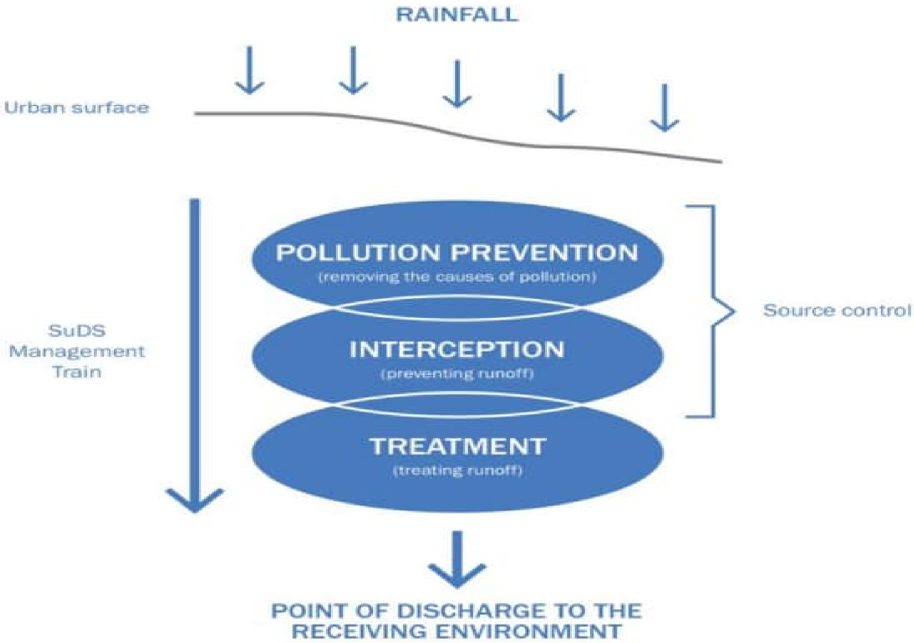

Figure 2.4 – Generic Pollution Control Design Process (Source: Statutory Standards for Sustainable Drainage Systems (2018))

2.5.47. Standard S4 – Amenity

- The design of the surface water management system should maximise amenity benefits; and
- SuDS components to ensure that where possible, to enhance the provision of high quality, attractive public space which can help provide health and wellbeing benefits, they improve liveability for local communities, and they contribute to improving the climate resilience of new developments.

2.5.48. Standard S5 - Biodiversity

- The aim of standard S5 is to ensure that, wherever possible, and having regard to the need to prioritise infiltration drainage, the SuDS scheme makes the best use of a site to maximise benefits for biodiversity. Biodiversity benefits will usually be best achieved by drainage systems which are on the surface and visible with vegetated components.

2.5.49. Standard S6 – Design of drainage for Construction, Operation and Maintenance and Structural Integrity

- All elements of the surface water drainage system should be designed so that they can be constructed, maintained and operated easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon.

Overarching National Policy Statement for Energy (EN-1) (July 2011) (Ref. 2.16)

2.5.50. The Overarching National Policy Statement for Energy (EN-1) (**Ref. 2.16**) sets out the Government's policy for delivery of major energy infrastructure.

2.5.51. To satisfactorily manage flood risk, arrangements are required to manage surface water and the impact of the natural water cycle on people and property.

2.5.52. Surface water drainage systems should cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without adverse impacts.

2.5.53. The surface water drainage arrangements should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project.

2.5.54. It may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the site.

2.5.55. The sequential approach should be applied to the design. More vulnerable uses should be located on parts of the site at lower probability and residual risk of flooding. Seek opportunities to use open space for multiple purposes such as amenity, wildlife habitat and flood storage uses. Opportunities should be taken to lower flood risk by reducing the built footprint of previously developed sites and using SuDS.

2.5.56. The term SuDS refers to the whole range of sustainable approaches to surface water drainage management including:

- Source control measures including rainwater recycling and drainage;
- Infiltration devices to allow water to soak into the ground, that can include individual soakaways and communal facilities;
- Filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns;

- Filter drains and porous pavements to allow rainwater and run-off to infiltrate into permeable material below ground and provide storage if needed;
- Basins ponds and tanks to hold excess water after rain and allow controlled discharge that avoids flooding; and
- Flood routes to carry and direct excess water through developments to minimise the impact of severe rainfall flooding.

3. CLIMATE CHANGE

3.1. BACKGROUND INFORMATION

3.1.1. As explained in the Climate Change Adaptation Sub-Committee Progress Report 2014 (**Ref. 3.1**), increased flood risk is the greatest threat to the UK from climate change. Models of the climate system suggest floods of the type experienced in England and Wales in autumn 2000, and between December 2013 and February 2014, have become more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.

3.1.2. More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.

3.1.3. Increased rainfall affects surface water flood risk and how the drainage systems need to be designed.

3.1.4. EA (**Ref. 3.2**) and Flood Consequences Assessments: Climate change allowances issued by Welsh government (**Ref. 3.3**) provide up to date information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

3.1.5. EA (**Ref. 3.2**) guidance on climate change allowances was updated on the 27th May 2022. The main changes are that the peak rainfall and river flow allowances are now provided for "management catchments" rather than a set of single national allowances for England. Two epochs '2050s' and '2070s' are provided rather than three as previously. 2050s epoch is used for development with a lifetime up to 2060, and 2070s epoch for development with a lifetime between 2061 to 2125.

3.1.6. EA Peak Rainfall Allowances map (**Ref. 3.4**) is used to determine the management catchments for development sites in England. River Basin Districts map issued by Welsh Government (**Ref. 3.5**) is used to determine the river basin districts for development sites in Wales.

3.1.7. The following development sites are under Weaver Gowy management catchment:

- Ince AGI (England); and
- Stanlow AGI (England).

3.1.8. The following development sites are under Dee management catchment:

- Rock Bank BVS (England);
- Mollington BVS (England);
- Aston Hill BVS (Wales);
- Northop Hall AGI (Wales);

- Flint AGI (Wales);
- Cornist Lane BVS (Wales);
- Pentre Halkyn BVS (Wales); and
- Babell BVS (Wales).

3.2. DEVELOPMENT LIFESPAN

3.2.1. The lifespan for the development sites is 25 years.

3.3. IMPACT OF CLIMATE CHANGE ON THE DEVELOPMENT

3.3.1. Surface water flood risk is generally expected to increase in the future as a consequence of climate change and the expected increase in extreme rainfall events. For peak rainfall the guidance provides an upper end and central allowance depending on epoch. NPPF (**Ref. 2.1**) states that upper end allowance and credible maximum climate change scenario should be applied to Nationally Significant Infrastructure Projects (NSIPs). Therefore, when undertaking this Outline SWDS, the attenuation storages have been designed to accommodate runoff during all events up to and including the 100 years plus 40% CC allowance.

4. BASELINE SITE DESCRIPTION

4.1. SITE DESCRIPTION

4.1.1. Site locations are shown in **Figure 3-2 – DCO Proposed Development (Volume IV)**.

Ince – AGI

4.1.2. Ince AGI is located off a private access road which connects to Elton Lane, Cheshire, England. It is centred at National Grid Reference SJ 46900 76143 (E: 346900, N: 376143).

4.1.3. The current site use is greenfield and is approximately 0.18 ha in area.

Stanlow – AGI

4.1.4. Stanlow AGI is within the boundaries of the Essar Stanlow Refinery, located off A5117 Chester Road, Cheshire, England. It is centred at National Grid Reference SJ 44626 74949 (E: 344626, N: 374949).

4.1.5. The current site use is brownfield and is approximately 0.27 ha in area.

Rock Bank – BVS

4.1.6. Rock Bank BVS is located off Chorlton Lane, Cheshire, England. It is centred at National Grid Reference SJ 41119 71362 (E: 341119, N: 371362).

4.1.7. The current site use is greenfield and is approximately 0.11 ha in area.

Mollington – BVS

4.1.8. Mollington BVS is located off Overwood Lane, Cheshire, England. It is centred at National Grid Reference SJ 38172 70188 (E: 338172, N: 370188).

4.1.9. The current site use is greenfield and is approximately 0.11 ha in area.

Aston Hill – BVS

4.1.10. Aston Hill BVS is located off Upper Aston Hall Lane, Flintshire, Wales. It is centred at National Grid Reference SJ 31137 66907 (E: 331137, N: 366907).

4.1.11. The current site use is greenfield and is approximately 0.11 ha in area.

Northop Hall – AGI

4.1.12. Northop Hall AGI is located off B5125 Village Road, Flintshire, Wales. It is centred at National Grid Reference SJ 25896 67983 (E: 325896, N: 367983).

4.1.13. The current site use is greenfield and is approximately 0.12 ha in area.

Flint – AGI

4.1.14. Flint AGI is located off Allt-Goch Lane, Flintshire, Wales. It is centred at National Grid Reference SJ 25133 70797 (E: 325133, N: 370797).

4.1.15. The current site use is greenfield and is approximately 0.56 ha in area.

Cornist Lane – BVS

4.1.16. Cornist Lane BVS is located off Cornist Lane, Flintshire, Wales. It is centred at National Grid Reference SJ 21838 72407 (E: 321838, N:372407).

4.1.17. The current site use is greenfield and is approximately 0.11 ha in area.

Pentre Halkyn – BVS

4.1.18. Halkyn BVS is approximately 165.0m southwest of Gelli Fowler Farm and located off the B5121 Allt Y Chwiler Road, Flintshire, Wales. It is centred at National Grid Reference SJ 17440 73287 (E: 317440, N: 373287).

4.1.19. The current site use is greenfield and is approximately 0.11 ha in area.

Babell – BVS

4.1.20. Babell BVS is approximately 195.0m west of Plas Newydd Farm and located off Racecourse Lane, Flintshire, Wales. It is centred at National Grid Reference SJ 14830 74532 (E: 314830, N: 374532).

4.1.21. The current site use is greenfield and is approximately 0.11 ha in area.

4.2. SITE TOPOGRAPHY

4.2.1. Topographical surveys are included in **Annex A**.

Ince – AGI

4.2.2. The existing elevation of the Ince AGI site ranges from 3.9m Above Ordnance Datum (AOD) in the northwest to around 4.7m AOD in the southeast. The existing private access road to the site ranges from 4.3m AOD to 5.0m AOD.

Stanlow – AGI

4.2.3. The existing elevation of the Stanlow AGI site ranges from 9.3m AOD in the southwest to around 10.5m AOD in the northeast.

4.2.4. **Rock Bank – BVS**

The existing elevation of the Rock Bank BVS site ranges from 18.1m AOD in the northwest to around 20.0m AOD in the southeast. The existing Chorlton Lane to the site ranges from 17.2m AOD to 19.5m AOD.

Mollington – BVS

4.2.5. The existing elevation of the Mollington BVS site ranges from 29.0m AOD in the southeast to around 29.7m AOD in the northwest. The existing Overwood Lane to the site ranges from 29.8m AOD to 31.5m AOD.

Aston Hill – BVS

4.2.6. The existing elevation of the Aston Hill BVS site ranges from 35.4m AOD in the northwest to around 37.1m AOD in the southeast. The existing Upper Aston Hill Lane to the site ranges from 41.8Maod to 42.8m AOD.

Northop Hall – AGI

4.2.7. The existing elevation of the relocated Northop Hall AGI site ranges from approximately 116.0m AOD in the northeast to around 96.0m AOD in the west. The existing B5125 Village Road to the site ranges from 119.1m AOD to 118.5m AOD.

Flint – AGI

4.2.8. The existing elevation of the Flint AGI site ranges from approximately 53.5m AOD in the northeast to around 58.5m AOD in the southwest. The existing Allt Goch Lane to the site ranges from 58.6m AOD to 56.9m AOD.

Cornist Lane – BVS

4.2.9. The existing elevation of the relocated Cornist Lane BVS site ranges from approximately 152.8m AOD in the south-eastern corner to around 129.0m AOD in the north-west.

Pentre Halkyn – BVS

4.2.10. The existing elevation of the Pentre Halkyn BVS site ranges from approximately 211.7m AOD in the west to around 213.5m AOD in the east.

Babell – BVS

4.2.11. The existing elevation of the Babell BVS site ranges from approximately 174.0m AOD in the northeast to around 172.0m AOD in the southwest. The existing access road to the site ranges from 175.5m AOD to 173.8m AOD. The existing farm track crossing the site has an elevation of approximately 174.0m AOD.

4.3. GEOLOGY AND HYDROGEOLOGY

4.3.1. This section gives a brief description of the geology and hydrogeology for the development sites. For full details, refer to **Chapter 18 – Water Environment and Flood Risk (Volume II).**

Ince – AGI

4.3.1. The superficial deposits beneath the Ince AGI site consists of the tidal flat deposits, described by the British Geological Survey (BGS) GeoIndex (**Ref. 4.1**) as unconsolidated sediment, mainly mud and/or sand. They may form the top surface of a deltaic deposit and are normally a consolidated soft silty clay, with layers of sand, gravel and peat. A ground investigation (GI) undertaken by Fugro at the site recorded the tidal flat deposits to a depth of 8.0m below ground level (bgl), below which glacial deposits are found. The GI has described the glacial deposits as slightly gravelly clay, proven to a depth of 17.0m bgl.

4.3.2. The bedrock geology beneath the Ince AGI site consists of Kinnerton Sandstone Formation, described by the BGS GeoIndex (**Ref. 4.1**) as a red-brown to yellow sandstone, generally pebble-free, fine to medium-grained and cross-stratified.

The GI did not encounter bedrock in this area, with the superficial deposits proven to a depth of 17.0m bgl.

4.3.3. According to the EA Magic map (**Ref. 4.2**), the site is not within a groundwater source protection zone. In addition, the Strategic Flood Risk Assessment (SFRA) (2016) (**Ref. 4.3**) indicates that the site lays in an area susceptible to risk of groundwater flooding.

4.3.4. A CPT test (Location ID: LB_21_202_CPT) was carried out within the footprint which recorded a water strike at 0.4m bgl, this might represent a minor dewatering risk for this AGI.

<u>Stanlow – AGI</u>

4.3.5. The superficial deposits below the Stanlow AGI have been identified as glacial Devensian till. The GI has described the superficial deposits as sands and gravel with low to medium cobble content. The GI has recorded the superficial deposits at the Stanlow AGI to a depth of 3.7m bgl before meeting bedrock.

4.3.6. The bedrock geology beneath the Stanlow AGI site consists of the Chester Sandstone Formation, described by the BGS GeoIndex (**Ref. 4.1**) as conglomerates and reddish brown, cross-bedded, pebbly sandstones with subordinate beds of red-brown mudstone. The conglomerates have a reddish-brown sandy matrix and consist mainly of pebbles of brown or purple quartzite, with quartz conglomerate and vein quartz. At the Stanlow AGI, the Chester Sandstone Formation has been recorded from 3.7m bgl, proven to 14.7m bgl.

4.3.7. The EA Magic Map (**Ref. 4.2**) geological data mapping indicates that the site is not within a groundwater protection zone. The SFRA (2016) (**Ref. 4.3**), indicates that the site is not particularly susceptible to risk of groundwater flooding.

4.3.8. A groundwater monitoring borehole (Location ID: LB_21_02_BH) located approximately 150.0m south of the Stanlow AGI has recorded groundwater levels between 3.2m bgl and 3.7m bgl during February 2022.

<u>Rock Bank – BVS</u>

4.3.9. The BGS GeoIndex (**Ref. 4.1**) has indicated that superficial deposits are not present at the Rock Bank BVS, however a GI borehole at the BVS site (Location ID: LB_21_21_BH) has indicated that 2.0-3.0 m of glacial Devensian till deposits are present (consisting of slightly clayey sand), below which bedrock is present.

4.3.10. The bedrock geology beneath the Rock Bank BVS site consists of Chester Sandstone Formation. The Chester Sandstone Formation has been recorded by the GI at the Rock Bank BVS from 3.2m bgl, proven to 5.2m bgl.

4.3.11. The EA Magic Map (**Ref. 4.2**) geological data mapping indicates that the site is not within a groundwater protection zone. The SFRA (2016) (**Ref. 4.3**), indicates that the site is susceptible to risk of groundwater flooding.

4.3.12. Groundwater was not encountered by the GI at the Rock Bank BVS. The Environment Agency groundwater contour map indicates that groundwater levels may be 5.0 – 10.0m bgl at the Rock Bank BVS.

Mollington – BVS

4.3.13. The superficial deposits below the Mollington BVS site consist of glacial Devensian till. The GI has described the glacial till as sandy/gravelly clay and has proven the deposit to 20.0m bgl without encountering bedrock (Location ID: LB_21_99_BH).

4.3.14. The bedrock geology beneath the Mollington BVS site consists of Chester Sandstone Formation. The sandstone is found at depth below the thick superficial deposits and was not proven by the GI. However, BGS historic borehole SJ36NE12 (**Ref. 4.1**) encountered bedrock at Mollington at 21.0m bgl, recorded as soft sandstone.

4.3.15. The EA Magic Map (**Ref. 4.2**) geological data mapping indicates that the site is not within a groundwater protection zone. The SFRA (2016) (**Ref. 4.3**), indicates that the site is not susceptible to risk of groundwater flooding

4.3.16. Groundwater was not encountered by the GI at the Mollington BVS, approximately 350.0m north of the BVS the GI recorded a groundwater level of 3.65m bgl (Location ID: LB_21_32_BH).

Aston Hill – BVS

4.3.17. The superficial deposits below the Aston Hill BVS consist of glaciofluvial deposits and glacial Devensian till. The BGS GeoIndex (**Ref. 4.1**) has described the glaciofluvial deposits as coarse-grained sediments (sand and gravel) with some finer-grained lenses of silt, clay or organic material. The GI has recorded the superficial deposits to a depth of 7.5m bgl at the Aston Hill BVS before they meet bedrock.

4.3.18. The bedrock geology beneath the Aston Hill BVS site consists of Pennine Coal Measures Group, described by the BGS GeoIndex (**Ref. 4.1**) as an alternation of sandstone, grey siltstone and grey mudstone, with frequent coal seams and seatearth. The Pennine Coal Measures Group has been recorded by the GI at the Aston Hill BVS from 7.5m bgl, proven to 10.5m bgl.

4.3.19. The NRW geological data mapping (**Ref. 4.4**) indicates that the site does not lie within a groundwater source protection zone. Furthermore, the map indicates that the site lies within an area with medium to low groundwater vulnerability.

4.3.20. Water seepage was observed by the GI at the base of the inspection pit of LB_21_95_BH however no groundwater level was recorded. Approximately 450.00m northeast of the Aston Hill BVS a groundwater monitoring borehole (Location ID: LB_21_109_BH) recorded groundwater levels between 1.5m bgl and 2.3m bgl during December 2021.

Northop Hall – AGI

4.3.21. The superficial deposits beneath the Northop Hall AGI site consists of glacial Devensian till. The GI has described the glacial till as sandy/gravelly clay and has recorded the deposit to approximately 1.0 – 3.0m bgl before meeting bedrock.

4.3.22. The bedrock geology beneath the Northop Hall AGI site consists of sandstone beds of the Pennine Coal Measures Group. The GI has recorded the bedrock below the superficial deposits near the Northop Hall AGI site at approximately 1.0 – 3.0m bgl, proven to a depth of 8.0m bgl.

4.3.23. The NRW geological data mapping (**Ref. 4.4**) indicates that the site does not lie within a groundwater source protection zone. Furthermore, the map indicates that the site lies within an area with medium to low groundwater vulnerability.

4.3.24. Groundwater was not encountered by the GI near the Northop Hall AGI site. The BGS historic borehole SJ26NE27 (**Ref. 4.1**) approximately 700.0m southeast of the Northop Hall AGI has recorded a groundwater level of 6.0m bgl.

Flint – AGI

4.3.25. The superficial deposits beneath the Flint AGI site consists of glacial Devensian till. The GI has described the glacial till as sandy/gravelly clay and has proven the superficial deposit to a depth of 14.0m bgl without meeting bedrock.

4.3.26. The bedrock geology beneath the Flint AGI site consists of Pennine Coal Measures Group. The GI did not encounter bedrock at the Flint AGI, with the superficial deposits proven to 14.0m bgl. 1.3km southeast of the Flint AGI site, BGS historic borehole SJ26NE1635 (**Ref. 4.1**) has recorded the coal measures at 50.0m bgl.

4.3.27. The NRW geological data mapping (**Ref. 4.4**) indicates that the site does not lie within a groundwater source protection zone. In addition, the map indicates that the site is within an area of high risk of groundwater vulnerability.

4.3.28. Groundwater was not encountered by the GI at the Flint AGI.

Cornist Lane – BVS

4.3.29. The BGS GeoIndex (**Ref. 4.1**) indicates that superficial deposits are not present beneath the Cornist Lane BVS site, however the GI has identified sand and clay deposits, proven to a depth of 2.7m bgl.

4.3.30. The bedrock geology beneath the Cornist Lane BVS site consist of the Bowland Shale Formation, described by the BGS GeoIndex (**Ref. 4.1**) as a mainly dark grey fissile and blocky mudstone, weakly calcareous, with subordinate sequences of interbedded limestone and sandstone, fossiliferous in more-or-less discrete bands. The GI trial pits at the Cornist Lane BVS did not encounter bedrock. The Site is not located within a groundwater source protection zone and no groundwater was encountered in any of the trial pits at the Cornist Lane BVS.

<u>Pentre Halkyn – BVS</u>

4.3.31. The superficial deposits beneath the Pentre Halkyn BVS site consist of the glacial Devensian till and glaciofluvial deposits. The GI has identified layers of sand, gravel, silt and clay within the trial pits at the Pentre Halkyn BVS, proven to a depth of 2.1m bgl.

4.3.32. The bedrock geology beneath the Pentre Halkyn BVS site consists of the Clwyd Limestone Group. The BGS GeoIndex (**Ref. 4.1**) has described the Clwyd Limestone Group as a diverse range of limestone facies with subordinate sandstone and mudstone units and exhibit local dolomitization. The GI trial pits at the Pentre Halkyn BVS did not encounter bedrock. The Site is not located within a groundwater source protection zone and no groundwater was encountered in any of the trial pits at the Pentre Halkyn BVS.

<u>Babell – BVS</u>

4.3.33. The superficial deposits beneath the Babell BVS site consists of glacial Devensian till, glaciofluvial deposits and head deposits. Head deposits have been described by the BGS GeoIndex (**Ref. 4.1**) as poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes. The GI has recorded sand and clay deposits within the trial pits at the Babell BVS, proven to a depth of 2.3m bgl.

4.3.34. The bedrock geology beneath the Babell BVS site consist of the Clwyd Limestone Group. The GI trial pits at the Pentre Halkyn BVS did not encounter bedrock. BGS borehole SJ17SE124 (**Ref. 4.1**), 0.5km to the south-east of the Babell BVS encountered limestone at 3.5m bgl.

4.3.35. A review of the Strategic Flood Consequence Assessment Flintshire, Wales (July 2018) (**Ref. 2.11**) indicates that the site is not within a groundwater source protection zone. In addition, the NRW geological data mapping (**Ref. 4.4**) indicates that the site has medium to high groundwater vulnerability.

4.3.36. Groundwater seepage was observed at the base of the inspection pit of LB_21_309_BH however no groundwater level was recorded. BGS borehole SJ17SE124 (**Ref. 4.1**) has recorded a groundwater level at 62.0m bgl.

4.4. EXISTING WATERCOURSES

4.4.1. This section gives a brief description of the existing watercourses. For full details, refer to **Chapter 18 – Water Environment and Flood Risk (Volume II).**

4.4.2. For watercourse locations, refer to **Figure 18-1 – Watercourses (Volume IV).**

<u>Ince – AGI</u>

4.4.3. The closest watercourse to the Ince AGI is East Central Drain located approximately 40.0m north of the site. There is also another watercourse Elton Lane Ditch located approximately 60.0m east of the site.

Stanlow – AGI

4.4.4. The closest watercourse to the Stanlow AGI is Gale Brook, tributary of the main river Gowy. It is located approximately 150.0m west of the site. The watercourse is culverted beneath the A5117 dual carriageway and flows north. There is also another watercourse Elton Brook Trib 1 located approximately 155.0m south of the site.

Rock Bank – BVS

4.4.5. The closest watercourse to the Rock Bank BVS is Canal Ditch located approximately 300.0m south of the site.

Mollington – BVS

4.4.6. The closest watercourse to the Mollington BVS is Overwood Ditch located approximately 35.0m east of the site which connects to an unnamed pond located approximately 95.0m northeast of the site.

Aston Hill – BVS

4.4.7. The closest watercourse to the Aston Hill BVS is Aston Hall Brook Trib located approximately 250.0m northeast of the site. There is also another watercourse Aston Hall Brook located approximately 340.0m west of the site adjacent to Aston Hall. The watercourse flows northeast through Queensferry where it is culverted beneath the A494 before joining the River Dee.

Northop Hall – AGI

The closest watercourse to the Northop AGI is Wepre Brook Trib 1 located approximately 380.0m south of the site. The watercourse is culverted beneath the A55 dual carriageway and flows east towards Northop. In addition, there is 6 unnamed ponds located approximately 70.0m southwest of the site.

Flint – AGI

4.4.8. The closest watercourse to the Flint AGI is Little Lead Brook located approximately 50.0m northeast of the site. The watercourse flows north towards Flint where it is culverted beneath the A548 Chester Road before joining Pentre Brook in the Dee Estuary.

Cornist Lane – BVS

4.4.9. The closest watercourse to the Cornist Lane BVS is the Nant-y-Fflint located approximately 310.0m west of the site.

Pentre Halkyn – BVS

4.4.10. The closest watercourse to the Pentre Halkyn BVS is the Afon Pant-Gwyn located approximately 1.4km west of the site.

Babell – BVS

4.4.11. The closest open watercourse to the Babell BVS is the Afon Wys located approximately 400.0m southwest of the site.

4.5. EXISTING SEWER AND DRAINAGE INFRASTRUCTURE

Ince – AGI

4.5.1. The current use of the proposed location for Ince AGI is agricultural. The utility record (**Ref. 4.5**) of the area shows no buried assets in the proximity of the AGI.

4.5.2. The proposed location for Ince AGI is surrounded by ditches which drain surface water runoff from the proposed location for Ince AGI and adjacent fields. The EA have advised that this low-lying area is drained by pumping stations that are currently operated and maintained by the EA.

4.5.3. Based on the information provided by United Utilities (UU) (**Ref. 4.5**) the nearest surface water sewer asset appears to be located approximately 180.0m to the north of the proposed location for Ince AGI.

4.5.4. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Stanlow – AGI

4.5.5. The current use of the proposed location for Stanlow AGI is industrial. The utility record (**Ref. 4.5**) of the area shows an extensive network of buried assets in the area.

4.5.6. Based on the information provided by UU (**Ref. 4.5**), the nearest sewer assets are located 100.0m south of the proposed Stanlow AGI. These are a surface water sewer and a foul water sewer running parallel of the A5117.

4.5.7. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Rock Bank – BVS

4.5.8. The proposed location for Rock Bank BVS is currently undeveloped. The utility record (**Ref. 4.5**) of the area shows only a buried asset, a telecommunication service east of Chorlton Lane in the proximity of the BVS. Therefore, it is assumed that it is not served by any drainage infrastructure.

4.5.9. This is consistent with the information provided by UU (**Ref. 4.5**), which indicates that there are not sewers assets within 1.5km of the BVS.

4.5.10. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Mollington – BVS

4.5.11. The current proposed location for Mollington BVS is currently undeveloped, the utility record (**Ref. 4.5**) of the area shows no buried assets in the proximity of the BVS.

4.5.12. The closest sewer asset belongs to Welsh Water according to the utility search carried out in 2021 (**Ref. 4.5**) and runs under Overwood Lane and Parkgate road. UU (**Ref. 4.5**) indicates that there are no sewers assets within 1.0km of the BVS.

4.5.13. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Aston Hill – BVS

4.5.14. Given that the current site use at the Aston Hill BVS site is agricultural, it is unlikely that the Site is served by any sewer infrastructure.

4.5.15. Dŵr Cymru Welsh Water (DCWW) assets information has been obtained and there are no known DCWW assets that have been identified to be within the BVS.

4.5.16. DCWW have indicated that Blackburn Avenue (approximately 150.0m east of the BVS) has a sewer system that is over capacity and therefore could be a cause for concern. However, a review of the location of the DCWW asset indicates that it does not fall within the Newbuild Infrastructure Boundary and Newbuild Carbon Dioxide Pipeline (indicative location). In addition, Blackburn Avenue is located 5m AOD below the Site and any risk of sewer flooding from this area onto the Newbuild Infrastructure Boundary is therefore considered to be negligible.

4.5.17. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Northop Hall – AGI

4.5.18. Given that the current site use at the Northop AGI site is agricultural, it is unlikely that the Site is served by any sewer infrastructure.

4.5.19. DCWW asset information has been obtained and there are no known DCWW assets that have been identified to be within the AGI.

4.5.20. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Flint – AGI

4.5.21. Given that the current use of the proposed Flint AGI site is agricultural, it is unlikely that the Site is served by any sewer infrastructure.

4.5.22. DCWW asset information has been obtained and there are no known DCWW assets that have been identified to be within the AGI.

4.5.23. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Cornist Lane – BVS

4.5.24. Given the current site use at the Cornist Lane BVS site is agricultural, it is unlikely that the Site is served by any sewer infrastructure.

4.5.25. DCWW records do not show any assets in the area.

4.5.26. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Pentre Halkyn – BVS

4.5.27. Given the current use of the Pentre Halkyn BVS site is agricultural, it is unlikely that the Site is served by any sewer infrastructure.

4.5.28. The BVS is crossed by a 63mm diameter watermain, which is a DCWW asset. As DCWW only provided point location data for the watermain, its alignment is unknown.

4.5.29. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

Babell – BVS

4.5.30. Given the current use of the proposed Babell BVS site is agricultural, it is unlikely that the BVS is served by any sewer infrastructure.

4.5.31. DCWW records do not show any assets in the area.

4.5.32. A subsurface utilities survey including drainage, would be recommended to inform the detail design works.

4.6. EXISTING FLOOD DEFENCES

Ince – AGI

4.6.1. Ince AGI is in an area benefitting from fluvial flood defences. These are mainly Natural High Ground and are shown in **Figure 4.1** below.

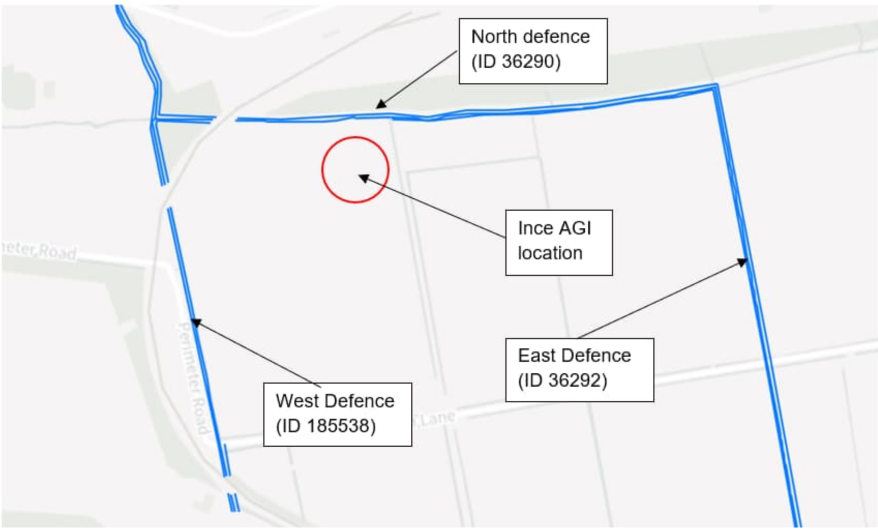

Figure 4.1 – Ince Fluvial Flood Defences

4.6.2. From a tidal perspective, Ince AGI is protected by tidal flood defence (EA Flood Map for planning (**Ref. 4.6**)). The flood defence consists of the embankment MSC (Manchester Ship Canal) which forms a barrier between the Mersey Estuary and its southern floodplains. This defence is shown in Figure 4.2 below.

Figure 4.2 – Ince Tidal Flood Defences

4.6.3. For further detail refers to **Appendix 18.4 – Flood Risk Assessment (Volume III).**

Stanlow – AGI

4.6.4. Stanlow AGI is protected from fluvial flooding by Natural High Ground as shown in **Figure 4.3** below.

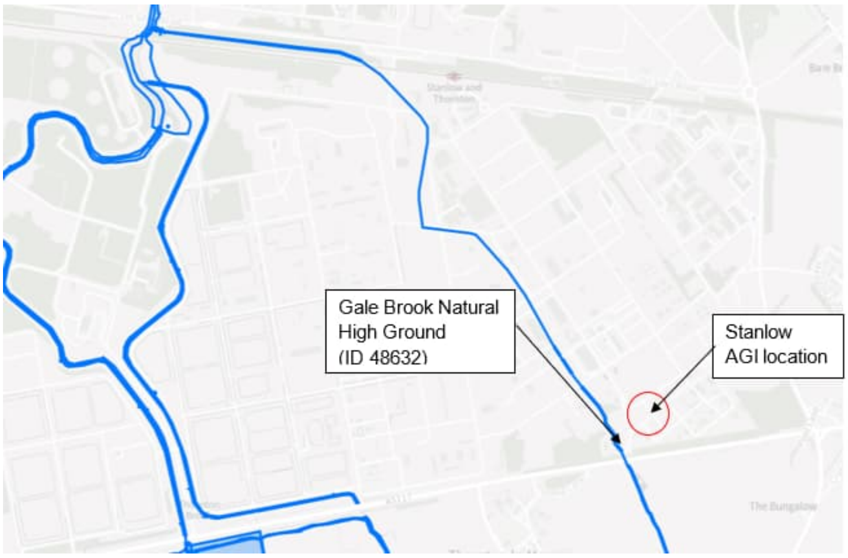

Figure 4.3 – Stanlow Fluvial Flood Defences

4.6.5. From a tidal perspective, Stanlow AGI is protected by tidal flood defence (EA Flood Map for planning (**Ref. 4.6**)). The flood defence consists of a Tidal Flap located next to the Stanlow Thornton train station. This defence is shown in **Figure 4.4** below.

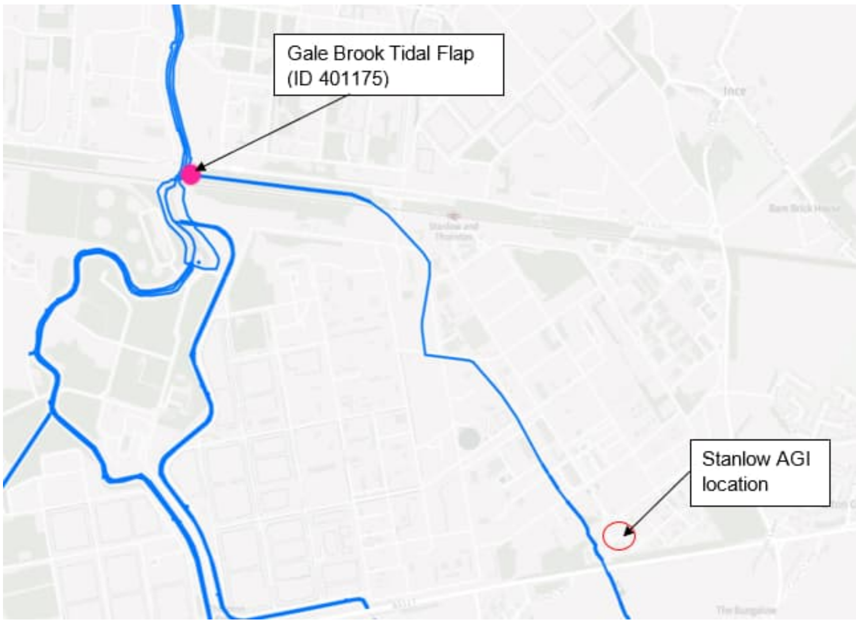

Figure 4.4 – Stanlow Tidal Flood Defences

4.6.6. For further detail refers to **Appendix 18.4 – Flood Risk Assessment (Volume III).**

4.6.7. There are no known flood defences serving the following development sites:

- Rock Bank BVS
- Mollington BVS
- Aston Hill BVS;
- Northop Hall AGI;
- Flint AGI;
- Cornist Lane BVS;
- Pentre Halkyn BVS; and
- Babell BVS

4.6.8. For further detail refers to **Appendix 18.4 – Flood Risk Assessment ((Volume III)** and **Appendix 18.5 – Flood Consequences Assessment (Volume III).**

5. PROPOSED WORKS

5.1.1. The DCO Proposed Development will form part of the HyNet North West Project with the aim to reduce Carbon Dioxide (CO_2) emissions from the industry, homes and transport and support economic growth in the North West of England and North Wales.

5.1.2. The DCO Proposed Development includes Ince AGI, Stanlow AGI, Northop Hall AGI and Flint AGI as well as the following six BVSs:

- The proposed Stanlow AGI to Flint AGI Pipeline (Rock Bank BVS, Mollington BVS, Aston Hill BVS); and
- The existing Flint Connection to PoA Terminal Pipeline (Cornist Lane BVS, Pentre Halkyn BVS, Babell BVS).

5.1.3. The lifespan for DCO Proposed Development is 25 years.

5.1.4. The DCO Proposed Development also briefly includes a new 20” CO_2 pipeline between Ince AGI and Stanlow AGI, a new 36” CO_2 pipeline between Stanlow AGI and Flint AGI, and a new section of 24” CO_2 pipeline between Flint AGI and connection point with the existing pipeline which runs between PoA Terminal and Connah’s Quay power station. However, as the above new pipelines will be buried below ground, they are not included in this Outline SWDS.

5.1.5. Indicative Proposed Development plans are included in **Annex A**.

5.1.6. Refer to **Chapter 3 – Description of the DCO Proposed Development (Volume II)** for a more comprehensive description of the Proposed Development.

6. PROPOSED SURFACE WATER DRAINAGE STRATEGY

6.1. OVERVIEW

6.1.1. An Outline SWDS is essential for any new above ground development to ensure that surface water is managed effectively limiting the risk off-site as well as on-site.

6.1.2. This section of the Report discusses the principles of the proposed surface water drainage strategy with appropriate design calculations and drainage maintenance requirements provided thereafter. The general principles of the outline drainage strategy and drainage calculation methodology for the Proposed Development are also discussed.

6.1.3. All proposed drainages have been designed in accordance with local policy, local SuDS guidance, national standards, and best practice where applicable during detailed design stages.

6.1.4. The proposed surface water drainage strategy for the Proposed Development has been designed to:

- Collect and convey surface water away from developed areas in a safe and controlled manner;
- Provide measures to improve the quality of runoff, where contamination could occur, prior to discharge;
- Be sustainable and maintainable; and
- Ensure structural integrity over the duration of the development design life.

6.1.5. In order to protect the receiving waters and the local ecology, SuDS have been incorporated across the Proposed Development to minimise the risk of pollution to the water environment and create habitat. SuDS are used to mimic more natural processes to convey surface water away from the Proposed Development. They can beneficially:

- Manage runoff flow rates;
- Protect or enhance water quality;
- Be sympathetic to the environmental setting;
- Provide a habitat for wildlife; and
- Encourage natural groundwater recharge, where appropriate.

6.1.6. Silt, sediment, hydrocarbons and other contaminants from runoff will be reduced through SuDS Systems. Runoff will be treated through an appropriate treatment train, depending on the hazard classification of the surface water runoff and the sensitivity of the receiving water.

6.1.7. Runoff will be captured from the AGI/BVS and discharged following the drainage hierarchy:

- To the ground;
- Watercourse;
- Surface water sewer; and
- Combined sewer.

6.1.8. Ince AGI, Stanlow AGI, Rock Bank BVS and Mollington BVS in England have followed LLFA requirements; Aston Hill BVS, Northop Hall AGI, Flint AGI, Cornist Lane BVS, Pentre Halkyn BVS and Babell BVS in Wales have followed SAB requirements. The SuDS options proposed for each development site are presented under each sub-section.

6.1.9. The runoff from the new permanent access tracks to each of the AGI/BVS is not considered in this Outline SWDS as the new access tracks will be compacted gravelled tracks which do not contain critical infrastructure that needs positive drainage.

6.1.10. Typical drainage construction details drawings are included in **Annex B.**

6.2. SURFACE WATER DISCHARGE RATES

6.2.1. To ensure the off-site impact is mitigated in terms of surface water flood risk, it is proposed to target a surface water discharge rate as close to greenfield runoff rate as appropriate. However, the existing greenfield runoff rates are relatively low. Therefore, in order to reduce the risk of blockages of the network, it is proposed that the Proposed Development will discharge at 2.0 l/s during all events, with Stanlow AGI as an exception which it will discharge unrestricted to the wider existing drainage network.

6.3. PROPOSED SURFACE WATER DISCHARGE METHODS

Ince – AGI

6.3.1. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 1 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from LLFA.

6.3.2. The sole use of infiltration techniques across the whole development site is not considered viable because of the geology of the site.

6.3.3. In line with the drainage hierarchy, the development should look next to discharge to a watercourse. The two closest watercourses are East Central Drain located approximately 40.0m north of the development site, and Elton Lane Ditch 1 located approximately 60.0m east of the development site.

6.3.4. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

6.3.5. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the AGI. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

6.3.6. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

6.3.7. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

6.3.8. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

6.3.9. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

6.3.10. A filter drain is proposed to link SuDS components together.

6.3.11. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into ~~East Central Drain or~~ Elton Lane Ditch 1 via vegetated open channel. At this stage, it is not envisaged that a headwall will be required as it is proposed that the open channel would directly discharge to the connecting watercourse but will be confirmed at the detailed design.

6.3.12. The open channel would be approximately 300mm wide and 300mm below ground, however it will be confirmed in detailed design.

6.3.13. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS. Groundwater monitoring post planning should be undertaken to obtain long term groundwater data and to be reviewed in detailed design stage.

Stanlow – AGI

~~6.3.13.~~6.3.14. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 1 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from LLFA.

~~6.3.14.~~6.3.15. Stanlow AGI will be installed within the boundaries of the Essar Stanlow Refinery. The redevelopment of the Essar Stanlow Refinery for the Hydrogen Production Plant (HPP) proposal is taken account into the proposed Stanlow AGI. It is proposed the runoff from the Stanlow AGI will drain into the existing refinery network and be treated as part of the Essar Stanlow Refinery's effluents.

~~6.3.15.~~6.3.16. Provision of SuDS will be reviewed as part of detailed design in line with Essar refinery's overall drainage system.

~~6.3.16.~~6.3.17. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.17.~~6.3.18. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the AGI. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.18.~~6.3.19. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.19.~~6.3.20. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.20.~~6.3.21. A vortex separator is considered to be beneficial. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.21.~~6.3.22. A filter drain is proposed to link SuDS components together.

~~6.3.22.~~6.3.23. The discharge rate is unrestricted within the proposed development site as it is part of a wider network. At the final discharge point the outfall is restricted.

~~6.3.23.~~6.3.24. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Rock Bank – BVS

~~6.3.24.~~6.3.25. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 3 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from LLFA.

~~6.3.25.~~6.3.26. The sole use of infiltration techniques across the whole development site is not considered viable because of the geology of the site. The ground conditions comprise of clay which is considered to be a poor infiltration media.

~~6.3.26.~~6.3.27. In line with the drainage hierarchy, the development should look next to discharge to a watercourse. The closet watercourse is Canal Ditch located approximately 300.0m south of the development site.

~~6.3.27.~~6.3.28. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.28.~~6.3.29. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the BVS. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.29.~~6.3.30. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.30.~~6.3.31. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.31.~~6.3.32. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.32.~~6.3.33. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

~~6.3.33.~~6.3.34. A filter drain is proposed to link SuDS components together.

~~6.3.34.~~6.3.35. A flow control is proposed to restrict the outfall to 2.0 l/s prior discharging runoff into Canal Ditch via vegetated open channel. At this stage, it is not envisaged that a headwall will be required as it is proposed that the open channel would directly discharge to the connecting watercourse but will be confirmed at the detailed design.

~~6.3.35.~~6.3.36. The open channel would be approximately 300mm wide and 300mm below ground, however it will be confirmed in detailed design.

~~6.3.36.~~6.3.37. It is noted that proposed BVS may be lower than existing ground level, level design will need to be reviewed in detailed design stage to confirm the feasibility of this drainage strategy.

~~6.3.37.~~6.3.38. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Mollington – BVS

~~6.3.38.~~6.3.39. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 4 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from LLFA.

~~6.3.39.~~6.3.40. The sole use of infiltration techniques across the whole development site is not considered viable because of the geology of the site. The ground conditions comprise of clay which is considered to be a poor infiltration media.

~~6.3.40.~~6.3.41. In line with the drainage hierarchy, the development should look next to discharge to a watercourse. The closet watercourse is Overwood Ditch located approximately 35.0m east of the development site.

~~6.3.41.~~6.3.42. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.42.~~6.3.43. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the BVS. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.43.~~6.3.44. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.44.~~6.3.45. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.45.~~6.3.46. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.46.~~6.3.47. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

~~6.3.47.~~6.3.48. A filter drain is proposed to link SuDS components together.

~~6.3.48.~~6.3.49. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into Overwood Ditch via vegetated open channel. At this stage, it is not envisaged that a headwall will be required as it is proposed that the open channel would directly discharge to the connecting watercourse but will be confirmed at the detailed design.

~~6.3.49.~~6.3.50. The open channel would be approximately 300mm wide and 300mm below ground, however it will be confirmed in detailed design.

~~6.3.50.~~6.3.51. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Aston Hill – BVS

~~6.3.51.~~6.3.52. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 5 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from SAB.

~~6.3.52.~~6.3.53. The sole use of infiltration techniques across the whole development site is not considered viable because of the geology of the site. The ground conditions comprise of clay which is considered to be a poor infiltration media.

~~6.3.53.~~6.3.54. In line with the drainage hierarchy, the development should look next to discharge to a watercourse. The closet watercourse is Aston Hall Brook Trib located approximately 250.0m northeast of the development site.

~~6.3.54.~~6.3.55. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.55.~~6.3.56. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the BVS. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.56.~~6.3.57. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

6.3.57.6.3.58. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

6.3.58.6.3.59. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

6.3.59.6.3.60. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

6.3.60.6.3.61. A filter drain is proposed to link SuDS components together.

6.3.61.6.3.62. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into Aston Hall Brook Trib via underground pipe.

6.3.62.6.3.63. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Northop Hall – AGI

6.3.63.6.3.64. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 6 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from SAB.

6.3.64.6.3.65. Soakage test has been undertaken however current data is insufficient to calculate infiltration rate as per BRE 365 standard. Further testing will be done in detailed design stage and if such subsequent tests confirm infiltration is suitable, then drainage strategy will adopt soakaway.

6.3.65.6.3.66. In this Outline SWDS, the approach of discharging to a watercourse is considered. The closet watercourse is Wepre Brook located approximately 350m southwest of the development site.

6.3.66.6.3.67. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

6.3.67.6.3.68. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the AGI. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.68.~~6.3.69. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.69.~~6.3.70. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.70.~~6.3.71. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.71.~~6.3.72. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

~~6.3.72.~~6.3.73. A filter drain is proposed to link SuDS components together.

~~6.3.73.~~6.3.74. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into Wepre Brook Trib 1 via vegetated open channel. At this stage, it is not envisaged that a headwall will be required as it is proposed that the open channel would directly discharge to the connecting watercourse but will be confirmed at the detailed design.

~~6.3.74.~~6.3.75. The open channel would be approximately 300mm wide and 300mm below ground, however it will be confirmed in detailed design.

~~6.3.75.~~6.3.76. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Flint – AGI

~~6.3.76.~~6.3.77. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 7 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from SAB.

~~6.3.77.~~6.3.78. The sole use of infiltration techniques across the whole development site is not considered viable because of the geology of the site. The ground conditions comprise of clay which is considered to be a poor infiltration media.

~~6.3.78.~~6.3.79. In line with the drainage hierarchy, the development should look next to discharge to a watercourse. The closet watercourse is Little Lead Brook located approximately 50m northeast of the development site.

~~6.3.79.~~6.3.80. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.80.~~6.3.81. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the AGI. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.81.~~6.3.82. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.82.~~6.3.83. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.83.~~6.3.84. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.84.~~6.3.85. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

~~6.3.85.~~6.3.86. A filter drain is proposed to link SuDS components together.

~~6.3.86.~~6.3.87. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into Little Lead Brook via vegetated open channel. At this stage, it is not envisaged that a headwall will be required as it is proposed that the open channel would directly discharge to the connecting watercourse but will be confirmed at the detailed design.

~~6.3.87.~~6.3.88. The open channel would be approximately 300mm wide and 300mm below ground, however it will be confirmed in detailed design.

~~6.3.88.~~6.3.89. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Cornist Lane – BVS

~~6.3.89.~~6.3.90. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 8 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from SAB.

~~6.3.90.~~6.3.91. Soakage tests have been undertaken however current data is insufficient to calculate infiltration rate as per BRE 365 standard. Further testing will be done in detailed design stage and if such subsequent tests confirm infiltration is suitable, then drainage strategy will adopt soakaway.

~~6.3.91.~~6.3.92. In this Outline SWDS, the approach of discharging to a watercourse is considered. The closet watercourse is Nant-y-Fflint located approximately 310m west of the development site.

~~6.3.92.~~6.3.93. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.93.~~6.3.94. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the BVS. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.94.~~6.3.95. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.95.~~6.3.96. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.96.~~6.3.97. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.97.~~6.3.98. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

~~6.3.98.~~6.3.99. A filter drain is proposed to link SuDS components together.

~~6.3.99.~~6.3.100. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into Nant-y-Fflint via an underground surface water pipe and vegetated open channel. At this stage, it is not envisaged that a headwall will be required as it is proposed that the discharge network would directly discharge to the connecting watercourse but will be confirmed at the detailed design.

~~6.3.100.~~6.3.101. The open channel would be approximately 300mm wide and 300mm below ground, however it will be confirmed in detailed design.

~~6.3.101.~~6.3.102. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Pentre Halkyn – BVS

~~6.3.102.~~6.3.103. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 9 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from SAB.

~~6.3.103.~~6.3.104. In line with the drainage hierarchy, traditional infiltration techniques have been considered, however because of the ground condition, these are not viable discharge methods. There is no watercourse, surface water sewer, highway drain or combined sewer in close proximity to the site. Therefore, the development is proposed to discharge via drainage field infiltration system.

~~6.3.104.~~6.3.105. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.105.~~6.3.106. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the BVS. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment.

~~6.3.106.~~6.3.107. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.107.~~6.3.108. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.108.~~6.3.109. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.109.~~6.3.110. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

~~6.3.110.~~6.3.111. A filter drain is proposed to link SuDS components together.

~~6.3.111.~~6.3.112. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into the drainage field infiltration system.

~~6.3.112.~~6.3.113. The principle of the drainage field infiltration system is to discharge surface water over a large cross-sectional area to allow infiltration over time by using agricultural land drainage in trenches below the ground.

~~6.3.113.~~6.3.114. A drainage field infiltration system is approximately 120.0m in length and 572.0m^2. The pipework is situated 1.0m bgl. Design of the system should be confirmed with agricultural specialist in the detailed design. Refer to Agriculture and Horticulture Development Board's (AHDB) field drainage guide for more details.

~~6.3.114.~~6.3.115. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

Babell – BVS

~~6.3.115.~~6.3.116. The proposed conceptual drainage layout EN070007-D.6.5.13.1-LAY-Sheet 10 is included in **Annex B**. Positioning and alignment of drainage features shown on the drawing are indicative and subject to detailed design and approval from SAB.

~~6.3.116.~~6.3.117. In line with the drainage hierarchy, traditional infiltration techniques have been considered, however because of the ground condition, they are not a viable discharge method.

~~6.3.117.~~6.3.118. It is noted that at the north of the field there has a service chamber cover however no further information is known hence it cannot be utilised in this Outline SWDS. However, this opportunity would be explored further during detailed design and, if considered viable, further engagement with the SAB (and any other stakeholder, as considered necessary) would be undertaken regarding any amendment to the drainage design.

~~6.3.118.~~6.3.119. In this Outline SWDS, it is considered that there is no watercourse, surface water sewer, highway drain or combined sewer in close proximity to the site. Therefore, the development is proposed to discharge via drainage field infiltration system.

~~6.3.119.~~6.3.120. Surface water should be managed as close to source as is reasonably practicable in line with best practice. It is proposed to store surface water prior to discharge at a restricted rate via several SuDS features at or below ground level. It is anticipated that the development site will discharge surface water under gravity.

~~6.3.120.~~6.3.121. As the first step of source control, an infiltration trench is proposed at the gravelled areas within the BVS. The trench can be used to filter, attenuate, and dissipate storm water into the ground through the base and sides of the trench and provide a level of treatment prior to reaching a secondary SuDS feature.

~~6.3.121.~~6.3.122. In the event of heavy rainfall which results in saturated ground, the runoff is then conveyed to the surface water network by land drain.

~~6.3.122.~~6.3.123. A filter drainage channel is proposed along the hardstanding pavement. The multi-stage substrate technology provides water quality treatment by filtering and binding organically and non-organically materials contained in runoff.

~~6.3.123.~~6.3.124. A vortex separator is considered to be beneficial prior to the vegetated detention pond. It removes fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of surface water treatment. Typically, the vortex separator is approximately 1.5m – 2.0m below ground, however the necessity and depth would be confirmed in detailed design.

~~6.3.124.~~6.3.125. A vegetated detention pond is proposed as a site control to attenuate runoff. The soil surface can absorb some runoff in which it can also be used to support the prevention of runoff from the development site for small rainfall events. The principal water quality benefits of vegetated detention pond are associated with the removal of sediment and buoyant materials. However, levels of nutrients, heavy metals, toxic materials, and oxygen-demanding materials could also be significantly reduced.

~~6.3.125.~~6.3.126. A filter drain is proposed to link SuDS components together.

~~6.3.126.~~6.3.127. A flow control is proposed to restrict the outfall to 2.0 l/s prior to discharging runoff into the drainage field infiltration system.

~~6.3.127.~~6.3.128. The principle of the drainage field infiltration system is to discharge surface water over a large cross-sectional area to allow infiltration over time by using agricultural land drainage in trenches below the ground.

~~6.3.128.~~6.3.129. A drainage field infiltration system is approximately 120.0m in length and $572.0m^2$. The pipework is situated 1.0m bgl. Design of the system should be confirmed with agricultural specialist in the detailed design. Refer to Agriculture and Horticulture Development Board's (AHDB) field drainage guide for more details.

~~6.3.129.~~6.3.130. Further design work will be undertaken on this outline design to reflect the detailed design of the DCO Proposed Development and the detailed SWDS would be developed within the parameters set out in this Outline SWDS.

6.4. SURFACE WATER MODELLING AND RESULTS

6.4.1. When undertaking the modelling for the Outline SWDS the following assumptions were made:

- HR Wallingford Surface Water Storage Volume Estimation Tool (www.ukSuDS.com) and Micro-Drainage software were used to determine the storage volumes;
- FEH rainfall method was used;
- HOST Class was obtained from EA Magic Map (**Ref. 4.2**);
- BFI and SPR were calculated from HOST Class;
- The proposed storage volumes have been designed for the 1 in 100 years plus 40% CC event;
- The Proposed AGIs/BVSs consist of paved areas and gravelled areas. Due to the geology of the development sites, the total development site areas were considered to be 100% impermeable for the purpose of storage volume calculations in this Outline SWDS. Subject to further discussion with LLFA/SAB in detailed design stage, runoff coefficient may be applied to gravelled areas. **Table 6.1** below summarises the area for each AGI and BVS; and
- Urban creep allowance factor 1 was used.

Table 6.1– Proposed AGIs/BVSs Areas

Development Site Location	Paved Area (m^2)	Gravelled Area (m^2)	Total Area (m^2)
Ince AGI	716.00	1084.00	1800.00
Stanlow AGI	617.50	2038.50	2656.00
Rock Bank BVS	303.50	746.50	1050.00
Mollington BVS	303.50	746.50	1050.00
Aston Hill BVS	303.50	746.50	1050.00
Northop Hall AGI	526.75	628.25	1155.00
Flint AGI	1100.00	4500.00	5600.00
Cornist Lane BVS	303.50	746.50	1050.00

Pentre Halkyn BVS	266.50	783.50	1050.00
Babell BVS	303.50	746.50	1050.00

- For the purpose of storage volume calculations, surface water runoff was restricted to 2.0 l/s; and
- **Table 6.2** below summarises the proposed storage volume for each development site. Full calculations are included in **Annex C.**

Table 6.2– Proposed Storage Volume for 1 In 100 Years + 40% CC

Development Site Location	Storage Volume (m^3)
Ince AGI	94.0
Stanlow AGI	0.0
Rock Bank BVS	36.0
Mollington BVS	36.0
Aston Hill BVS	39.0
Northop Hall AGI	47.0
Flint AGI	550.0
Cornist Lane BVS	40.0
Pentre Halkyn BVS	40.0
Babell BVS	39.0

7. SURFACE WATER QUALITY CONTROL

7.1. OVERVIEW

7.1.1. SuDS provide natural variability in their ability to remove contamination from surface water runoff which drains across a development site, therefore the management of water quality is founded on a risk-based approach. The current SuDS Manual CIRIA C753 (**Ref. 2.3**) suggests a risk-based approach based on land use type and specific contaminants.

7.1.2. The SuDS Manual CIRIA C753 (**Ref. 2.3**), Table 26.1 suggests a Simple Index Approach (SIA) for low-risk developments, which follows a three-step process, namely:

- Allocate suitable pollution hazard indices for the proposed land use;
- Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index; and
- Where the discharge is protected surface waters or groundwater, consider the need for a more precautionary approach.

7.1.3. To successfully deliver adequate treatment, the chosen SuDS components should have a total pollution mitigation index that equals or exceeds the pollution hazard index.

Total SuDS mitigation index ≥ Pollution hazard index

7.1.4. Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required, where:

Total SuDS mitigation index = mitigation index$_1$ + 0.5 (mitigation index$_2$)

Where:

Mitigation Index$_n$ = mitigation index for component n

7.1.5. A factor of 0.50 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentration.

7.1.6. **Table 7.1** below shows the pollution hazard indices for different land use. Land use category row 3 with Total suspended solids (TSS) (0.5), Metals (0.4) and Hydrocarbons (0.4) have been used for Proposed Development for calculation.

Table 7.1– Pollution Hazard Indices for Different Land Use Classifications (Source: The SuDS Manual, CIRIA C753)

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

7.1.7. In England and Wales, where the principal destination of the runoff is to a surface water, but small amounts of infiltration may occur from unlined components, then the groundwater indices (**Table 7.2** below) should be used for the discharge to groundwater, and the surface water indices (**Table 7.3** below) should be used for the main surface water discharge.

Table 7.2– Indicative SuDS Mitigation Indices for Discharges to Groundwater (Source: The SuDS Manual, CIRIA C753)

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5, 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Table 7.3 – Indicative SuDS Mitigation Indices for Discharges to Surface Water (Source: The SuDS Manual, CIRIA C753)

	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

7.2. PROPOSED SUDS MITIGATION INDICES

7.2.1. **Table 7.4** and **Table 7.5** below summarise the proposed mitigation indices for discharge to surface water and groundwater for the following development sites:

- Ince AGI;
- Rock Bank BVS;
- Mollington BVS;
- Aston Hill BVS;
- Northop Hall AGI;
- Flint AGI;
- Cornist Lane BVS;
- Pentre Halkyn BVS and
- Babell BVS.

Table 7.4 – Summary of Proposed Mitigation Indices for Discharges to Surface Water

	Mitigation Indices		
Type of SuDS Component	TSS	Metals	Hydrocarbons
Filter drainage channel* ***Filer channel is assumed to provide same mitigation indices as permeable paving, this will be explored further in detailed design**	0.70	0.60	0.70
Filter Drain	0.40	0.40	0.40
Detention Pond	0.50	0.50	0.60
Total Suds Mitigation Index	1.90	1.05	1.20

Table 7.5– Summary of Proposed Mitigation Indices for Discharges to Groundwater

	Mitigation Indices		
Type of SuDS Component	TSS	Metals	Hydrocarbons
Infiltration trench where a suitable material is included that provides treatment ie graded gravel with sufficient smaller particles but not single size coarse aggregate	0.40	0.40	0.40
Filter drainage channel* *Filer channel is assumed to provide same mitigation indices as permeable paving, this will be explored further in detailed design	0.70	0.60	0.70
Total SuDS Mitigation Index	0.75	0.70	0.75

7.2.2. The total SuDS mitigation index within the development sites is greater than the pollution hazard index, therefore meeting the requirements of the SIA as specified in SuDS CIRIA C753 (**Ref. 2.3**). This will be further reviewed during the detailed design to ensure compliance.

Tables Table 7.6 and

7.2.3. Table 7.7 below summarise the proposed mitigation indices for discharge to surface water and groundwater for Stanlow AGI.

Table 7.6 – Summary of Proposed Mitigation Indices for Discharges to Surface Water for Stanlow AGI

	Mitigation Indices		
Type of SuDS Component	TSS	Metals	Hydrocarbons
Filter drainage channel* *Filer channel is assumed to provide same mitigation indices as permeable paving, this will be explored further in detailed design	0.70	0.60	0.70
Filter Drain	0.40	0.40	0.40
Total SuDS Mitigation Index	0.90	0.80	0.90

Table 7.7 – Summary of Proposed Mitigation indices for Discharges to Groundwater for Stanlow AGI

	Mitigation Indices		
Type of SuDS Component	TSS	Metals	Hydrocarbons
Infiltration trench where a suitable material is included that provides treatment ie graded gravel with sufficient smaller particles but not single size coarse aggregate	0.40	0.40	0.40
Filter drainage channel* ***Filer channel is assumed to provide same mitigation indices as permeable paving, this will be explored further in detailed design**	0.70	0.60	0.70
Total SuDS Mitigation Index	0.75	0.70	0.75

7.2.4. The total SuDS mitigation index within the development sites is greater than the pollution hazard index, therefore meeting the requirements of the SIA as specified in SuDS CIRIA C753 (**Ref. 2.3**). This will be further reviewed during the detailed design to ensure compliance.

8. MONITORING, MANAGEMENT, OPERATION AND MAINTENANCE

8.1. OVERVIEW

8.1.1. Accumulation of litter and debris can lead to water contamination, creating a hazard associated with the spread of disease and illness. This applies to all SuDS features across the development sites, which must be maintained according to a SuDS maintenance schedule. The outline maintenance strategies for specific SuDS structures are shown in the following sections. The monitoring and management of the SuDS features during operation of the DCO Proposed Development will be the responsibility of the Applicant.

8.1.2. The maintenance regime of SuDS features present on-site will consist of regular maintenance, occasional tasks and remedial works. The frequency of regular maintenance will be determined based on final design, the occasional tasks and remedial works should be conducted as required.

8.1.3. As part of their normal function many SuDS features, are intended to act as a repository for potential pollutants such as sediment, hydrocarbons and heavy metals, thus improving the water quality of runoff. Certain pollutants, such as hydrocarbons, can be broken down via biodegradation. However, other pollutants, namely the particulate or sediment type, such as metals, remain trapped within elements of the sustainable drainage feature. At end-life, all SuDS shall therefore be disposed of in accordance with the relevant rules, regulations, and available guidance at the time.

8.2. FILTER DRAINS

8.2.1. Filter drains require regular maintenance to ensure continuing operation to design performance standards. Adequate access should always be provided to the filter drain for inspection and maintenance.

8.2.2. Table 8.1 below summarises the operation and maintenance requirements for filter drains.

Table 8.1 – Operation and Maintenance Requirements for Filter Drains (Source: The SuDS Manual, CIRIA 2015)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

8.3. DETENTION PONDS

8.3.1. Detention ponds require ongoing regular maintenance to ensure continuing operation to design performance standards. The major maintenance requirement for detention pond is usually mowing. regular mowing in and around the detention pond is only required along maintenance access routes, amenity, across any embankment and across the main storage area, the remaining areas can be managed as 'meadow'.

8.3.2. Mowing should ideally retain grass lengths of 75 - 150mm across the main 'treatment' surface to asset in filtering pollutants and retaining sediments and to reduce the risk of flattening during runoff events.

8.3.3. Table 8.2 below summarises the operation and maintenance requirements for detention pond.

Table 8.2 – Operation and Maintenance Requirements for Detention Ponds (Source: The SuDS Manual, CIRIA 2015)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	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 banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

8.4. INFILTRATION TRENCHES

8.4.1. Infiltration trenches require regular maintenance to ensure continuing operation to design performance standards. The useful life and effective operation of an infiltration component is related to the frequency of maintenance and the risk of sediment being introduced into the system.

8.4.2. **Table 8.3** below summarises the operation and maintenance requirements for infiltration trench.

Table 8.3 – Operation and Maintenance Requirements for Infiltration Trenches (Source: The SuDS Manual, CIRIA 2015)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter, debris and trash	Monthly
	Cut grass – for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional maintenance	Reseed areas of poor vegetation growth	Annually, or as required
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly

8.5. MANHOLES

8.5.1. Regular maintenance includes checking every 6 months for the accumulation of debris and silt and cleaned as necessary. Monitoring will be done every 6 months or after large storms.

8.6. FLOW CONTROLS

8.6.1. Regular maintenance includes inspection every 3 months or as needed if problems occur. Monitoring will be done every 3 months or after large storms.

9. CONCLUSION

9.1.1. WSP have prepared this Outline SWDS on behalf of Liverpool Bay CCS Ltd, to support the HyNet CO_2 Pipeline DCO in relation to the following above ground features:

- Ince AGI;
- Stanlow AGI;
- Rock Bank BVS;
- Mollington BVS;
- Aston Hill BVS;
- Northop Hall AGI;
- Flint AGI;
- Cornist Lane BVS;
- Pentre Halkyn BVS; and
- Babell BVS.

9.1.2. This Outline SWDS has been developed to manage surface water runoff within the development sites, taking into account potential climate change impact with the overall aim to reduce the rate of surface water runoff from the proposed development sites and limit the impact.

9.1.3. SuDS treatment methods have been identified and optimised to satisfy the pollution control requirements stated in various policies. The implementation of the proposed SuDS features including infiltration trench, filter drain, filter drainage channel, vortex separator and detention pond.

9.1.4. Stanlow AGI will be installed within the boundaries of the existing Essar Stanlow Refinery. It is proposed that the runoff from the AGI will drain into the existing refinery network. The discharge rate will be unrestricted within the Stanlow AGI site as it is part of a wider network.

9.1.5. For development sites:

- Ince AGI;
- Rock Bank BVS;
- Mollington BVS;
- Aston Hill BVS;
- Northop Hall AGI;
- Flint AGI;
- Cornist Lane BVS;
- Pentre Halkyn BVS; and
- Babell BVS.

9.1.6. The greenfield runoff rates calculated are relatively low. Therefore, in order to reduce the risk of blockages, it is proposed that the development sites will discharge at 2.0 l/s for all storms events up to and including the 1 in 100 years plus 40% CC.

9.1.7. The attenuation volume on-site will be provided by detention ponds located within soft landscape areas of the development sites.

9.1.8. It is considered that with the surface water drainage design in place, the development sites will not increase the risk of surface water flooding on or off-site or have any adverse impacts on existing watercourses and network.

9.1.9. This Outline SWDS has been presented to the SAB in presentation format as an introduction to the development, however further consultation beyond the presentation has been limited. Consultation responses from other relevant statutory authorities are also limited at the time of writing this Report. Any additional information which becomes available will be incorporated into the further detailed design. This Outline SWDS presents a conservative approach and detailed design will seek to refined within the parameters set.

9.1.10. Drainage strategies will be subject to further intrusive site surveys to confirm the topographies, condition of the development sites and feasibility of connections at detailed design stage.

9.1.11. It is recommended that BVS design should be informed by a site-specific drainage strategy to not attract surface water from adjacent fields. All station sites include some element of cutting into the hillslope and filling of lower areas to provide level platforms for the installation of equipment.

9.1.12. Where applicable and where there are modifications in the proposed ground levels, for example, proposed cut and fill operations, the surface water drainage design systems will be required to taken into consideration the contribution of adjacent catchments to prevent the risk of overland surface water runoff. This will be assessed in detailed design.

10. REFERENCES

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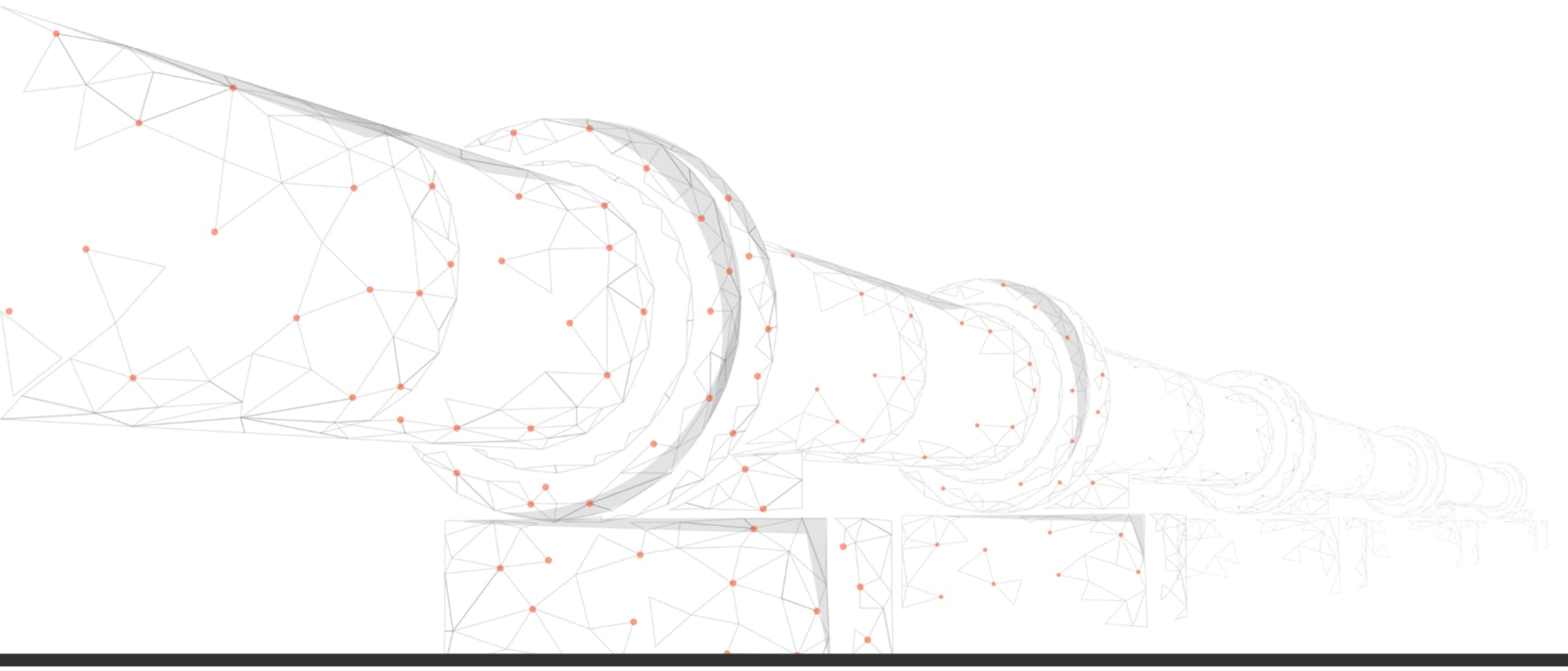
HyNet North West

Annex A

PROPOSED DEVELOPMENT PLANS & TOPOGRAPHICAL SURVEYS



HyNet Carbon Dioxide Pipeline DCO

Outline Surface Water Drainage Strategy (Tracked Change)

Ince AGI Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 1

Stanlow AGI Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 2

Rock Bank BVS Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 3

Mollington BVS Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 4

Aston Hill BVS Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 5

Northop Hall AGI Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 6

Flint AGI Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 7

Cornist Lane BVS Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 8

Pentre Halkyn BVS Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 9

Babell BVS Proposed Site Plan & Topo data – EN070007-D.6.5.13.2-LAY-SHEET 10

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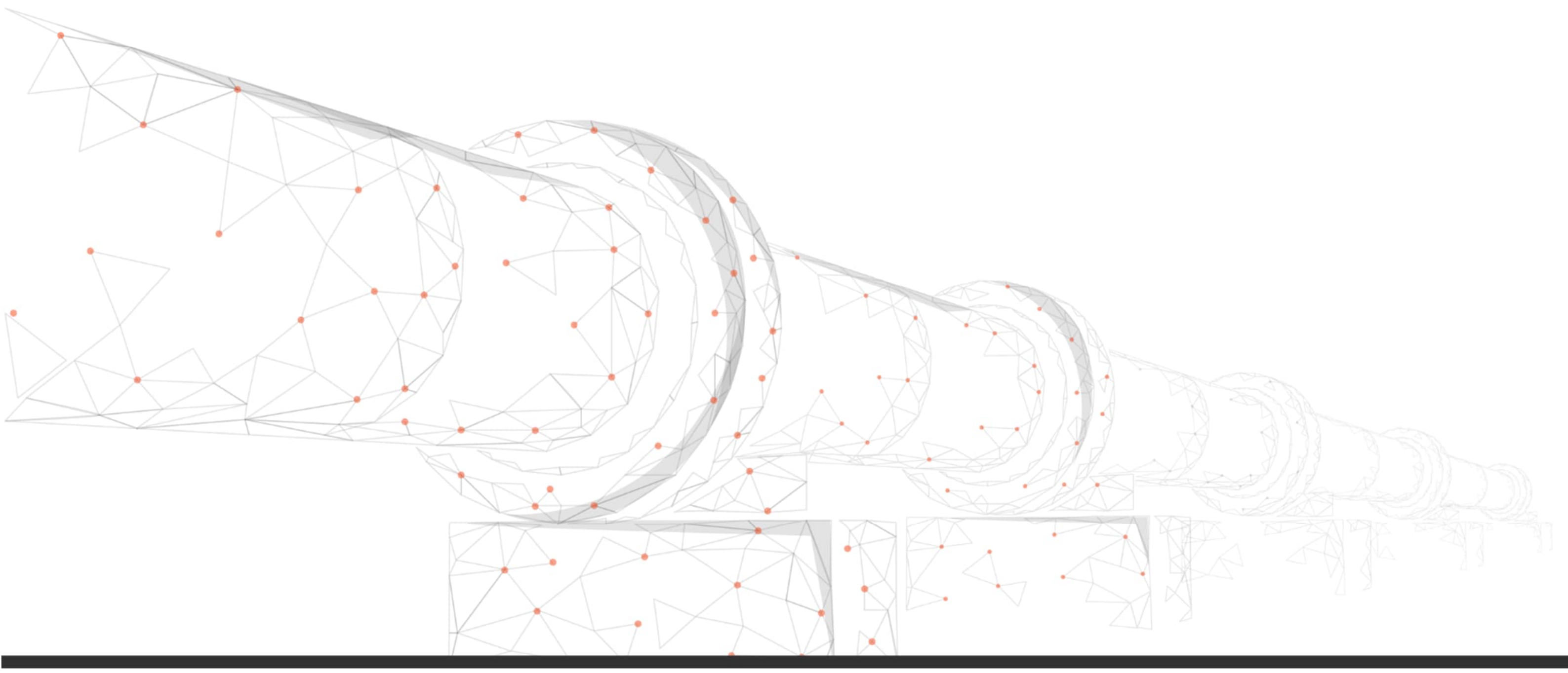
Annex B

PROPOSED CONCEPTUAL DRAINAGE LAYOUTS AND TYPICAL DRAINAGE CONSTRUCTION DETAILS



Ince AGI Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 1

Stanlow AGI Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 2

Rock Bank BVS Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 3

Mollington BVS Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 4

Aston Hill BVS Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 5

Northop Hall AGI Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 6

Flint AGI Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 7

Cornist Lane BVS Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 8

Pentre Halkyn BVS Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 9

Babell BVS Drainage Layout – EN070007-D.6.5.13.1-LAY-SHEET 10

Typical Drainage Construction Details Sheet 1 - EN070007-D.6.5.13.1-DET-SHEET 1

Typical Drainage Construction Details Sheet 2 - EN070007-D.6.5.13.1-DET-SHEET 2

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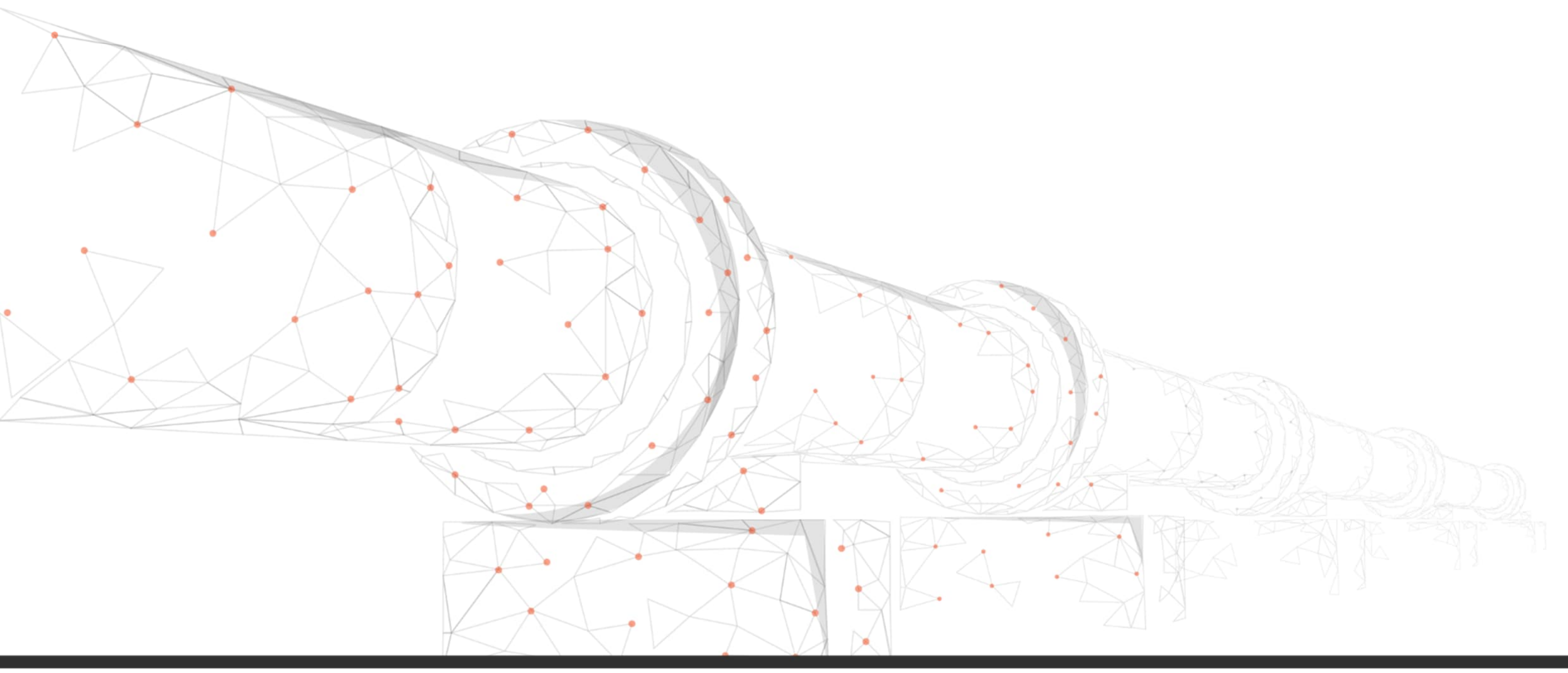
Annex C

PROPOSED STORAGE CALCULATIONS



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Outline Surface Water Drainage Strategy (Tracked Change)

Ince AGI Storage calculation

Rock Bank BVS Storage calculation

Mollington BVS Storage calculation

Aston Hill BVS Storage calculation

Northop Hall AGI Storage calculation

Flint AGI Drainage Layout Storage calculation

Cornist Lane BVS Storage calculation

Pentre Halkyn BVS Storage calculation

Babell BVS Storage calculation

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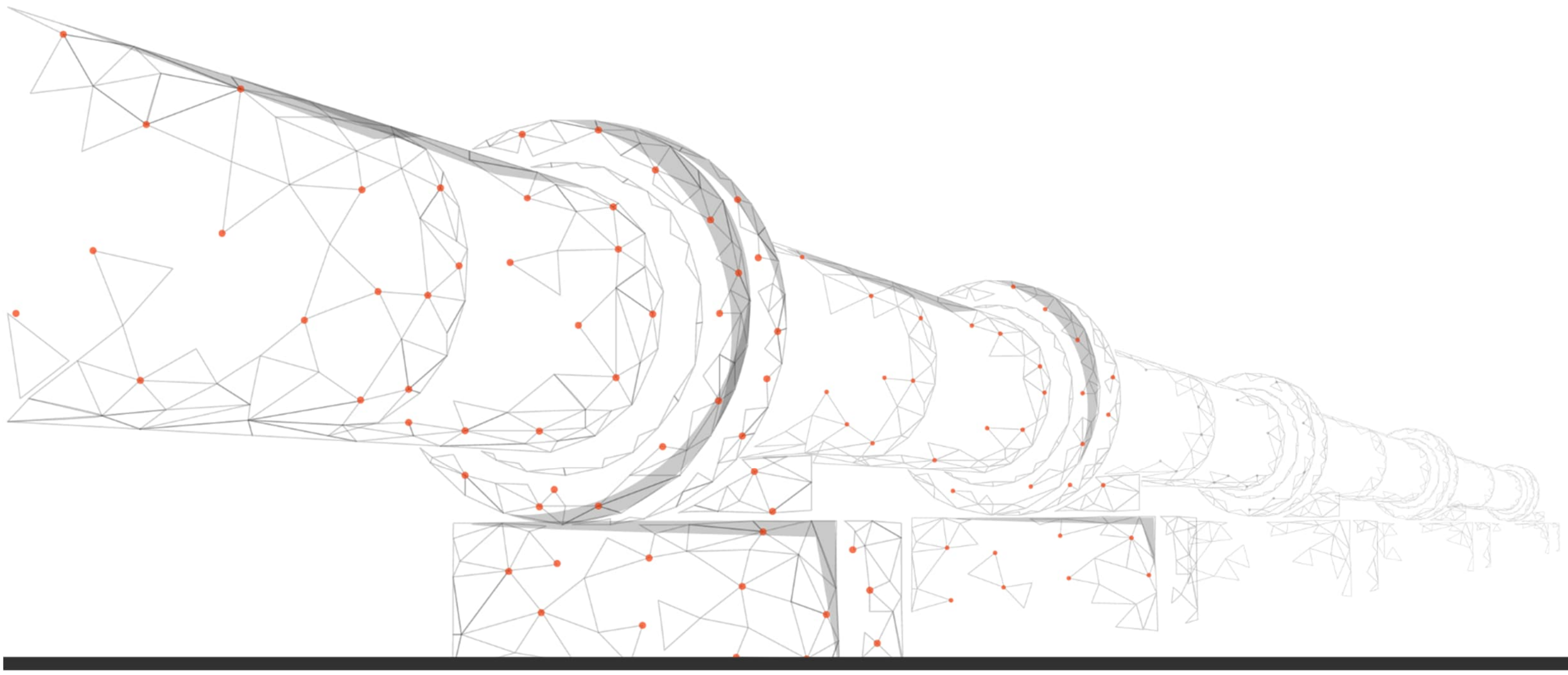
Annex D

CORRESPONDENCES



HyNet Carbon Dioxide Pipeline DCO

Outline Surface Water Drainage Strategy (Tracked Change)

Flintshire SAB Pre application advice

Cheshire West and Chester LLFA Pre application advice