SECTION 1:

DRAINAGE ASSESSMENT AND STATEMENT

PROPOSED ERECTION OF 11 INDUSTRIAL UNITS AND 4 OFFICE UNITS

STEPHENSON AVENUE, PINCHBECK, SPALDING, LINCOLNSHIRE PE11 3SW

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1.0 INTRODUCTION

1.1 Purpose of Statement

This Drainage Statement has been prepared to accompany a planning application for the proposed development of 11 industrial units and 4 office units at Stephenson Avenue, Pinchbeck, Spalding, Lincolnshire PE11 3SW. The statement sets out the comprehensive drainage strategy for the development, detailing how both surface water and foul water will be managed in accordance with current building regulations, local planning policy, and national guidance. This document should be read in conjunction with the accompanying Flood Risk Assessment and associated drainage plans.

1.2 Site Context

The application site is located within an established industrial estate on Stephenson Avenue, Pinchbeck, approximately 200 metres north of the River Welland. The site comprises an area of approximately 2,710 square metres of previously developed brownfield land with existing permeable surfaces. The proposed development will result in a total building footprint of 1,047.65 square metres, accommodating 11 industrial units suitable for light industrial, manufacturing, storage and distribution uses, together with 4 office units providing modern office accommodation. The development will utilise steel portal frame construction with 5.0 metre eaves height and galvanised steel cladding, consistent with the established character of the surrounding industrial estate.

1.3 Regulatory Framework and Standards

This drainage strategy has been developed in full accordance with the following standards, codes of practice, and guidance documents to ensure compliance with current legislation and best practice. The design incorporates the requirements of BS EN 752 relating to drain and sewer systems outside buildings, BS EN 1610 concerning the construction and testing of drains and sewers, BS EN 124 governing gully tops and manhole tops for vehicular and pedestrian areas, and BS 8301 providing the code of practice for building drainage. Additionally, the strategy complies with the Building Regulations 2010 as amended, specifically Approved Document H addressing drainage and waste disposal, and Approved Document C concerning site preparation and resistance to contaminates and moisture. Reference has been made to the National Planning Policy Framework, the Non-statutory technical standards for sustainable drainage systems published by DEFRA, and the CIRIA SuDS Manual (C753). The design also incorporates guidance from South Holland District Council's local planning policies and the Environment Agency's standing advice on flood risk and drainage matters.

2.0 EXISTING SITE CONDITIONS

2.1 Site Description and Topography

The development site is situated within an established industrial estate with the site benefiting from an existing connection to utility infrastructure in the surrounding area. The site occupies a relatively flat topography with ground levels at approximately 3.2 metres above Ordnance Datum throughout, presenting no significant topographical constraints that would adversely affect drainage provision or complicate the installation of drainage infrastructure. The site currently exists as brownfield industrial land with permeable surfaces that allow some degree of natural infiltration, although no formal drainage infrastructure is present within the site boundaries at present.

2.2 Flood Risk Context

The site has been comprehensively assessed in terms of flood risk from all sources as detailed in the accompanying Flood Risk Assessment. The site is located within Environment Agency Flood Zone 3a, indicating a high probability of flooding from fluvial sources, specifically from the River Welland located approximately 200 metres to the south. However, the river benefits from maintained flood defence embankments providing a quoted standard of protection to the 1 in 100 year flood event. The site lies at an elevation of 3.2 metres above Ordnance Datum, which is 1.32 metres below the modelled 1 in 100 year flood level of 4.52 metres above Ordnance Datum. Climate change allowances have been applied in accordance with current Environment Agency guidance, resulting in a design flood level of 4.68 metres above Ordnance Datum for the 1 in 100 year plus climate change scenario. The proposed development incorporates appropriate mitigation measures including raised floor levels and flood resilience measures as detailed in the Flood Risk Assessment.

2.3 Ground Conditions and Infiltration

The underlying ground conditions comprise clay and silty clay over mudstone, typical of the local geological context in this part of Lincolnshire. Soil permeability has been assessed as poor, with a Soil Index of 0.40 indicating limited infiltration potential. Whilst the site currently benefits from some natural infiltration through existing permeable brownfield surfaces, detailed assessment indicates that reliance on full infiltration drainage systems such as traditional soakaways would not be appropriate for this site due to the low permeability of the underlying soils. The drainage strategy therefore incorporates a hybrid approach utilising permeable paving for source control combined with underground attenuation storage and controlled discharge to the existing public surface water sewer system.

2.4 Existing Drainage Infrastructure

Investigation of existing drainage infrastructure in the vicinity of the site confirms the presence of a public surface water sewer measuring 825 millimetres in diameter located within Stephenson Avenue adjacent to the western site boundary. This sewer is maintained by Anglian Water Services Limited and has been confirmed as having adequate capacity to receive controlled surface water discharge from the proposed development subject to agreement of discharge rates. A main foul sewer connection is available at the south-western boundary of the site, providing capacity for foul drainage from the development. The site currently drains via natural infiltration and overland flow to site boundaries, with drainage patterns directing water towards the small watercourse located along the eastern boundary which flows northward to Scraggs Dyke and eventually discharges to the River Welland via the River Glen system.

3.0 PROPOSED DEVELOPMENT

3.1 Development Composition and Land Use

The proposed development will transform the 2,710 square metre site into a modern industrial and office complex comprising 11 industrial units and 4 office units. The building footprint will cover 1,047.65 square metres of the total site area, representing approximately 38.6% of the site. Hard landscaping will occupy 1,486.94 square metres, representing approximately 54.9% of the site area, and will consist entirely of permeable paving materials comprising permeable tarmac or permeable asphalt surfacing to facilitate surface water infiltration and source control. Soft landscaping comprising grass and shrub planting will cover the remaining 175.41 square metres, representing approximately 6.5% of the site area, providing additional surface water attenuation capacity, biodiversity enhancement, and visual amenity.

3.2 Site Layout and Access

Primary vehicular access to the development will be provided via Stephenson Avenue to the west of the site. Internal circulation routes have been designed to accommodate vehicles associated with light industrial operations, with adequate provision for vehicle turning and manoeuvring. Car parking provision has been designed in accordance with South Holland District Council's adopted parking standards, with dedicated parking areas for both staff and visitors. Service areas for loading and unloading operations have been integrated into the layout adjacent to the industrial units. The permeable paving system will be designed to accommodate the loadings associated with heavy goods vehicle movements whilst maintaining its drainage functionality.

3.3 Drainage Requirements

The proposed development will generate both foul water and surface water requiring appropriate collection, treatment where necessary, and disposal in accordance with building regulations and environmental protection requirements. Foul water will be produced from sanitary facilities within both the industrial and office units, including WCs, urinals, wash hand basins, cleaners' sinks, and kitchen facilities where provided. The volume of foul water generation will be determined by the occupancy levels and water usage patterns typical of light industrial and office uses. Surface water will be generated from roof areas of all buildings, amounting to 1,047.65 square metres of fully impermeable surface, together with surface water runoff from the hard landscaping areas which, despite comprising permeable paving materials, will generate some level of runoff during intense rainfall events. The drainage strategy must ensure that both foul and surface water are managed effectively without increasing flood risk to the site or to neighbouring properties and without causing pollution or other environmental harm.

4.0 FOUL WATER DRAINAGE STRATEGY

4.1 Design Principles and Approach

The foul water drainage system has been designed to convey all domestic sewage and foul water discharge from the development to the public foul sewer in accordance with Building Regulations Approved Document H and the requirements of Anglian Water Services Limited as the statutory sewerage undertaker. The system adopts a gravity drainage approach wherever practicable to minimise maintenance requirements and operational costs, with pipework sized and laid to gradients that ensure adequate flow velocities for self-cleansing whilst avoiding excessive velocities that could cause erosion or damage. The system incorporates appropriate access points for inspection, testing, and maintenance

through the provision of manholes and inspection chambers at strategic locations. All components have been specified to meet or exceed the requirements of relevant British Standards and European Standards.

4.2 Collection System Design

Foul drainage from sanitary appliances within each industrial and office unit will be collected via internal drainage pipework installed in accordance with Approved Document H. Soil and waste pipes will be manufactured from uPVC or other approved materials conforming to BS EN 1329-1 or BS 5255 as appropriate. Branch connections will incorporate appropriate access points such as rodding eyes or inspection chambers to facilitate future maintenance and clearing of blockages. Where pipework passes through the building structure, appropriate fire stopping measures will be incorporated in accordance with Approved Document B to maintain compartmentation. All sanitary appliances will be connected via appropriate traps to prevent the passage of foul air whilst allowing free discharge of waste water, with trap seal depths maintained in accordance with Building Regulations requirements.

4.3 Site Drainage Network Layout

The external foul drainage network, as indicated on the submitted drainage plan, will be constructed using uPVC pipes conforming to BS EN 1401-1 or clay pipes conforming to BS EN 295-1, with all joints being watertight and installed in accordance with BS EN 1610. Pipe diameters will be not less than 100 millimetres for connections from individual units, with the main site drain sized at 150 millimetres diameter to accommodate the combined flows from all units with appropriate allowance for future potential intensification of use. Pipework will be laid to falls not less than 1 in 80 to ensure self-cleansing velocities are achieved, with gradients designed such that a flow velocity of at least 0.75 metres per second can be achieved at times of peak flow. All pipework will be laid on a suitable granular bed and surrounded with granular material in accordance with the pipe manufacturer's recommendations to provide adequate support and protection. Pipe runs will be kept as straight as practicable, with changes in direction achieved through the use of properly constructed manholes or inspection chambers rather than tight radius bends which could be prone to blockage.

4.4 Manholes and Inspection Chambers

Manholes and inspection chambers will be provided at all changes in direction, changes in gradient, junctions between pipes, and at intervals not exceeding 90 metres on straight pipe runs in accordance with Approved Document H guidance. Chambers will be constructed using precast concrete sections conforming to BS EN 1917 or engineering brick construction conforming to BS 3921, with channel sections and benching formed to ensure smooth flow and to minimise the potential for blockages. Chamber covers and frames will conform to BS EN 124 and will be selected to match the appropriate load classification for their location, with Class D400 covers specified for areas subject to vehicular traffic and Class B125 covers for pedestrian areas. All chambers will be sealed to prevent infiltration of groundwater or exfiltration of foul water, with appropriate sealing gaskets provided at pipe entry points. Step irons or other suitable access provisions will be incorporated into deeper chambers to facilitate safe access for inspection and maintenance operations.

4.5 Connection to Public Sewer

The site drainage network will discharge to the existing public foul sewer connection point located at the south-western boundary of the site, as indicated by the magenta colouring on the submitted drainage

plan. The connection will be made in accordance with Anglian Water's requirements and will incorporate a new inspection chamber immediately prior to the point of connection to facilitate adoption and to provide a clear demarcation between private and public drainage systems. The connection detail will be designed to prevent surcharge from the public sewer affecting the site drainage system under normal operating conditions. Prior to commencement of the development, formal application will be made to Anglian Water for a connection agreement under Section 106 of the Water Industry Act 1991, and all connection works will be carried out by an approved contractor in accordance with Anglian Water's Code of Practice. Upon completion and successful testing, the external drainage system up to the connection point will be offered for adoption by Anglian Water in accordance with the provisions of Section 104 of the Water Industry Act 1991.

4.6 Design Flows and Capacity Assessment

Foul water generation has been assessed using the discharge unit method outlined in BS EN 12056-2 and Approved Document H, with appropriate allowances for peak flows based on the simultaneous usage factors applicable to the mix of sanitary appliances proposed. For the industrial units, an allowance of 6 litres per second per 100 square metres of floor area has been adopted, whilst for the office units a standard office occupancy rate has been assumed giving approximately 50 litres per person per day. These assumptions result in a total estimated peak foul discharge rate of approximately 3.5 litres per second for the entire development. The proposed 150 millimetre diameter main site drain is adequately sized to convey this flow at part-full running conditions, ensuring that sewer capacity is not exceeded and that self-cleansing velocities are maintained. The capacity of the existing public foul sewer to receive this additional flow will be confirmed through consultation with Anglian Water during the Section 106 connection application process.

4.7 Materials and Standards Compliance

All foul drainage pipework, fittings, manholes, and associated components will conform to the requirements of BS EN 752 (Drain and sewer systems outside buildings), BS EN 1610 (Construction and testing of drains and sewers), BS EN 124 (Gully tops and manhole tops for vehicular and pedestrian areas), and BS 8301 (Code of practice for building drainage). Pipe materials will be selected based on their appropriateness for the site conditions, anticipated loadings, and chemical resistance requirements. uPVC pipework will conform to BS EN 1401-1 and will be manufactured from virgin material with appropriate colour coding to indicate its intended use. Clay pipes, where used, will conform to BS EN 295-1 and will incorporate flexible joints to accommodate minor ground movements. All materials will bear appropriate third-party certification marks such as BSI Kitemark or equivalent to demonstrate compliance with relevant standards.

4.8 Installation and Testing Requirements

Installation of the foul drainage system will be carried out in accordance with BS EN 1610, which specifies requirements for workmanship, materials, and testing of drain and sewer systems. Excavations will be properly supported where necessary to prevent collapse, and adequate dewatering will be provided to ensure that pipework is laid in dry conditions. Pipe bedding and surround will be placed and compacted in accordance with the pipe manufacturer's recommendations to provide uniform support along the pipe length and to prevent point loading. Upon completion of installation and prior to backfilling, the drainage system will be subjected to comprehensive testing including air testing or water testing to verify that all joints are watertight and that the system is free from defects. A CCTV survey of the completed drainage

system will be conducted to provide a visual record of the system condition and to verify that no defects, debris, or blockages are present. All test results will be documented and provided to Building Control and to Anglian Water as part of the adoption process.

5.0 SURFACE WATER DRAINAGE STRATEGY

5.1 Design Philosophy and Sustainable Drainage Principles

The surface water drainage strategy adopts a sustainable approach based on the principles of sustainable drainage systems, seeking to manage surface water as close to its source as possible and to mimic natural drainage patterns. The strategy follows the hierarchy established in national planning guidance, with priority given to infiltration where ground conditions permit, followed by discharge to watercourses, and finally discharge to sewers only where other options are not reasonably available. Given the poor infiltration characteristics of the underlying soils on this site, a hybrid approach has been adopted incorporating permeable paving for source control and attenuation, supplemented by underground storage with flow control and ultimate discharge to the existing public surface water sewer. This approach ensures that surface water runoff is managed effectively, that flood risk is not increased either on the site or elsewhere, and that water quality is protected through the filtering and treatment effects of the sustainable drainage components.

5.2 Existing Site Runoff Characteristics

The existing site in its current brownfield condition with permeable surfaces generates relatively low rates of surface water runoff due to the infiltration capacity of the existing surfaces and the absence of concentrated impermeable areas. Based on the site area of 2,710 square metres and the existing surface characteristics, the estimated existing runoff rate during a 1 in 100 year rainfall event is in the order of 2.5 to 3.0 litres per second. This provides a baseline against which the performance of the proposed drainage system can be assessed, with the objective of achieving betterment by ensuring that post-development discharge rates do not exceed, and preferably are lower than, the existing rates. This approach ensures that the development does not increase flood risk to neighbouring properties or to downstream watercourses and sewers.

5.3 Proposed Development Runoff Generation

The proposed development will alter the site's surface characteristics, increasing the proportion of impermeable surfaces and therefore the volume and rate of surface water runoff requiring management. The building footprint of 1,047.65 square metres represents fully impermeable roof area from which rainfall will be collected via guttering and downpipes. The hard landscaping area of 1,486.94 square metres will comprise permeable paving materials which, whilst significantly reducing runoff compared to conventional impermeable paving, will still generate some level of runoff particularly during intense rainfall events when the infiltration capacity of the paving structure may be exceeded. The soft landscaping area of 175.41 square metres will function largely as a pervious surface with minimal runoff generation. Taking into account appropriate runoff coefficients for each surface type, the effective impermeable area contributing to runoff is calculated as approximately 1,590 square metres. Without

mitigation, this would result in significantly increased runoff rates compared to the existing situation, potentially generating flows in excess of 11 to 14 litres per second during a 1 in 100 year plus climate change event.

5.4 Climate Change Allowances

In accordance with current Environment Agency guidance on climate change allowances, the surface water drainage system has been designed to accommodate increased rainfall intensity resulting from climate change over the design life of the development. For commercial development with a 75-year design life extending from 2025 to 2100, the Higher Central climate change allowance of 40% has been applied to the design rainfall intensity. This precautionary approach ensures that the drainage system will continue to perform satisfactorily even as climate patterns change and rainfall intensities increase. The 40% allowance is applied to the 1 in 100 year design storm, resulting in a design event equivalent to the 1 in 100 year rainfall intensity increased by 40%, which represents a substantial additional capacity requirement compared to designing for current climate conditions alone.

5.5 Permeable Paving System

The hard landscaping areas totalling 1,486.94 square metres will be constructed using permeable paving materials comprising either permeable tarmac, permeable asphalt, or permeable block paving, all of which provide effective source control of surface water runoff. Permeable paving systems function by allowing rainfall to infiltrate through the surface course into an open-graded sub-base where water is temporarily stored before either infiltrating to the underlying ground or, in this case given the poor ground permeability, being collected and conveyed to the underground attenuation storage system. The permeable paving will be constructed with a surface course thickness of 40 to 60 millimetres, an open-graded base course of 80 to 100 millimetres, and a sub-base layer of 150 to 300 millimetres depth using Type 3 open-graded stone or equivalent approved material. A geotextile membrane will be installed between the sub-base and the underlying subgrade to prevent migration of fines whilst allowing water movement. The permeable paving structure provides multiple benefits including reduction of peak runoff rates through temporary storage within the pavement voids, improvement of water quality through filtration as water passes through the pavement layers, and provision of a trafficable surface suitable for vehicle movements including heavy goods vehicles when designed with appropriate structural depth.

Within the total hard landscaping area of 1,486.94 square metres, a sub-area of 1,104.37 square metres, indicated by cyan colouring on the submitted drainage plan, has been specifically allocated for the installation of the underground soakaway attenuation storage system beneath the permeable paving. This integration of permeable paving with underground storage provides an efficient use of space whilst maintaining the surface functionality required for vehicle circulation and parking. The permeable paving in this area will be designed with additional sub-base depth to accommodate the geocellular storage crates or other modular storage units, whilst the remaining permeable paved areas will be constructed to standard specifications appropriate for the anticipated traffic loading.

5.6 Roof Drainage Collection

Surface water runoff from the building roofs will be collected via uPVC guttering systems sized at 150 millimetre half-round or equivalent profile, installed with appropriate falls to prevent standing water and incorporating stop-ends, angles, and outlets as required by the roof geometry. Guttering will be installed to manufacturers' specifications with proper support brackets spaced at centres not exceeding 1.0 metre to prevent sagging and ensure long-term performance. Leaf guards or other debris exclusion devices will

be fitted to gutter outlets to minimise the potential for blockage. Downpipes will be manufactured from 100 millimetre diameter uPVC pipe, sized to convey the anticipated peak flows from the roof areas during the design storm event with adequate capacity to prevent surcharging of the guttering system. Downpipes will be securely fixed to the building facades using appropriate pipe clips at maximum 1.8 metre centres.

At ground level, downpipes will connect into the site surface water drainage system via appropriate gullies or direct connections into the underground drainage pipework. Gullies will incorporate sediment traps to capture silt and debris before it enters the main drainage system, thereby protecting the downstream components from blockage and reducing maintenance requirements. Where downpipes discharge in areas of permeable paving, connection may be made directly to the permeable paving sub-base or to collector drains running beneath the paving. Where downpipes are located adjacent to building footprints in non-permeable areas, connection will be made to a piped collection system which will convey flows to the underground attenuation storage.

5.7 Underground Attenuation Storage System

The surface water drainage strategy incorporates underground attenuation storage with a total capacity of 105 cubic metres, designed to accommodate the volume of surface water runoff generated during the 1 in 100 year rainfall event plus 40% climate change allowance whilst restricting the discharge rate to the public sewer to the target rate of 3.0 litres per second. The storage system will be constructed using modular geocellular crate storage units installed beneath the permeable paving in the designated area of 1,104.37 square metres shown in cyan on the drainage plans. Geocellular storage systems comprise interlocking plastic crate modules that provide a high void ratio typically in the order of 95%, meaning that the vast majority of the excavated volume is available for water storage with only 5% occupied by the structural elements of the crates themselves.

The storage crates will be installed within an excavation of appropriate depth, with the formation level prepared and compacted to provide a stable base. The base of the excavation will be overlaid with a geotextile membrane to separate the storage structure from the underlying subgrade and to prevent migration of fines into the storage void. The geocellular crates will be assembled in accordance with the manufacturer's instructions to create a storage volume with the required capacity, with typical individual crate dimensions being approximately 1.0 metre by 0.5 metre by 0.4 metre. The crates will be wrapped in a non-woven geotextile membrane to prevent ingress of soil particles whilst allowing water to enter the storage volume. The storage tank will be backfilled with clean angular stone of 20 to 40 millimetre grading, or in accordance with the crate manufacturer's specification, to provide additional storage capacity within the voids between stones and to assist with load distribution.

An example configuration to provide the required 105 cubic metres of effective storage would comprise a storage tank with overall dimensions of approximately 8.0 metres by 7.0 metres in plan and 2.0 metres in depth, installed at a formation level approximately 2.5 metres below finished ground level to allow for both the storage depth and the overlying construction depth of the permeable paving. With a typical void ratio of 95% for the geocellular crates, a gross volume of approximately 110 cubic metres would be required to achieve the target effective storage volume of 105 cubic metres. The final detailed design will optimise the storage tank dimensions based on the specific site constraints and the actual void ratios of the selected proprietary storage system.

5.8 Flow Control and Discharge Limitation

Discharge from the underground attenuation storage system to the public surface water sewer will be controlled by means of a hydrobrake or vortex flow control device sized to restrict the outflow to a maximum rate of 3.0 litres per second under all operating conditions up to and including the design storage depth. The flow control device operates through vortex action, with the discharge rate being dependent on the water level within the storage tank such that flows increase progressively as the water level rises, reaching the maximum design flow of 3.0 litres per second when the tank is approaching its full storage capacity. This type of device is passive in operation with no moving mechanical parts, thereby providing high reliability and minimal maintenance requirements.

The flow control device will be installed within a dedicated control chamber located at the outlet from the underground storage tank, with the chamber constructed to provide access for inspection and maintenance of the device. The controlled discharge will then pass via a 150 millimetre diameter pipe to the connection point with the public surface water sewer in Stephenson Avenue. The outfall pipe will be laid to a gradient not less than 1 in 200 to ensure self-cleansing whilst avoiding excessive velocities, and will be sized to operate part-full at the maximum discharge rate to provide a free surface and prevent backing up of water into the storage tank under normal conditions. A non-return valve or flap valve will be incorporated into the outfall connection to prevent surcharge from the public sewer backing up into the site drainage system during periods of high flows in the sewer network.

5.9 Emergency Overflow Provisions

The attenuation storage system will incorporate emergency overflow arrangements to provide a safe discharge route for surface water in the event that the storage capacity is exceeded during extreme rainfall events more severe than the design event, or in the event of blockage or malfunction of the flow control system. The overflow will comprise a 300 millimetre diameter pipe installed with its invert level set at an appropriate elevation within the storage tank such that the overflow only operates when the water level exceeds the design level for the 1 in 30 year storm event. This ensures that the overflow functions only under extreme conditions and not during routine rainfall events.

The emergency overflow will discharge to a controlled location within the site boundary where surface flooding can occur safely without causing damage to buildings or posing risks to people or property. The overflow route will be designed to direct flood water away from building entrances and to areas of soft landscaping where water can pond temporarily before infiltrating or evaporating. Flood exceedance routes across the site have been identified and assessed to ensure that in the event of system exceedance, flood water flows remain on the site and do not affect neighbouring properties. The site grading and levels will be designed to ensure that all buildings have finished floor levels elevated above the anticipated flood levels during exceedance events.

5.10 Surface Water Quality Management

The surface water drainage system incorporates water quality management features to ensure that runoff discharged to the public sewer does not contain excessive levels of suspended solids, hydrocarbons, or other pollutants that could cause environmental harm or affect the performance of the receiving sewer system. The permeable paving provides a high level of treatment through filtration as runoff percolates through the paving layers, with pollutants being trapped and biodegraded within the paving structure. Additionally, the underground storage system provides settlement of suspended solids, with heavier particles settling to the base of the storage tank where they can be removed during periodic maintenance operations.

Where the site includes areas with potential for spillage of oils or other hydrocarbons, such as loading areas or heavy vehicle circulation routes, consideration may be given to the provision of oil interceptors or other specialised treatment devices upstream of the main attenuation storage. However, given the nature of the proposed industrial uses and the relatively low risk of significant contamination, it is anticipated that the treatment provided by the permeable paving and storage system will be adequate. If future occupiers' activities present elevated pollution risks, additional treatment measures can be retrofitted into the system. Gullies and inspection chambers will incorporate silt traps to capture coarse sediment before it enters the main drainage system, with these traps being accessible for regular cleaning and removal of accumulated material.

5.11 Connection to Public Surface Water Sewer

The controlled discharge from the site will connect to the existing Anglian Water 825 millimetre diameter public surface water sewer located in Stephenson Avenue adjacent to the western site boundary. The connection will be made in accordance with Anglian Water's requirements and will incorporate a new inspection chamber immediately prior to the point of connection to provide a clear demarcation between private and public drainage systems and to facilitate future adoption. Prior to commencement of development, formal application will be made to Anglian Water for agreement to discharge surface water to the public sewer, including submission of supporting calculations and drainage drawings to demonstrate that the proposed discharge rate of 3.0 litres per second is acceptable and will not cause hydraulic problems in the receiving sewer system. The connection works will be carried out by an approved contractor in accordance with Section 106 of the Water Industry Act 1991.

5.12 Soft Landscaping Contribution

The soft landscaping areas comprising 175.41 square metres of grass and shrub planting will make a modest contribution to the overall surface water management strategy through provision of infiltration capacity and evapotranspiration. Whilst not relied upon in the hydraulic calculations due to their relatively small area, these landscaped zones provide additional resilience and help to reduce the overall effective impermeable area of the site. The planting will be selected to be tolerant of occasional inundation and to provide good ground cover, thereby minimising soil erosion and reducing the potential for sediment to enter the surface water drainage system. The soft landscaping also contributes to wider environmental objectives including biodiversity enhancement, visual amenity, and urban cooling through provision of vegetation.

5.13 Drainage Calculations and Storage Requirements

Detailed hydraulic calculations have been undertaken to determine the required attenuation storage volume, taking account of the site area, the proportion of impermeable surfaces, the runoff coefficients applicable to each surface type, design rainfall intensities for the critical storm duration, and the permitted discharge rate. The calculations follow the methodology set out in the CIRIA SuDS Manual and industry standard practice, using rainfall data derived from the Flood Estimation Handbook for the site location. The design storm event is the 1 in 100 year rainfall event with the addition of a 40% climate change allowance, applied over a range of storm durations to identify the critical duration that generates the maximum storage requirement.

The critical storm duration has been identified as 240 minutes, which represents the storm duration at which the difference between the total inflow volume to the attenuation system and the total outflow volume via the flow control device is maximised. For this critical duration, the cumulative inflow volume

accounting for the contributing impermeable area and climate-adjusted rainfall depth is approximately 147.5 cubic metres, whilst the cumulative outflow volume over the same duration at the restricted discharge rate of 3.0 litres per second is 43.2 cubic metres, giving a net storage requirement of 104.3 cubic metres. With appropriate allowances for sediment accumulation and design tolerance, a design storage volume of 105 cubic metres has been specified, which provides adequate capacity to accommodate the design storm whilst maintaining a modest freeboard for additional resilience.

The storage system has been sized conservatively with runoff coefficients selected to represent realistic long-term performance accounting for potential deterioration of permeable paving performance if maintenance is inadequate. Sensitivity analysis has been conducted to assess the impact of variations in key parameters, confirming that the proposed storage volume of 105 cubic metres remains adequate across a reasonable range of assumptions. The most sensitive parameter is the discharge rate, and it is therefore critical that the flow control device is maintained properly and that the 3.0 litres per second discharge limitation is not exceeded.

6.0 CONSTRUCTION STANDARDS AND SPECIFICATIONS

6.1 Drainage Pipe Materials and Standards

All drainage pipework will be manufactured from materials appropriate to their intended use and will conform to relevant British Standards and European Standards as specified. Foul drainage pipes will be manufactured from uPVC conforming to BS EN 1401-1 or vitrified clay conforming to BS EN 295-1, with all pipes being of appropriate thickness and strength to withstand the anticipated loading conditions including vehicle surcharge where pipes pass beneath access roads or parking areas. Surface water drainage pipes will similarly be manufactured from uPVC conforming to BS EN 1401-1, with pipe wall thickness selected based on anticipated depth of cover and loading class. Pipes will be marked with the manufacturer's identification, material specification, and nominal size, and will bear third-party certification marks where applicable.

Joints between pipes will be of the flexible ring-seal type conforming to the requirements of the relevant pipe standard and will be assembled in accordance with the manufacturer's instructions to ensure watertight performance. Lubricant applied to joints will be of a type recommended by the pipe manufacturer and will not contain petroleum-based products that could degrade rubber sealing rings. Where pipes change size or direction, proprietary fittings such as bends, junctions, and reducers will be used in preference to field-cut modifications that could compromise performance.

6.2 Installation and Bedding Requirements

All drainage pipes will be laid on prepared beds and surrounded with bedding and surround materials in accordance with BS EN 1610 and the pipe manufacturer's recommendations. Trench bottoms will be prepared to provide a uniform bearing surface free from protruding stones or other hard objects that could cause point loading on the pipe. Where soft spots or unsuitable material is encountered at formation level, such material will be excavated and replaced with suitable granular material properly compacted.

The bedding material will typically comprise 10 millimetre single-sized pea gravel or coarse sand to Class D bedding in accordance with the classification system detailed in Sewers for Adoption guidance, providing a minimum 100 millimetre thickness beneath the pipe and extending to at least the pipe springings on either side.

Initial backfill to a level 300 millimetres above the pipe crown will comprise selected granular material free from stones exceeding 40 millimetres in any dimension, carefully placed and compacted in layers not exceeding 150 millimetres thickness to avoid damage to or displacement of the pipe. Compaction will be achieved using hand-held compaction equipment in the immediate vicinity of the pipe, with mechanical compaction equipment only being used at distances sufficient to avoid pipe damage. Final backfill to finished ground level may comprise excavated site material provided this is suitable and free from excessive clay, organic matter, or deleterious material. Where pipes pass beneath areas subject to vehicular traffic, particular attention will be paid to achieving adequate compaction of backfill material to prevent subsequent settlement and surface deformation.

6.3 Manhole and Inspection Chamber Construction

Manholes and inspection chambers will be constructed using precast concrete sections conforming to BS EN 1917, supplied complete with factory-formed channels and benching to ensure smooth flow transitions and minimise turbulence that could lead to deposition of solids. Chamber sections will be installed truly vertical with joints between sections sealed using manufacturer-approved jointing compounds or gaskets to prevent infiltration of groundwater or exfiltration of sewage. The base section will be installed on a prepared concrete foundation of adequate thickness and strength to prevent settlement, typically comprising a minimum 150 millimetre thickness of C20 concrete.

Internal benching will be formed to provide smooth transitions between incoming and outgoing pipes, with benching slopes not less than 1 in 12 falling towards the channel to prevent ponding and accumulation of solids. Where step irons are required for access into deeper chambers, these will be manufactured from durable materials such as galvanised steel or polypropylene and will be installed at 300 millimetre vertical centres in accordance with Health and Safety Executive guidance on safe access to confined spaces. Chamber covers and frames will be bedded on mortar to ensure level installation and to prevent rocking or movement under traffic loading.

Cover and frame assemblies will be selected to provide the appropriate load classification for their location in accordance with BS EN 124, with Class D400 assemblies specified for areas subject to vehicle traffic and Class B125 for pedestrian areas. Where covers are located in areas visible to the public or where aesthetics are important, consideration will be given to recessed covers capable of receiving a surface infill matching the surrounding paving material. All covers will be clearly marked to indicate the nature of the drainage system, with "FW" marking for foul water chambers and "SW" marking for surface water chambers.

6.4 Testing and Commissioning Requirements

Upon completion of installation and prior to backfilling of trenches or commissioning of the drainage system, comprehensive testing will be undertaken to verify that the installation has been completed to the required standards and that all components are functioning correctly. Testing of foul drainage pipework will be conducted in accordance with Approved Document H and BS EN 1610, employing either air testing or water testing methods as appropriate to the pipe material and configuration. Air testing will be conducted at a pressure of 100 millimetres water gauge maintained for a test period of five minutes, with

acceptance criteria requiring that pressure loss during the test period does not exceed specified limits indicating the presence of leaks.

Water testing will be employed where air testing is not practicable, with test sections being sealed at the lower end and filled with water to a level providing a test head equivalent to the depth of cover plus one metre, subject to a maximum head of six metres. The water level will be monitored over a test period of 30 minutes, with acceptance based on the rate of water loss being within specified limits accounting for absorption by pipe and joint materials. Following successful completion of pressure testing, a CCTV survey will be conducted throughout the entire length of the drainage system to provide a visual record of the installation condition and to verify that no defects, damage, or blockages are present. The CCTV survey will be recorded digitally and copies provided to Building Control, the Local Authority, and Anglian Water as appropriate.

Surface water drainage components including the underground attenuation storage system, flow control device, and permeable paving will similarly be tested to verify correct installation and performance. The attenuation storage tank will be inspected visually prior to backfilling to ensure that all crate modules are correctly assembled, that geotextile wrapping is complete and undamaged, and that inlet and outlet connections are properly sealed. A flooding test may be conducted by filling the storage tank with water to verify that the specified storage volume is achieved and that the flow control device restricts discharge to the design rate. All test results and inspection records will be documented in a comprehensive commissioning report which will form part of the handover documentation and will be retained for future reference during maintenance operations.

7.0 ADOPTION AND MAINTENANCE

7.1 Adoption Proposals

It is proposed that the external drainage system, comprising both foul water and surface water drainage infrastructure up to the respective connection points with the public sewerage system, be offered for adoption by Anglian Water Services Limited under the provisions of Section 104 of the Water Industry Act 1991. This will provide long-term security for the maintenance and operation of the principal drainage infrastructure and will transfer liability for the public sewers to the statutory undertaker. Prior to commencement of construction, detailed design drawings and specifications will be submitted to Anglian Water for technical approval to ensure compliance with Sewers for Adoption standards. Construction will be carried out by contractors approved by Anglian Water and will be subject to supervision and inspection by Anglian Water representatives at key stages including commencement, pipe laying, testing, and practical completion.

Following successful completion and testing of the drainage works, formal application for adoption will be submitted to Anglian Water together with all required documentation including as-built drawings, test certificates, CCTV survey records, and health and safety information. Upon adoption, Anglian Water will assume responsibility for maintenance, repair, and renewal of the adopted sewers, with the point of adoption being clearly defined at the connection manholes adjacent to the public sewer connection points. Elements of the drainage system that are not adopted, including any private lateral drains serving individual units between the buildings and the main site sewers, will remain the responsibility of the property owners and will require maintenance under private arrangements.

7.2 Pre-Adoption Maintenance Arrangements

During the period between practical completion of the drainage works and formal adoption by Anglian Water, which may extend for up to 12 months following completion of the final property connection, maintenance responsibility will rest with the developer or the site management company. A commuted sum may be payable to Anglian Water to cover this initial maintenance period, calculated in accordance with Anglian Water's standard rates. During this pre-adoption period, regular inspection and maintenance of the drainage system will be undertaken to ensure that it remains in good working order and that any defects arising from the construction phase are identified and rectified. Particular attention will be paid to ensuring that inspection chambers remain clean and free from accumulated sediment or debris, that the attenuation storage system is operating correctly with the flow control device restricting discharge as designed, and that permeable paving surfaces are maintained in a clean condition to preserve their infiltration capacity.

7.3 Long-Term Maintenance Requirements

Whether the drainage infrastructure is adopted by Anglian Water or remains under private management arrangements, ongoing maintenance will be essential to ensure continued satisfactory performance throughout the design life of the development. A comprehensive maintenance schedule will be established identifying the frequency and scope of maintenance activities for each component of the drainage system. This schedule will be incorporated into the site management regime and will be communicated to all tenants and occupiers to ensure awareness of maintenance requirements and to facilitate reporting of any drainage problems that may arise.

8.0 FLOOD RESILIENCE AND CLIMATE ADAPTATION

Flood resilience and climate adaptation have been covered in greater detail as part of section 2 to the assessment of drainage and flood risk documents as part of this application; pleae refer to the enclosed Flood Risk Statement and Assessment for further explanation.

9.0 COMPLIANCE AND APPROVALS

9.1 Building Regulations Compliance

The drainage design complies with the requirements of the Building Regulations 2010 as amended, specifically Approved Document H which sets out requirements for drainage and waste disposal. The design addresses all relevant aspects of Approved Document H including sanitary pipework design, foul drainage design, rainwater drainage design, solid waste storage, and drainage fields and mounds. Detailed drainage calculations have been prepared demonstrating compliance with the performance requirements of the regulations, and these calculations together with detailed drawings will be submitted to Building Control for approval prior to commencement of construction. The drainage installation will be subject to inspection by Building Control at key stages including excavation and bedding, pipe laying, backfilling, and testing, with certification being issued upon satisfactory completion of the works.

9.2 Water Authority Approvals

Applications for connection to the public foul sewer and public surface water sewer will be submitted to Anglian Water Services Limited under Section 106 of the Water Industry Act 1991 prior to commencement of construction. The applications will include detailed drawings showing the proposed connection arrangements, hydraulic calculations demonstrating the anticipated flows, and evidence that the design complies with Anglian Water's standards as set out in Sewers for Adoption guidance. Anglian Water will be required to either grant the connection approval or to provide a technical objection within 21 days of receipt of a properly completed application. Connection works to the public sewers will be carried out by contractors approved by Anglian Water and will be subject to inspection by Anglian Water representatives.

Following completion of the works, formal application will be made to Anglian Water for adoption of the site drainage system under Section 104 of the Water Industry Act 1991. The adoption application will include as-built drawings, test certificates, CCTV survey records, and all other documentation required by Anglian Water's adoption procedures. A commuted sum may be payable to Anglian Water to cover maintenance during the initial adoption period, calculated in accordance with Anglian Water's published rates. Upon adoption, Anglian Water will assume responsibility for maintenance and operation of the adopted sewers, with adoption being confirmed by formal adoption agreement between the developer and Anglian Water.

9.3 Lead Local Flood Authority Consultation

The surface water drainage proposals have been developed with consideration of the requirements of South Holland District Council as the Lead Local Flood Authority for management of surface water flooding. The strategy adopts sustainable drainage principles and incorporates source control through permeable paving, attenuation storage, and controlled discharge rates that provide betterment compared to the existing brownfield runoff rates. The design includes appropriate climate change allowances and has been sized to accommodate the 1 in 100 year plus 40% climate change storm event, providing a robust and resilient drainage solution that will not increase flood risk to the site or to neighbouring properties.

Consultation will be undertaken with the Lead Local Flood Authority during the planning application process to confirm acceptance of the proposed drainage strategy and to address any comments or requirements that may be raised. Following grant of planning permission, detailed drainage design drawings and calculations will be submitted to the Lead Local Flood Authority for technical approval prior to commencement of construction if required by planning condition. The drainage system will be constructed in accordance with the approved details and any variations will be subject to approval by the Lead Local Flood Authority.

9.4 Environment Agency Consultation

Given that the site is located within Flood Zone 3a and is within 20 metres of a main river (the River Welland being located approximately 200 metres to the south), the development proposals have been assessed against Environment Agency requirements for development in flood risk areas. The accompanying Flood Risk Assessment demonstrates that the development can be made safe for its design life without increasing flood risk elsewhere, and incorporates appropriate mitigation measures including raised floor levels and flood resilience measures. The surface water drainage strategy includes appropriate climate change allowances in accordance with Environment Agency guidance and ensures that surface water discharge rates do not exceed the existing rates from the site.

The planning application will be forwarded to the Environment Agency for consultation in accordance with national planning procedures, and any comments or requirements raised by the Environment Agency will be addressed through appropriate amendments to the proposals or through imposition of planning conditions. The development will be carried out in accordance with any requirements imposed by the Environment Agency, and liaison will be maintained with the Environment Agency during the construction phase if required to address any matters that may arise.

10.0 SUMMARY AND CONCLUSIONS

10.1 Drainage Strategy Overview

This Drainage Statement has set out a comprehensive drainage strategy for the proposed development of 11 industrial units and 4 office units at Stephenson Avenue, Pinchbeck, Spalding. The strategy addresses both foul water and surface water drainage requirements and incorporates sustainable drainage principles to ensure that the development can be adequately drained without increasing flood risk to the site or to neighbouring properties and without causing environmental harm. The drainage design has been developed in accordance with current building regulations, British Standards, and industry best practice guidance, and incorporates appropriate climate change allowances to ensure that the system will continue to perform satisfactorily throughout the design life of the development.

APPENDIX A:

PROPOSED SPECIFICATIONS FOR FOUL DRAINAGE INSTALLATIONS

A1. FOUL DRAINAGE SYSTEM

A1.1 System Overview

Foul sewerage from all 16 units will be collected via a ring drainage system connecting to the existing public foul sewer approximately 1 metre from the southern boundary.

A1.2 Ring Drainage System Design

A1.2.1 General Principles

- Gravity drainage system with appropriate falls
- Ring configuration providing redundancy and flexibility
- Access points for maintenance and inspection
- Compliance with Building Regulations Part H

A1.2.2 Pipe Specification

Main Ring Drainage Pipes:

- **Material:** uPVC to BS EN 1401-1
- **Diameter:** 150mm minimum for main runs
- **Joints:** Push-fit ring seal joints to BS EN 681-1
- **Colour:** Terracotta brown or orange for identification
- **Bedding:** Selected granular material to BS 882

Branch Connections:

- **Material:** uPVC to BS EN 1401-1
- **Diameter:** 110mm for individual unit connections
- **Gradient:** Minimum 1:80 (1.25%) for 110mm pipes
- **Maximum:** 1:40 where space permits

A1.2.3 Installation Specification

Excavation:

- Minimum 150mm clearance around pipe diameter
- Excavation width: pipe diameter + 300mm minimum
- Trench sides to be adequately supported
- Removal of stones >40mm diameter from trench bottom

Bedding and Backfill:

- **Bedding Material:** 10mm nominal single size aggregate to BS 882
- **Bedding Depth:** 100mm minimum beneath pipe invert

- **Side Support:** Granular material to spring line of pipe
- **Initial Backfill:** Selected granular material to 300mm above pipe crown
- **Final Backfill:** Excavated material free from stones >75mm, compacted in 150mm layers

Pipe Laying:

- Pipes laid to even gradient between manholes
- Joints made in accordance with manufacturer's instructions
- Pipe testing to BS EN 1610 prior to backfilling

A1.2.4 Access Points and Manholes

Manhole Locations:

- At changes of direction >30°
- At changes of gradient
- At junctions
- Maximum spacing 90m for 150mm pipes
- At connection to public sewer

Manhole Specification:

- **Type:** Precast concrete rings to BS 5911-3 or plastic to BS EN 13598-2
- **Internal Diameter:** 1200mm minimum
- **Base:** Precast concrete with benching to BS 5911-3
- **Cover:** Grade B125 to BS EN 124 for light traffic areas, Grade D400 for vehicular areas
- **Frame:** Cast iron to BS EN 124
- **Access:** Fixed step irons to BS 1247 where depth >1.2m

A1.2.5 Connection to Public Sewer

- Connection via new junction or Y-branch as approved by Anglian Water
- Application for connection under Section 106 of Water Industry Act 1991
- Works undertaken by approved contractor
- Flow rates not to exceed 1:4.5 litres/second/hectare

A1.3 Unit Connections

Each unit connected via individual branch drain:

- 110mm uPVC pipe from unit to ring main
- Minimum gradient 1:80
- Access rodding eye at building line

APPENDIX B:

PROPOSED SPECIFICATIONS FOR SURFACE WATER DRAINAGE INSTALLATION

B1. SURFACE WATER DRAINAGE SYSTEM

B1.1 System Overview

Surface water will be managed through a combination of:

- Permeable surfacing for source control
- Underground soakaway systems
- Integrated landscape-based infiltration
- Emergency overflow provisions where required

B1.2 Design Criteria

- **Return Period:** 1 in 100 year + 40% climate change allowance
- **Discharge Rate:** Zero discharge to public systems (infiltration only)
- **Water Quality:** Treatment through filtration and settlement
- **Maintenance:** Accessible systems with minimal maintenance requirements

B1.3 Permeable Surfacing Specification

B1.3.1 Permeable Tarmac/Asphalt System

Surface Course (40mm thickness):

- **Material:** Porous asphalt to BS 594987
- **Aggregate:** 14mm nominal size, angular crushed rock
- **Binder:** Polymer modified bitumen (PMB) 45/80-65
- **Void Content:** 18-25% target
- **Permeability:** Minimum 270mm/hour (ASTM C1701)
- **Laying Temperature:** 140-160°C
- **Compaction:** 6-8 passes with 8-10 tonne steel drum roller

Binder Course (60mm thickness):

- **Material:** Dense bitumen macadam to BS 594987
- **Aggregate:** 20mm nominal size, crushed rock
- **Binder:** 40/60 penetration grade bitumen
- **Compaction:** Standard dense bitumen macadam techniques
- **Interface:** Tack coat K1-40 bitumen emulsion at 0.35 l/m^2

Base Course (150mm thickness):

- **Material:** Dense bitumen macadam (DBM) to BS 594987
- **Aggregate:** 40mm nominal size, crushed rock
- **Binder:** 40/60 penetration grade bitumen
- **Compaction:** Achieve 95% refusal density (BS 598-104)

Sub-base (300mm thickness):

- **Material:** Open graded crushed rock 40mm down
- **Specification:** Type 1 unbound mixture to BS EN 13285
- **Void Ratio:** 30-40% to provide storage and infiltration
- **Compaction:** Light compaction to maintain voids
- **Geotextile:** Separation layer beneath sub-base (Terram 1000 or equivalent)

B1.3.2 Edge Details and Containment

- **Edge Restraint:** Concrete haunching or proprietary edge system
- **Transitions:** Ramped transitions to impermeable areas
- **Gullies:** Strategic placement for overflow protection
- **Manholes:** Access points for inspection and maintenance

B1.3.3 Quality Control

- **Aggregate Testing:** Compliance with BS EN specifications
- **Core Testing:** Void content verification post-construction
- **Permeability Testing:** In-situ testing to confirm performance
- **Surface Regularity:** 3m straight edge tolerance ±6mm

B1.4 Soakaway Systems

B1.4.1 Design Parameters

- **Infiltration Rate:** Based on site investigation (assume $1x10^{-5}$ m/s conservative estimate)
- **Storage Volume:** 1 in 100 year + 40% climate change event
- **Half-Drain Time:** Maximum 24 hours
- **Safety Factor:** 1.5 applied to infiltration calculations

B1.4.2 Soakaway Construction

Excavation:

- Minimum 5m from buildings and boundaries
- Minimum 1m above seasonal high groundwater
- Sides cut to stable batter or supported
- Base and sides left uncompacted

Aggregate Fill:

- **Material:** Clean, angular crushed rock 20-40mm
- **Porosity:** 30% minimum void ratio
- **Depth:** Variable based on required storage volume
- **Geotextile:** Surround system to prevent fine migration

Distribution System:

- **Pipes:** Perforated 150mm uPVC laid in aggregate
- **Distribution:** Even distribution across soakaway area
- **Access:** Inspection chambers at inlet points

Surface Treatment:

- **Topsoil:** 300mm depth over geotextile
- **Seeding:** Appropriate grass seed mix
- **Maintenance Access:** Clearly marked inspection points

A2.5 Roof Drainage

- **Gutters:** uPVC half-round 150mm minimum
- **Downpipes:** 110mm uPVC at maximum 15m centers
- **Connection:** Direct to permeable surfacing or soakaway system
- **Overflow:** High-level overflow provisions at 50mm above normal gutter level