CASTLE GREEN,
WELL STREET, BUCKLEY

29/07/2020

High Level Drainage Strategy

The Alan Johnston Partnership LLP

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Prepared By

Document Owner(s)	Project/Organization Role
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Project Closure Report Version Control

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P01	27/07/2020	K O'Brien	First Issue
P02	04/07/2023		Revised to inculde latest layout & Drainage

Record of Approval

Originator	Approved	Date
K O'Brien	D.Sinclair	27/07/2020
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Contents

1.0 INTRODUCTION

This drainage strategy has been prepared on behalf of Castle Green Homes in connection with a planning application for the construction of a new residential properties. The proposed development is on the site of a existing greenfield area located to the north of Well, Street, Buckley. A full FCA is required at a later date as even though the proposed development is located completely within Flood Zone A, the site is over 1.0ha in area.

The FCA will need to be prepared in accordance with the general requirements of Technical Advice Note 15: Development and Flood Risk (Welsh Assembly Government; 2004) (TAN 15), which provides a framework to guide planning decisions for new developments in relation to flood risk.

This involves the identification of flood risk to new development(s) on the site, the possible effect of this development on flood risk elsewhere and the investigation of the impact on the development as a result of increased sea levels, fluvial flows and larger pluvial events due to increased impermeable areas and climate change.

2.0 SITE DESCRIPTION

The proposed site is located to the north of Well Street, Buckley at National Grid reference SJ 26770 63636. The location of the existing site is illustrated in Appendix A and the extent of the area to which the application relates is also shown on the aerial photo, attached in Appendix B.

The existing site covers a total area of 5.4ha and currently consists of the existing undeveloped fields. The site is bounded to the north and east by existing residential properties, to the west and south the site is bounded by small agricultural buildings and fields.

The site is falls from north-west to south-east, with levels falling from approximately 157.58mAOD in the north-eastern corner to approximately 147.57mAOD in the south-western corner. The topographic survey is attached in Appendix C.

3.0 PROPOSED DEVELOPMENT

The proposed 5.4ha development consists of the construction of 155no. residential units with a mix of detached, semi detached and walk up flats. There will be a mix of 1, 2, 3 and 4 bed units.

The proposed development will also consist of minor amendments to the site entrance to enable safe access and egress

To enable a viable scheme, the proposed site levels are constrained by the existing building and also the surrounding highways and developments surrounding the site. Therefore, site levels are likely to remain similar to the existing. The proposed site plans for the development are attached in Appendix D.

4.0 SOURCES OF FLOODING

4.1 Flooding from Rivers

The TAN 15 Development Advice Map is included in Appendix E. It can be seen from the map that the entire development site is located in Flood Zone A with a chance of flooding of less than 0.1% (or 1 in 1000). The nearest watercourse is an unnamed tributary on the opposite side of Well Street, adjacent to Bristre Cottage Farm.

Therefore, the risk of flooding to the new development from rivers is considered to be low.

4.2 Flooding from the Sea

The site is not at risk of flooding from the sea. The lowest level of the site is approximately 147.57mAOD, i.e. well above tidal flood levels.

4.3 Flooding from Land

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding.

The Natural Resources Wales (NRW) Surface Water Flood map is included in Appendix E. It can be seen from the map that the majority of the site is classified as having a very low to low risk of surface water flooding, with a small area along the southern boundary of the site having a medium to high risk of surface water flooding.

Assessing the existing topographic survey, which is attached in Appendix C, it can be seen that the small areas of the site with a medium to high risk of flooding are at the lowest point on the site and we would expect this to be due to overland surface water gathering at this low spot.

This area has been designated as a POS with the architectural masterplan for which suitable SUDS systems can be implemented.

Therefore, as the site levels associated with the proposed development are to be reworked to suit the new layout, and the vast majority of the site will now be positively captured and drained (roads / roofs etc) therefore reducing this overland flow.

Therefore, the risk of flooding from overland flows due to surface water flooding is considered to be low and as such the overall site is considered to be at low risk of flooding from surface water/surrounding land.

4.4 Flooding from Groundwater

Groundwater flooding is caused by unusually high groundwater levels, it occurs as excess water emerges at the ground surface (or within manmade underground structures).

In general terms groundwater flooding can occur from three main sources: If groundwater levels are naturally close to the surface, then this can present a flood risk during times of intense rainfall. No groundwater flood risk has been identified during a walk over of the site and consultation with the various interested parties. Seepage and percolation occur where embankments above ground level hold water. In these cases, water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.

Groundwater recovery/rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water, table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre- pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is considered to be low

An intrusive SI is yet to take place to determine ground water levels but the report will be updated for the detailed application.

4.5 Flooding from Sewers

In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and wastewater known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away. It can also occur when the sewer becomes blocked or is of inadequate capacity, this could lead to there being a high risk of internal property flooding with contaminated water.

Welsh Water record drawings are still awaited at the time of writing.

Therefore, following a review of WW assets and pre dev enquiry this section of the report will be updated for the detailed application.

4.6 Flooding from Reservoirs, Canals and Other Artificial Sources

There are no canals within the immediate vicinity of the development site considered to present a flood risk to the site.

Therefore, the site is considered to be at low risk of flooding from reservoirs, canals and other artificial sources.

5.0 DEVELOPMENT AND DRAINAGE STRATEGY

5.1 Effect of Proposed Development

As previously outlined in Section 2.0, the proposed site covers a total area of 5.4ha and currently consists of the existing undeveloped fields as can be seen from the aerial photo, attached in Appendix B.

The masterplan indicates that the proposed site is to be split into 4.61ha for development and 0.7ha for POS.

We would expect a typical impermeable area of 60% to be drained.

This is indicated within the pre and post development impermeable areas drawing attached in Appendix G, with the areas summarized within the below table.

Total Development Site Area (ha)	Existing Impermeable Area (ha)	Proposed Impermeable Area (ha)
5.4	0.0	2.766

Therefore, the changes to the existing site will increase the areas of impermeable area and as such, the proposed development will lead to a increase in the;

- Volume of surface water ponding on the site.
- Volume of surface water runoff leaving the site or discharging into surrounding areas.
- Peak discharge rate from the site.

Despite this, site-wide drainage systems are required to drain the foul and surface water flows arising from the proposed development. Where possible, any existing drainage networks should be utilised. Appropriate design and construction of these systems as set out in Section 5.3 should ensure that there is no increase in offsite flood risk that would otherwise impact downstream areas.

5.2 Existing Drainage Systems

A request for Welsh Water services records in this area has submitted but at the time of writing this report remain outstanding.

We would expect there to be a FW sewer within Well Street serving the existing properties near the site entrance.

Once received this report will be updated to reflect findings for the detailed application.

5.3 Proposed Drainage Strategy

As outlined above in section 5.1, site-wide drainage systems are required to drain the foul and surface water flows arising from the proposed development. The proposed drainage systems must ensure that there is no increase in offsite flood risk that would otherwise impact downstream areas.

5.3.1 Surface Water Drainage

Standard S1 of the Statutory National Standards for Sustainable Drainage Systems (2018) details a hierarchy of potential methods for disposing of surface water as shown below in order of preference. Therefore, in compliance with Standard S1 of the Statutory National Standards for Sustainable Drainage Systems (2018) the surface water runoff destination should adhere to the following hierarchy of Priority Levels:

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

Unless exception criteria for each priority level can be met, the surface water runoff destination must adhere to the highest priority level outlined above.

Considering the hierarchy above, the surface water network for the proposed site should be collected for re-use. However, as there is no foreseeable demand for non-potable water on the site unless stipulated in the client ERs, would mean that the use of rainwater harvesting would not be cost effective for a development such as this and therefore it has been deemed unsuitable to collect the rainwater for use.

As the exception criteria for priority level 1 has been met, the surface water should infiltrate where possible. BRE365 compliant soakaway tests are to be completed as part of the Phase 2 works – if infiltration is viable then we would look to implement for priority 2.

Should infiltration prove not viable then surface water should discharge to a surface water body, to comply with priority level 3. There appears to be a surface water feature adjacent to the site which may prove viable. The Brook is to surveyed to ensure that a point of connection via gravity can be achieved.

If this proves not feasible then SW should discharge to a surface water sewer, highway drain, or another drainage system, as per priority level 4. However, at the time of writing we are still awaiting feedback from WW for assets in this area. This would also apply for combined sewers which would fall under priority level 5.

Standard S2 of the Statutory National Standards for Sustainable Drainage Systems (2018) details the management and hydraulic control of the surface water runoff from the site. To comply with Standard S2 of the Statutory National Standards for Sustainable Drainage Systems (2018) and in line with Sewers for Adoption (7th Edition), the requirements for the design of a new surface water drainage systems are as follows:

- Below ground piped drainage to be sized to accommodate the 1 in 2 year (50% AEP) design storm without surcharge.
- System to be designed not to flood any part of the site in a 1 in 30 year (3% AEP) design storm.
- For events in exceedance of the 1 in 30 year design storm and up to and including the 1 in 100 year event, site drainage and topography should be designed where practicable to route surface water run-off away from buildings to safe above-ground storage areas on site, thereby preventing this run-off from leaving the site and increasing flood risk elsewhere.

For each design case described above, the design storm is the critical storm duration for the site conditions. In the case of the 1 in 100 year design storm, a 40% increase in the peak rainfall intensity is applied to allow for the

estimated worst case impacts of climate change. This is in accordance with new advice, issued by the National Resources Wales, which updates previous climate change allowances outlined in the Planning Policy Wales.

While every effort to utilise any suitable existing systems should be made, the drainage systems should be designed to suit the proposed site layout and topography which aims to provide an efficient design.

Suitable systems of below ground drainage will be required to contain as a minimum requirement, the 1 in 30 year event. Additionally, any surface water run-off from events that exceed the capacity of the new drainage system, up to and including the 1 in 100 year (+40%) event, may be retained on-site in safe storage areas, away from the proposed buildings. These areas are to be identified during the detailed design stage when the volume and extents of any exceedance flooding and the proposed external ground levels have been confirmed.

As outlined within Clause G2.5 of the Statutory National Standards for Sustainable Drainage Systems (2018), consideration should be given to urban creep. Therefore, using the total post development impermeable area of 2.77ha and an additional 10% allowance for urban creep results in a total post development impermeable area of 3.047 ha.

A assessment of existing greenfield run off rates has been carried out and results listed below:

Total Development Site Area (ha)	Qbar – L/Sec
5.4	12

Using this total post development impermeable area of 3.047ha and a discharge rate limited to Qbar of **12 L/sec**, for the 1 in 100 year + 40% return period design storm, a storage volume between **2079 & 2712m^3** is required. The attenuation storage estimate is attached in Appendix H.

The storage estimate is intended to give a maximum storage estimate based on the most intense rainfall event (1 in 100 year +40%) As such, the storage estimate is subject to change and is dependent upon the proposed detailed drainage design.

The surface water drainage system is to be designed to restrict the discharge to the required rate, up to and including a 1 in 100 year plus 40% climate change design storm. This discharge rate should be confirmed via more detailed discussions with the Sustainable Drainage Approval Body (SAB), Lead Local Flood Authority (LLFA) and Welsh Water prior to the commencement of any works.

The use of Permeable paving, infiltration trenches and other infiltration techniques, in addition to the proposed swales have also been considered, as outlined below:

SuDS Technique	Suitable for This Development?	Reasoning
Green Roof	×	Impractical due to pitched nature of houses.
Rainwater Harvesting	×	Impractical due to lack of demand for non-potable water, maintenance costs associated with pumping.
Basins & Ponds	✓	Infiltration basin incorporated but dependent upon proposed topography of the site.
Filter Strips & Swales	✓	Suitable and incorporated within POS.
Infiltration Techniques	✓	Suitable if infiltration is feasible.
Permeable Surfaces	✓	Suitable if infiltration is feasible and topography allows.
Tanked/Piped Systems	✓	Suitable where above ground systems are not viable.

To comply with the exceedance flow paths and potential blockage requirements within the Statutory National Standards for Sustainable Drainage Systems (2018), if it envisaged that the ground levels around the proposed buildings will fall away from the buildings, ensuring any flooding from rainfall events in exceedance of the 1 in 100 year +40% climate change rainfall event will be directed onto the proposed access road areas and highway to the south, for use in exceptional circumstances.

Standard S3 of the Statutory National Standards for Sustainable Drainage Systems (2018) details the water quality management and addresses the drainage design requirements to minimise the potential pollution risk. As the proposed development consists of roof areas, small car park areas and low traffic roads, in accordance within Table G3.2 of the Statutory National Standards for Sustainable Drainage Systems (2018) the pollution hazard level is low and as such the simple index approach can be used to assess the treatment requirements for the low risk of pollution.

The simple index approach is outlined within Chapter 26 of CIRIA Report C753 – The SuDS Manual. Therefore, using Table 26.2 and applying the proposed site description above, results in the pollution hazard indices being; TSS – 0.5, Metals – 0.4 and Hydrocarbons – 0.4.

Assessing this against Table 26.3 of CIRIA Report C753 – The SuDS Manual and the proposed infiltration basin (assumed to be same as detention basin for this purpose) results in mitigation indices of; TSS – 0.5, Metals – 0.5 and Hydrocarbons – 0.6. Therefore, as the mitigation indices are equal to or greater than each of the pollution hazard indices the use of a single infiltration basin is deemed acceptable from a pollution mitigation perspective and as such complied with the water quality requirements of Standard S3 of the Statutory National Standards for Sustainable Drainage Systems (2018).

Standards S4 and S5 of the Statutory National Standards for Sustainable Drainage Systems (2018) address the amenity benefits and biodiversity benefits provided by the SuDS systems. As outlined in Section 5.1, the proposed development is reducing the total impermeable area and as such increasing the proposed permeable/landscaped amenity space across the site.

It is anticipated that the swale will be vegetated with grass and deep-rooted plants which will also improve the biodiversity across the site.

Standards S6 of the Statutory National Standards for Sustainable Drainage Systems (2018) details the requirements for the construction, operation and maintenance of the proposed drainage.

The proposed drainage should be designed and constructed in accordance with the relevant sections within CIRIA Report C753 – The SuDS Manual and CIRIA Report C768 – Guidance on the Construction of SuDS. Section 6.0 of this report identifies the future management and maintenance requirements for the current drainage proposal.

The surface water drainage strategy and discharge rate from the high-level overflow, all outlined above, should be confirmed via more detailed discussions with Welsh Water, the Sustainable Drainage Approval Body (SAB) and the Lead Local Flood Authority prior to the commencement of any works.

5.3.2 Foul Water Drainage

Foul water drainage disposal is set out in Part H of the Building Regulations in order of priority the preferred methods are;

1. Public sewer
2. Septic tank
3. Cesspool.

The foul water system shall be designed in accordance with;

- BS EN 752:2008 (Drain and sewer systems outside buildings)
- Sewers for Adoption (7th Edition)

- Technical Guidance to the Planning Policy Wales document (Department for Communities and Local Government, March 2012).
- BS EN 12056-2:2000 (Drainage systems inside buildings)
- Building Regulations Approved Document H, Drainage and waste disposal.

It is anticipated that the foul water from the proposed development will be collected and conveyed to the south of the site, where it will discharge, at an unrestricted rate into an existing public sewer. As with the surface water drainage strategy, the foul water drainage strategy and unrestricted discharge rate should be confirmed via more detailed discussions with Welsh Water, the Sustainable Drainage Approval Body (SAB) and the Lead Local Flood Authority prior to the commencement of any works.

6.0 FUTURE MANAGEMENT & MAINTENANCE

The proposed drainage solution uses SUDS techniques in accordance with the CIRIA SUDS Manual C753. The surface water run-off from the proposed development is to be collected via below ground pipe work and discharged into swales contained within the POS. Permeable paving will be ustilised wherever possible but due to the significant falls across the site, areas may be limited to avoid SW migrating from slopes / retaining walls. The final outfall need to be restricted using a vortex flow control device prior to connection but this is to be determined during detailed drainage design.

It is envisaged that the following components may be included within the drainage strategy for the proposed development:

- Inspection chambers, manholes and catchpits.
- Pipes.
- Drainage channels and gullies.
- Vortex flow control device.
- Swales
- Permeable paving

A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented. It is assumed that the maintenance of the surface and foul water drainage systems will be the responsibility of an on-site facilities management team and therefore a copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual.

As discussed, the maintenance of the specified SuDS should be included within the developments Operation and Maintenance Manual and should be detailed in accordance with the CIRIA SuDS Manual C753, as per the operation and maintenance guidance outlined below.

6.1 General Maintenance & Inspection Requirements

- No work shall be carried out on the drainage system without permission from a nominated person, who has access to information/a working knowledge of the system.
- Maintenance/inspection work shall be carried out in a safe/planned manner.
- All work is to be carried out by competent persons suitably trained and equipped in accordance with current statutory safe working policies.
- Entry into confined spaces shall be kept to a minimum and be restricted to suitably qualified/equipped persons working in accordance with current statutory safe working policies.
- Drainage systems shall be inspected on a regular basis or should any problems be suspected. Any debris/defects discovered shall be recorded and a programme of cleaning/ repair initiated. Urgent repairs/cleaning shall be actioned as soon as practicable.
- It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.

- Clearing of the drainage system can be achieved by a number of methods depending on the nature of the work;
    - Rodding – Manual/Mechanical with flexible rods.
    - Jetting – High pressure water jetting.
    - Plunging.

6.2 Inspection Chambers, Manholes and Catchpits

The appropriate health and safety equipment must be used when accessing manholes/catchpits. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access. The following operations should be carried out annually.

- Covers of inspection chambers and manholes shall be removed and the sides, benchings and channels cleared.
- Accumulated deposits of silt in inspection chambers, catchpits and manholes shall be removed. Any traps shall then be plunged and thoroughly flushed out with clean water. This should be completed in Autumn, after leaf fall.
- Main and branch drains shall be cleared as required and afterwards be flushed with clean water. Any obstructions found shall be removed and not flushed down the system.
- Covers of inspection chambers, manholes and catchpits shall be replaced, bedded in suitable grease or other sealing material as required and bolted/locked down as appropriate. Missing bolts and broken items shall be replaced in accordance with the manufacturer's details.

6.3 Pipes

Regular inspection and maintenance is important to identify areas which may have become obstructed/clogged and may not be draining correctly, as failure to do so would expose the development to a greater level of flood risk.

Pipes are proprietary products and therefore the materials used can vary across the site. As such, where used the manufacturer's recommendations should be followed. Access for maintenance of the pipes is provided through inspection chambers and manholes. The below table sets out the maintenace schedule for the pipe components of the proposed drianage systems.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect for evidence of poor operation via water levels. If required take remedial action.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.
	Check and remove large debris and/or vegetation growth near pipe runs.	Monthly or as required.
Remedial Actions	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue.	As required, if above actions do not improve performance.
Monitoring	Initial Inspection should be provided as post construction CCTV survey.	N/A
	Inspect/check all inlets, outlets and overflows to ensure they are in good condition and operating as designed.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.

6.4 Drainage Channels and Gullies

Channels and gullies should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Litter and debris removal.	Monthly or as required.
	Check and remove large debris and/or vegetation growth near pipe runs.	Monthly or as required.
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.
Remedial Actions	Inspect access/outlet boxes and rod through poorly performing channels and outlets as initial remediation.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue.	As required, if above actions do not improve performance.
Monitoring	Initial Inspection including channel outlet boxes and gully sumps.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating. The below stable sets out the maintenace schedule for the drainage channel and gullies components of the proposed drianage systems.

6.5 Vortex Flow Control Device

Regular inspection and maintenance is important to identify if the vortex flow control device has become obstructed/clogged and may not be functioning correctly, as failure to do so would expose the development to a greater level of flood risk.

Vortex flow control devices are proprietary products and therefore can vary from manufacturer to manufacturer. As such, where used the manufacturer's recommendations should be followed.

- Normally, little maintenance is required as there are generally a vortex flow control device has no moving parts.
- If blockages occur they tend to do so at the intake of the vortex flow control device.
- Vortex flow control devices are generally fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur.
- The smaller type conical units, below the minimum recommended size, are also supplied with roding facilities or vortex suppressor pipes as standard.
- Following installation of the vortex flow control device it is vitally important that any extraneous material i.e. Building materials are removed from the unit and the chamber.

- After the system is made live, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. Units should also be inspected within 48 hours after large storms.

6.6 Swale

Regular inspection and maintenance is important to identify if the inlets/outlets have become obstructed/clogged and may not be functioning correctly, as failure to do so would expose the development to a greater level of flood risk. The maintenance requirements for swales are outlined within Table 17.1 of the CIRIA SUDS Manual C753. An extract of that table is given below to set out the maintenace schedule for the swale components of the proposed drianage systems.

TABLE 17.1 Operation and maintenance requirements for swales

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

It should be noted that the Main Contractor should provide a Verification Report, including photographic evidence, to demonstrate that the drainage has been constructed as per the design drawings. As-built drawings should as be supplied by the Main Contractor, where the construction of the drainage varies from the design construction status drawings.

7.0 CONCLUSIONS & RECOMMENDATIONS

- The proposed development is located entirely within Flood Zone A but as the site has a total area over 1.0ha, to comply with the requirements of the Technical Advice Note 15 (TAN 15), a flood consequence assessment will be required at detailed application.

- An intrusive site investigation has yet to be completed but will include for BRE 365 testing to check on suitability of infiltration.

- It is recommended that a CCTV survey of the existing public and private drainage is undertaken to determine the exact location, condition and details of the existing drainage networks.

- If it is proposed to abandon or divert the existing public sewer as part of the proposed development works, then a Section 116 or Section 185 agreement with Welsh Water will be required but this will be determined during the detailed drainage design. Discussions with Welsh Water regarding any proposed abandonment or diversion works on the public sewers should be completed prior to the commencement of any works.

- All of the Standards (S1 – S6) within the Statutory National Standards for Sustainable Drainage Systems (2018) have been discussed and assessed within Section 5.3.1 and have resulted in the surface water SuDS solution comprising of an series of swales and permeable paving with final connection into adjacent water course (or nearest WW surface water sewer if connection not viable.)

- Applying an additional 10% allowance for urban creep, results in a total post development impermeable area of 3.044ha and using this total impermeable area and the Qbar discharge rate of 12 L/sec, for the 1 in 100 year + 40% return period design storm, a storage volume of approximately 2079 - 2712m^3 is required.

- Agreement of the maximum surface water discharge rate from the high-level overflow and point of connection should be confirmed via discussions with Welsh Water, the Sustainable Drainage Approval Body (SAB) and the Lead Local Flood Authority prior to the commencement of any works.

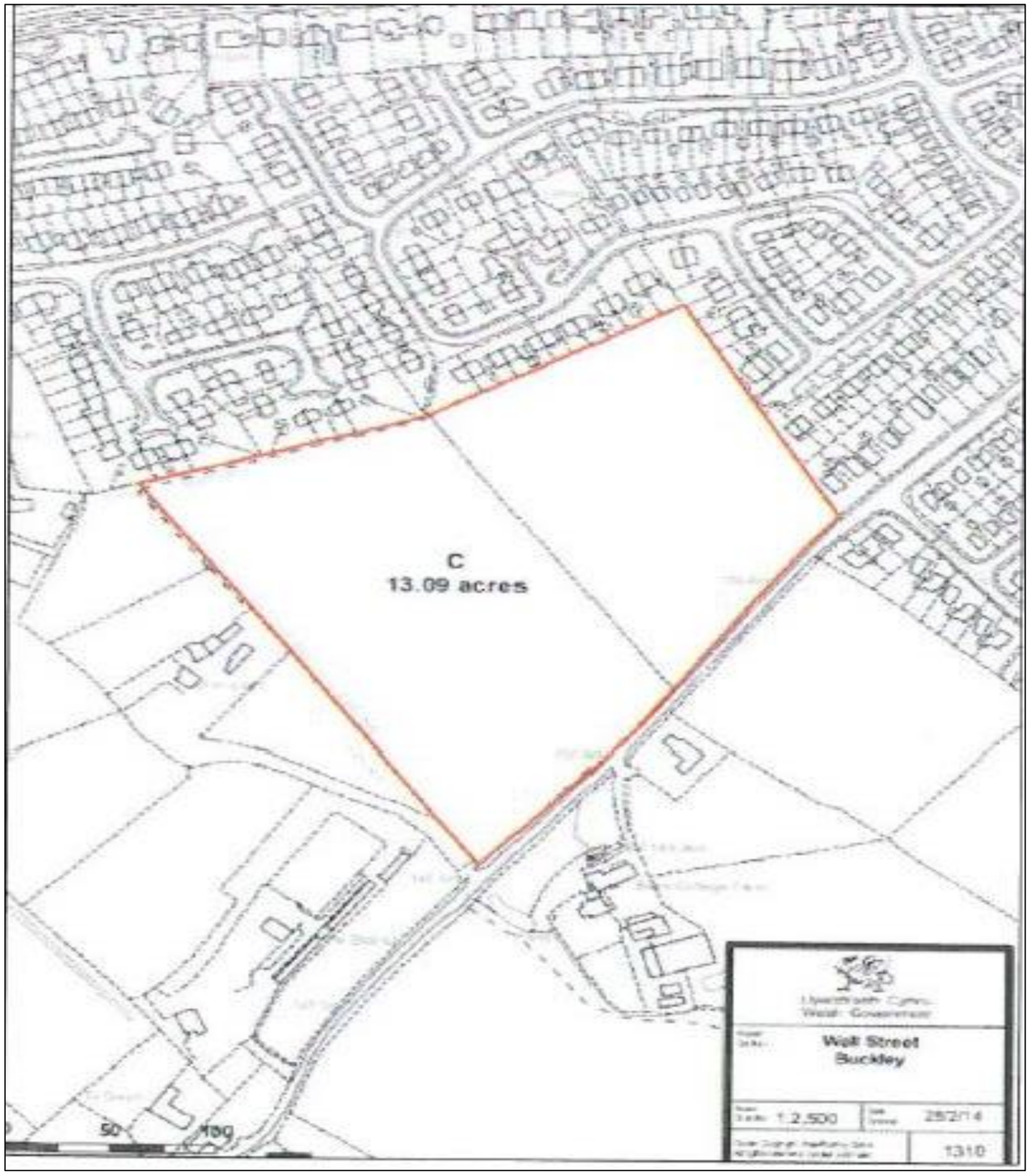
- The surface and foul water drainage strategies and discharge rates should be confirmed via more detailed discussions with Welsh Water, the Sustainable Drainage Approval Body (SAB) and the Lead Local Flood Authority prior to the commencement of any works.

Appendix A Site Location Plan

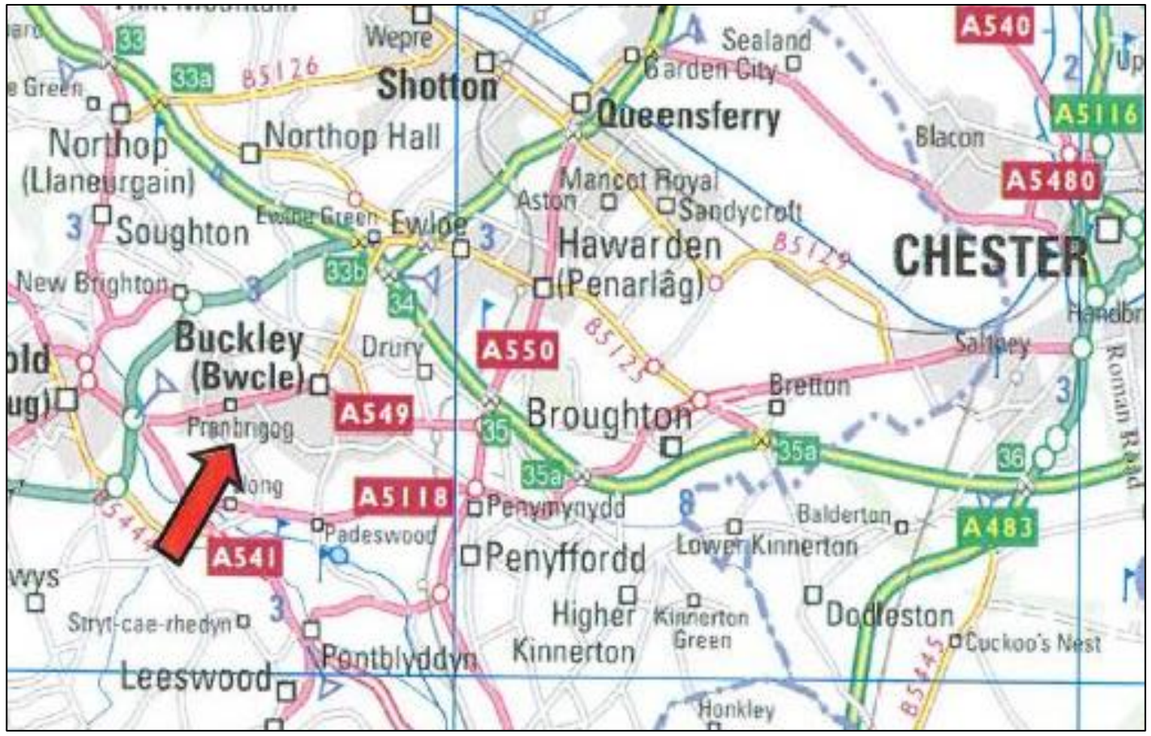
Appendix B Aerial Photo

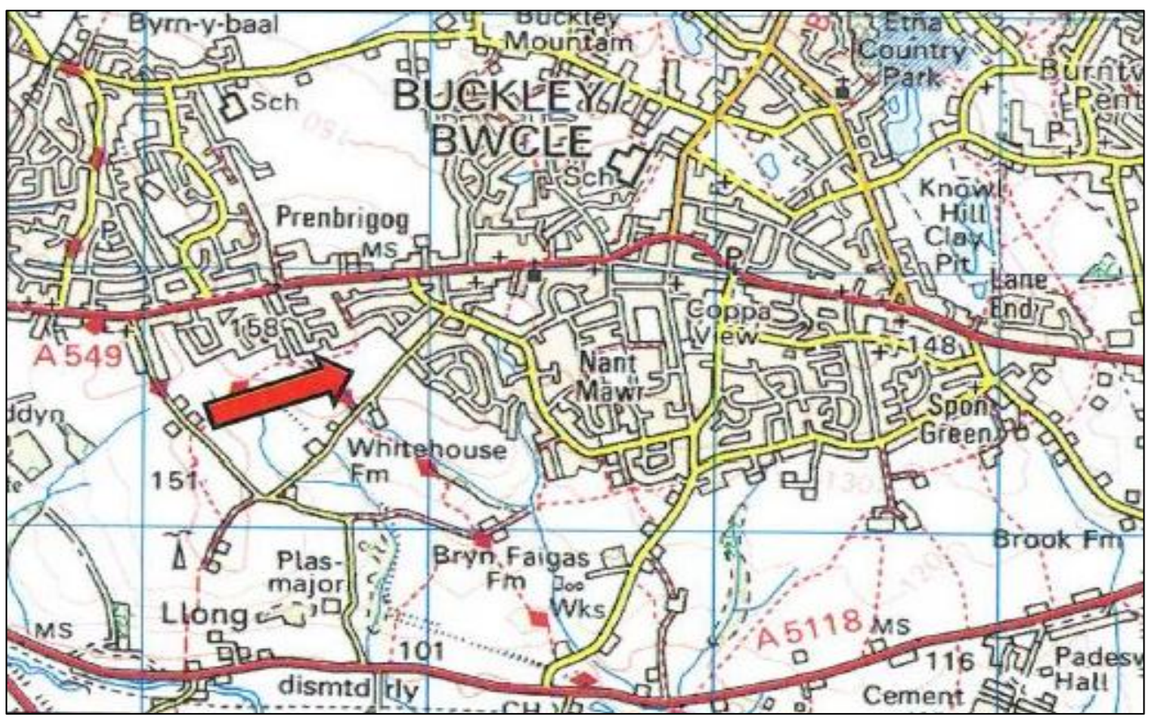
Land at Well Street, Buckley, Flintshire

Site Plan:

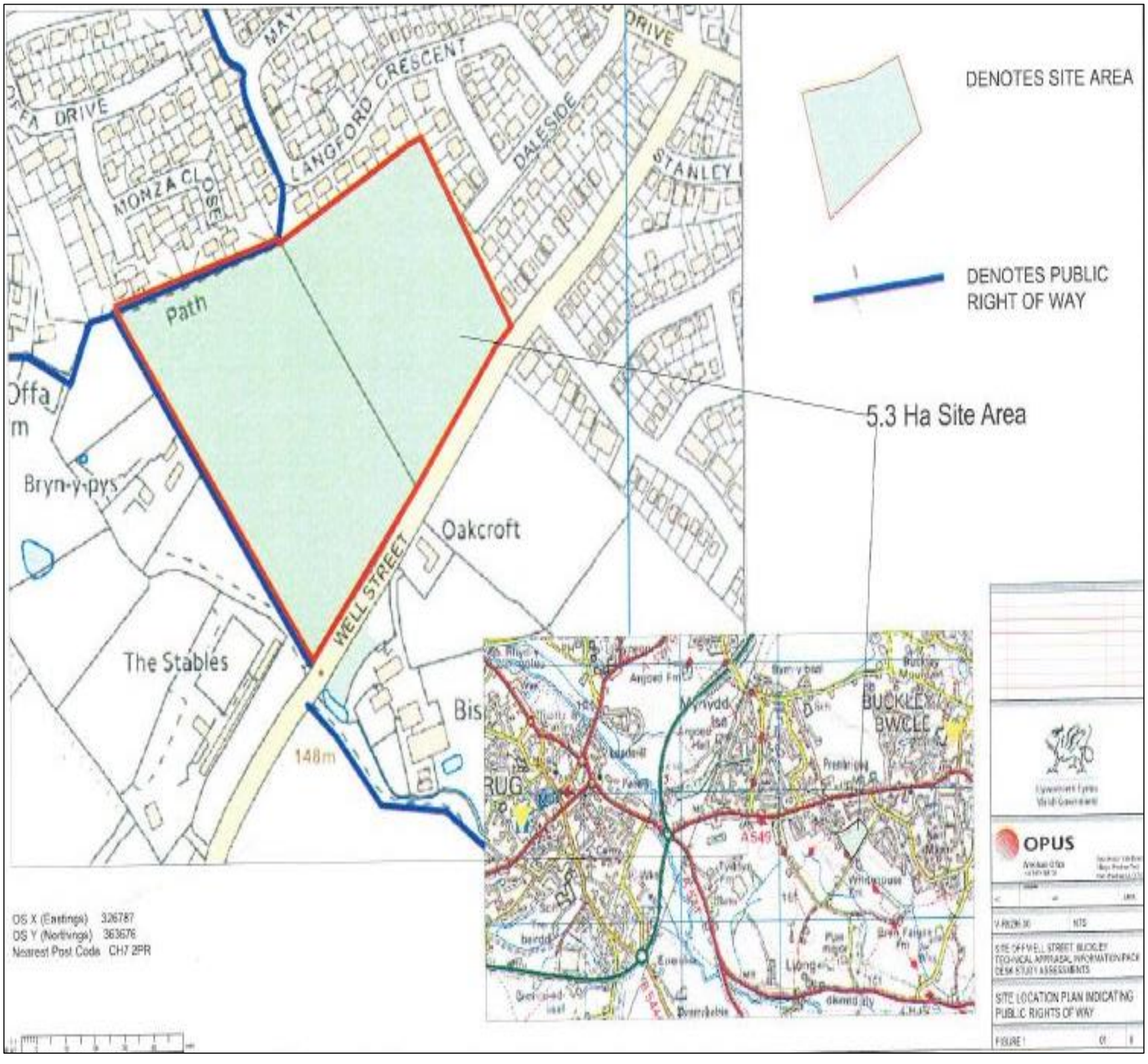


Location Plan of site:

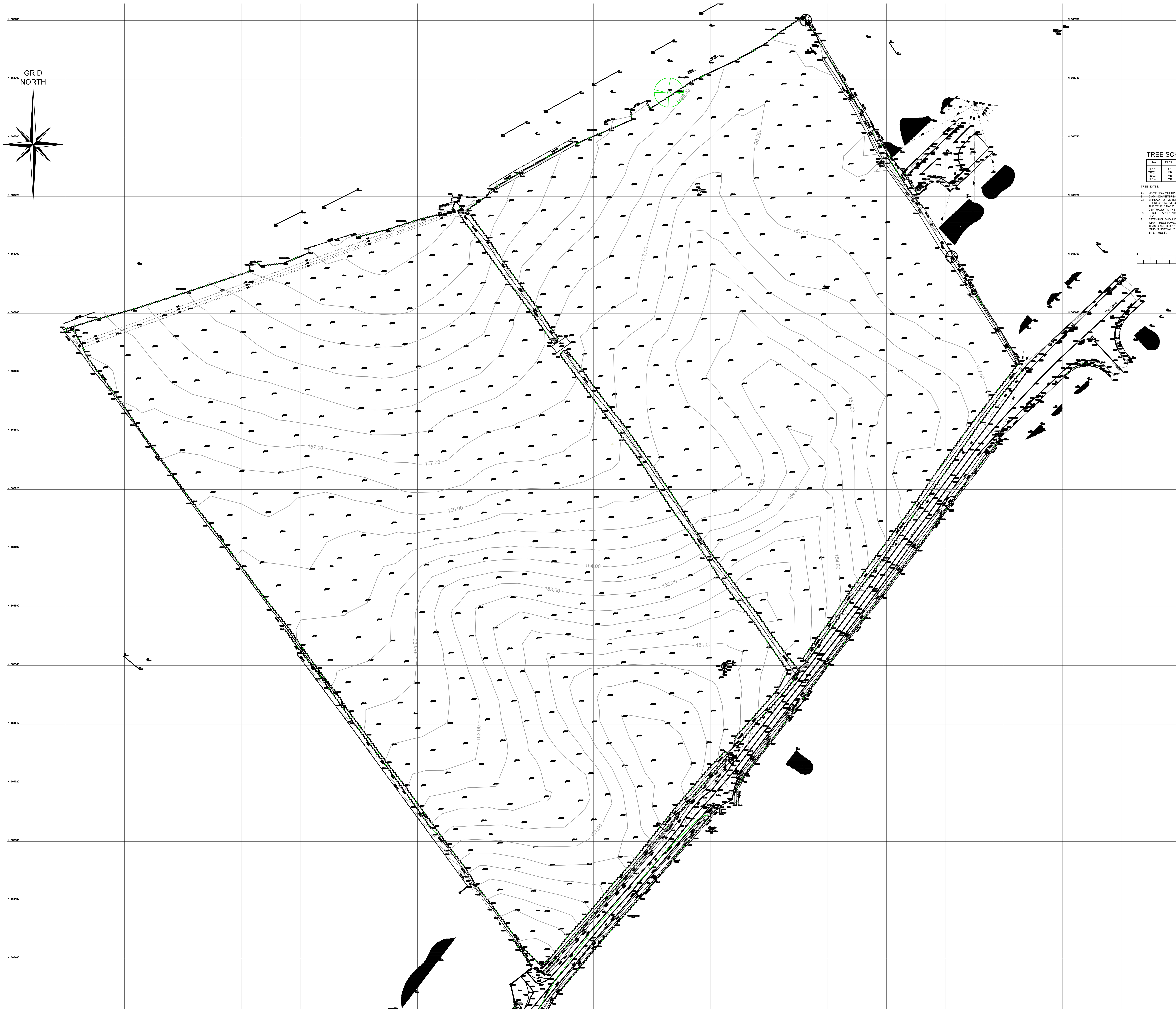




Site Location Plan Indicating Public Rights of Way including photographs of the existing site:



Appendix C Topographic Survey



TREE SCHEDULE

No.	CIRC.	SPREAD Ø	HEIGHT
TE/01	1.5	8	10
TE/02	MB	4	4
TE/03	MB	4	6
TE/04	MB	10	14

TREE NOTES:

A) MB "X" NO – MULTIPLE BOLES FOLLOWED BY NUMBER OF.
B) DIAM – DIAMETER MEASURED AT APPROXIMATELY 1.5M ABOVE GROUND LEVEL.
C) SPREAD – DIAMETER OF CANOPY. (TREE SPREADS ARE INDICATIVE ONLY AND ARE REPRESENTATIVE OF THE GENERALISED CANOPY SIZE, AND MAY NOT REPRESENT THE TRUE CANOPY POSITION AS OUTLINED ON SITE – TREE BOLES MAY NOT SIT CENTRALLY TO THE CANOPY).
D) HEIGHT – APPROXIMATE HEIGHT TO TOP OF CANOPY – ESTIMATED FROM GROUND LEVEL.
E) ATTENTION SHOULD BE PAID TO THE ORIGINAL TOPOGRAPHICAL BRIEF AS TO WHAT TREES HAVE ACTUALLY BEEN SCHEDULED; I.E. THOSE "TREES LARGER THAN DIAMETER "X" OR "ONLY TREES WITHIN THE IMMEDIATE SURVEY LIMITS". (THIS IS NORMALLY THE CASE UNLESS OTHERWISE SPECIFIED AS INCLUDING "OFF SITE" TREES).

0 20 METRES

A0

NOTES

1. SURVEY CONTROL:

A) SURVEY GRID (HORIZONTAL):

THIS SURVEY IS ORIENTATED TO ORDNANCE SURVEY GRID NORTH. THE SURVEY IS TO A PLANE GRID. HORIZONTAL MEASUREMENTS TAKEN FROM THIS SURVEY WILL BE GROUND DISTANCE.

FULL ORDNANCE SURVEY CO-ORDINATES CAN BE CALCULATED BY SCALING THE SURVEY ABOUT THE SITE CENTRE, WITH CO-ORDINATES E 326766.500 N 363635.500 AS FOLLOWS:

SHIFT: NOT REQUIRED
SCALE: LSF = 0.99967
ROTATION: NOT REQUIRED.

THE LOCAL SCALE FACTOR (LSF) APPLICABLE TO THIS SITE IS 0.99967, CALCULATED USING STANDARD TABULATED DATA.

THE CONTROL HAS BEEN ESTABLISHED BY TYING INTO THE ACTIVE ORDNANCE SURVEY CONTROL NETWORK. SEE NOTE C. BELOW.

(FOR THIS RELATIVELY LOW LEVEL SITE, MEAN SEA LEVEL CORRECTIONS (MSL) ARE DEEMED TO BE INSIGNIFICANT AND HAVE THEREFORE NOT BEEN APPLIED.)

B) VERTICAL DATUM:

ALTITUDES FOR THE CONTROL HAVE BEEN CALCULATED FROM GPS DERIVED HEIGHTS AND CONVERTED TO ORTHOMETRIC HEIGHTS (ORDNANCE DATUM NEWLYN - ODN) USING OSGM02 TRANSFORMATION PARAMETERS.

C) GPS CONTROL:

THE CO-ORDINATE SYSTEM USED FOR THE PRIMARY CONTROL IS OSGB36; THIS HAS BEEN CALCULATED FROM ETRS89 USING OSTN02 TRANSFORMATION PARAMETERS.

METHOD: FOR THIS PARTICULAR PROJECT, THE "TRIMBLE VRS NOW" NETWORK HAS BEEN USED. OBSERVATIONS HAVE BEEN TAKEN ON THE FOLLOWING DATE (S): 03/05/16

MANUFACTURERS QUOTED ACCURACY IS RMSE 10 – 20 mm IN PLAN AND 20 – 30 mm IN HEIGHT. HOWEVER, RESULTS MAY VARY DURING THE DAY AND CERTAIN CONDITIONS COULD CAUSE DEGRADATION TO THE FINAL SOLUTIONS. FOR SALIENT CONTROL AND WHEREVER POSSIBLE AND PRACTICAL, TOWER SURVEYS HAVE USED AN OPEN SKY WITH GOOD SATELLITE GEOMETRY SO AS TO MAINTAIN THE HIGHEST ACCURACY POSSIBLE.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS/DOCUMENTATION.

3. CHECK SCALE BAR AND GRID BEFORE TAKING NON-FIGURED DIMENSIONS FROM THIS DRAWING.

4. IF IN DOUBT ASK.

LEGEND

30.29 SPOT LEVEL
STN/4 SURVEY STATION
SAPLING
BUSHES/SHRUB
HEDGE/AREA OF UNDERGROWTH
TREE (INDICATIVE ONLY)
BUILDING
99.90 CONTOUR
R/W RETAINING WALL
BANKING
GATE
OVERHEAD CABLE
FENCE WITH DESCRIPTION

C/B	CLOSE BOARDED
C/L	CHAIN LINK
H/M	HIT AND MISS
I/R	IRON RAILING
Iwn	INTERWOVEN
P/W	POST AND WIRE
P/R	POST AND RAIL
P/S	POST AND STRING
W/M	WIRE MESH

ABBREVIATIONS

AXR	APEX ROOF LEVEL	LB	LITTER BIN
B	BOLLARD	LP	LAMP POST
BB	BELISHA BEACON	MKR	MARKER POST
BL	BED LEVEL	MH	MANHOLE
BOP	BACK OF PATH	MHC	MANHOLE-CIRCULAR
BP	BOUNDARY POST	MHS	MANHOLE-SQUARE
BS	BUS STOP	MHT	MANHOLE-TRIANGULAR
BT	BRITISH TELECOM IC	MP	MILE POST
CATV	CABLE TELEVISION IC	PB	PILLAR BOX
CC	CONTROL CABINET	PI	PIPE
CL	COVER LEVEL	PM	PARKING METER
COL	COLUMN	P	POST
CP	CATCH PIT	PYL	ELECTRIC PYLON
CR	CROWN LEVEL	RE	RODDING EYE
DK	DROP KERB	RF/RG	ROOF/RIDGE LEVEL
DRN	DRAIN	RNP	ROAD NAME PLATE
DWP	DOWN WATER PIPE	RS	ROAD SIGN
DP	DOWN PIPE	RWP	RAINWATER PIPE
EC	ELECTRICITY CONTROL BOX	SC	STOP COCK
ECB	ELECTRICITY CABLE	SFL	SOFFIT LEVEL
EV	EAVES LEVEL	SGY	STRIP GULLY
EP	ELECTRICITY POLE	SP/B	SIGN POST/BOARD
ER	EARTH ROD	ST	STOP TAP
FFL	FINISHED FLOOR LEVEL	SV	STOP VALVE
FH	FIRE HYDRANT	SW	STORM WATER
FL	FLOOD LIGHT	TAP	WATER TAP
FW	FOUL WATER	TCB	TELEPHONE CALL BOX
G	GULLY	THL	THRESHOLD LEVEL
GV	GAS VALVE	TL	TRAFFIC LIGHT
GP	GATE POST	TOF	TOP OF FENCE
IC	INSPECTION COVER	TP	TELEPHONE POLE
IL	INVERT LEVEL	TWL	TOP OF WALL
IC/M	MERCURY INSPECTION COVER	UTL	UNABLE TO LIFT
KB	KERB	WL	WATER LEVEL
KO	KERB OUTLET GULLY	WM	WATER METER
		WO	WASH OUT

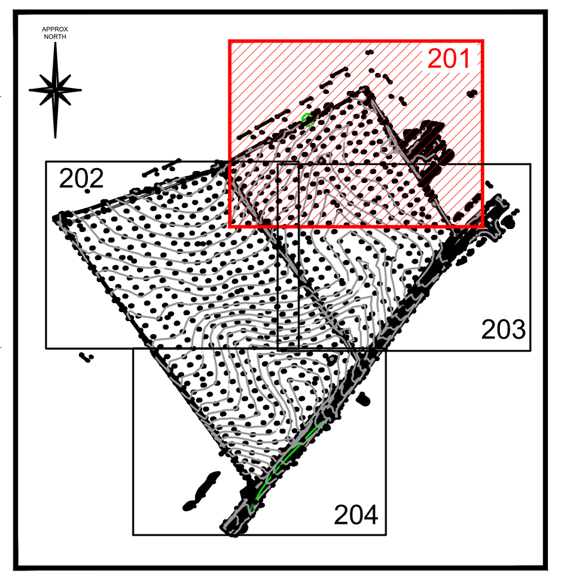
STATION CO-ORDINATES

STATION	EASTING	NORTHING	LEVEL	DESCRIPTION
STN/01	326923.51	363675.77	157.54	SURVEY NAIL
STN/02	326879.72	363614.95	156.17	PEG AND NAIL
STN/03	326807.14	363528.41	151.15	PEG AND NAIL
STN/04	326836.82	363563.82	153.22	SURVEY NAIL
STN/05	326739.86	363440.51	147.85	SURVEY NAIL
STN/06	326884.59	363743.94	156.77	SURVEY NAIL
STN/07	326918.45	363776.25	156.46	SURVEY NAIL
STN/08	326899.44	363640.00	157.13	SURVEY NAIL
STN/09	326838.90	363688.99	156.55	PEG AND NAIL

UNLESS OTHERWISE STATED THE SURVEY STATIONS LISTED ABOVE ARE ONLY INTENDED TO BE USED FOR TOPOGRAPHICAL SURVEYS AT THE STATED SCALE.

DUE CONSIDERATION SHOULD BE GIVEN TO LONG-TERM STABILITY OF SURVEY STATION MARKERS.

SHEET LAYOUT



NOT TO SCALE

GENERAL

- NO ALLOWANCE HAS BEEN MADE FOR SUB SURFACE ENTRY INTO MANHOLES OR OTHER CHAMBERS OR VOIDS BELOW GROUND LEVEL. THEREFORE ANY DETAILS RELATING TO DEPTHS, SIZES ETC. ARE TAKEN FROM ABOVE GROUND AND AS SUCH WILL BE APPROXIMATE ONLY.
- THE CONTRACTOR IS TO CHECK AND VERIFY ALL CRITICAL DIMENSIONS AND LEVELS BEFORE WORK STARTS.
- BURIED SERVICES SHOWN ON THIS DRAWING MAY BE ASSUMED ROUTES AND WILL NORMALLY BE OF UNKNOWN CONDITION, CONTRACTORS SHOULD UNDERTAKE SUITABLE VALIDATION WORK AND TAKE PARTICULAR CARE DURING EXCAVATION WORK; SAFE DIGGING PRACTICES SHOULD BE FOLLOWED.
- SHOULD THERE BE ANY CONFLICT BETWEEN THE DETAILS INDICATED ON THIS DRAWING AND THOSE INDICATED ON OTHER DRAWINGS, THEN TOWER SURVEYS SHOULD BE INFORMED PRIOR TO CONSTRUCTION ON SITE.
- IT IS IMPORTANT TO NOTE THAT THE SAME ACCURACIES IMPLIED BY THE PLOTTING SCALE ARE EQUALLY APPLICABLE TO DIGITAL DATA SUPPLIED FOR CAD.
- EVERY EFFORT IS MADE TO IDENTIFY ALL VISIBLE ABOVE GROUND FEATURES. HOWEVER, IT SHOULD BE BORNE IN MIND THAT THERE MAY BE ITEMS OBSCURED AT THE TIME OF SURVEY.
- VISIBLE FEATURES IN THE VICINITY OF THE BOUNDARIES, AS SHOWN ON THIS SURVEY, MAY NOT REPRESENT THE EXTENT OF LEGALLY CONVEYED OWNERSHIP.
- UNLESS OTHERWISE SPECIFIED FEATURES SHOWN USING LINE STYLES OR HATCHING ARE INDICATIVE ONLY, SUCH AS; ROAD MARKINGS, HEDGE CENTRELINES, BRICK HATCHING AND GLAZING DETAIL.

DESCRIPTION	REV	DATE	DRWN	CHKD	APPR

DRAWING STATUS

INFORMATION

Tower Surveys
Chartered Surveyors
Geomatics - Land, Utilities, Engineering & Building
RICS
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info@towersurveys.co.uk
www.towersurveys.co.uk
Regulated by RICS

CLIENT
OPUS INTERNATIONAL CONSULTANTS

PROJECT TITLE
WELL STREET, BUCKLEY
FLINTSHIRE

DRAWING DETAIL
TOPOGRAPHICAL SURVEY AS OF 04/05/16
SHEET 1 OF 4

DRAWN	DT	DATE	MAY 2016
PROJECT ENGINEER	PV		
CHECKED	ML	SCALE	1 : 200 (WHEN PLOTTED @ A0)
APPROVED	AC		

DRAWING NUMBER: R-11799/201
REVISION:

EFERENCE
6Projects\R-11799\R-11799_201-204_Issue01

CTB REFERENCE
\\CTB-files\TS-Topo-v01.ctb

Appendix D Proposed Site Plan

SCHEDULE OF ACCOMMODATION

HOUSETYPE	DESCRIPTION	SQFT	NUMBER	PERCENTAGE
Phase 1 - Affordable				
2F1B	1 Bed Walk Up Flat - Ground Floor	578 SQFT	8	12.90
2F1B	1 Bed Walk Up Flat - First Floor	648 SQFT	8	12.90
2B Bungalow	2 Bed, 1 Storey, Semi-Detached	620 SQFT	2	3.23
4P2B	2 Bed, 2 Storey, Semi-Detached	895 SQFT	16	25.81
5P3B	3 Bed, 2 Storey, Semi-Detached	1015 SQFT	18	29.03
Oxford	3 Bed, 2 Storey	1040 SQFT	5	8.06
Evesham	3 Bed, 2 Storey	1130 SQFT	4	6.45
Wentworth	4 Bed, 2 Storey	1344 SQFT	1	1.61
	Total	**54702**	**62**	**100.00**
Phase 2				
4P2B	2 Bed, 2 Storey, Semi-Detached	895 SQFT	12	12.90
5P3B	3 Bed, 2 Storey, Semi-Detached	1015 SQFT	32	34.41
Oxford	3 Bed, 2 Storey	1040 SQFT	17	18.28
Henley	3 Bed, 2 Storey	1040 SQFT	6	6.45
Evesham	3 Bed, 2 Storey	1130 SQFT	13	13.98
Wentworth	4 Bed, 2 Storey	1344 SQFT	13	13.98
	Total	**99302**	**93**	**100.00**
TOTAL		**154004 SQFT**	**155**	
Gross Site Area		13.2 Acres	5.34	Hectares
POS		2.22 Acres	0.90	Hectares
Existing Landscaping & Buffer		0.47 Acres	0.19	Hectares
Undevelopable: Entrance, Sringe Sided Road ETC		0.72 Acres	0.29	Hectares
NETT SITE AREA:		**9.79 ACRES**	**3.96**	**HECTARES**
Gross Density:		11.74 Units/Acre	29.02	Units/Hectare
NETT DENSITY:		**15.83 UNITS/ACRE**	**39.12**	**UNITS/HECTARE**
Gross Footage:		11666.97 SQFT/Acre	2678.34	SQM/Hectare
NETT FOOTAGE:		**15730.75 SQFT/ACRE**	**3611.25**	**SQM/HECTARE**

Key:

- Site Boundary
- 1.8m high boundary fence
- 1.8m high screen wall / fence
- Private Drive
- Indicative Landscaping. No landscaping to be withing 2x2m visibility splay to each drive - refer to landscaping design for exact details
- Number of parking spaces proposed to Semi-Detached and Detached Dwellings in accordance with LPA Parking Standards
- Parking space allocation to Frontage Parking Dwellings
- Existing retained hedges/landscaping
- * Affordable Housing

Rev:	Description:	Date:
A:	Access amended & Plots increased to 159	01/09/22
B:	Affordable provision amended to 40%	06/01/23
C:	Drainage basins updated	31/05/23
D:	Turning heads amended	26/06/23

Castle Green

Castle Green,
Unit 20,
St. Asaph Business Park,
St Asaph,
Denbighshire. LL17 0LJ.
Tel. 01745 536677

Site: Land at Well Street, Buckley, Flintshire

Title: Proposed Site Plan

Scale: 1:500@A0

Date: 19.07.22

Ref: WLST-BUC-SP01

Rev: D

Appendix E Natural Resources Wales Flood Risk Maps

High Extent	Surface Water and Small Watercourses Extent - High Risk
Medium Extent	Surface Water and Small Watercourses Extent - Medium Risk
Low Extent	Surface Water and Small Watercourses Extent - Low Risk

Appendix H Preliminary Storage Estimate

Quick Storage Estimate

Results: User Input

Quick Storage Estimate variables require approximate storage of between 2079m³ - 2712m³.

These values are estimates only and should not be used for final design purposes.

Area	3.044
Volumetric Runoff Coefficient	0.750
Discharge Rate (L/s)	12.0000
Infiltration Rate (m/hr)	0.00000

Appendix I Greenfield Runoff Rates

ICP SUDS Mean Annual Flood

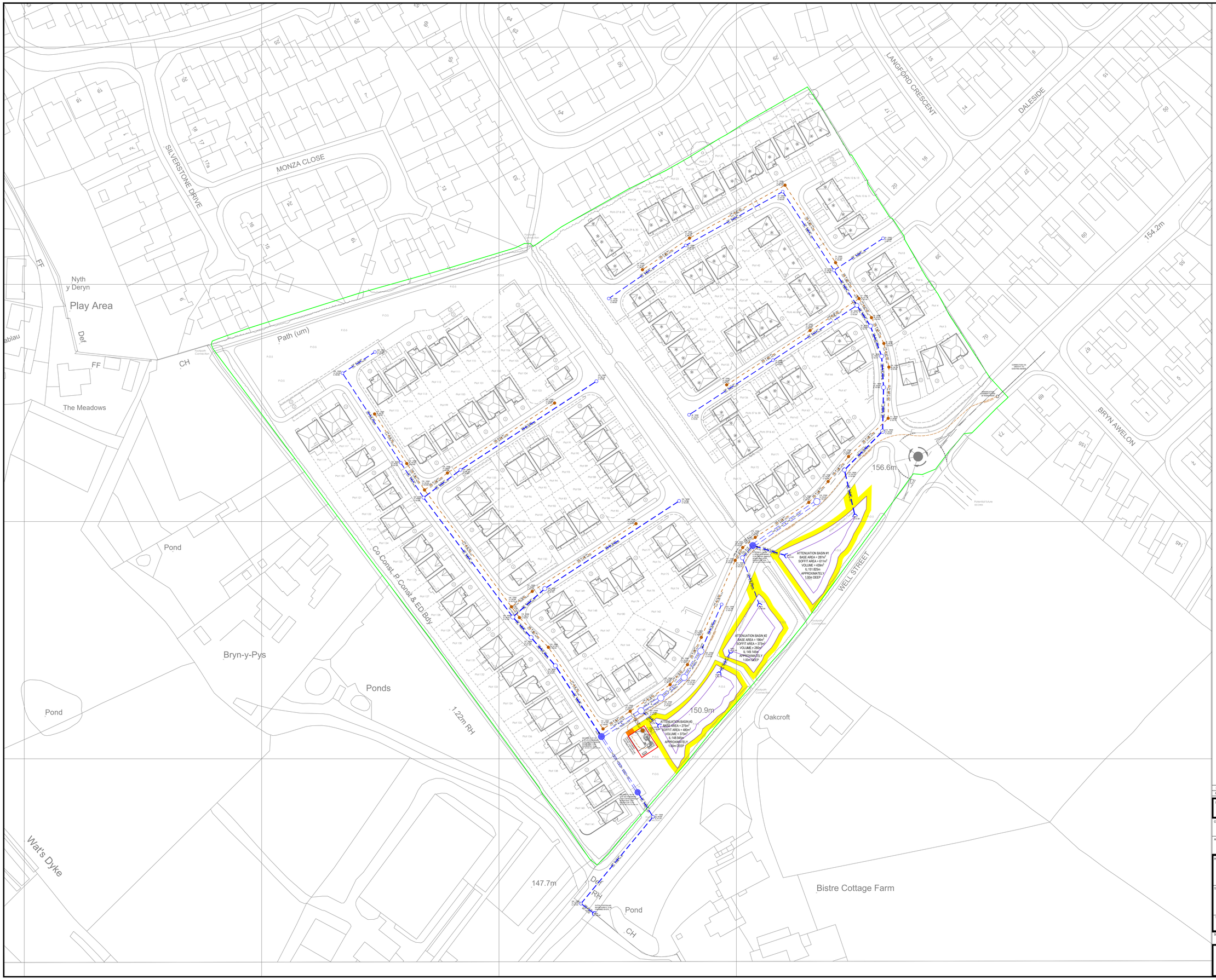
Input

Return Period(years)	1
Area (ha)	5.400
SAAR (mm)	836.000
Soil	0.300
Urban	0.000
Region	Region 9

Results

QBAR Rural (L/s)	12.1134
QBAR Urban (L/s)	12.1134
Q 1 (years)	10.5386
Q 1 (years)	10.5386
Q 30 (years)	20.5377
Q 100 (years)	25.1958

Appendix J Outline Drainage Strategy



REV	DATE	DESCRIPTION	BY	CHK	APP
P01	18.04.2023	PRELIMINARY ISSUE	LS	KOB	KOB

DRAWING STATUS: **PRELIMINARY**

CLIENT: CASTLE GREEN HOMES

ARCHITECT: CASTLE GREEN HOMES

PROJECT: WELL STREET, BUCKLEY, FLINTSHIRE

TITLE: PRELIMINARY DRAINAGE STRATEGY

MASTERPLAN

STATUS:	PROJECT No:	PROJECT	ORIGINATOR	VOL/SYS	LEVEL	TYPE	ROLE	DRAWING No.	REV:
S2	220-137	WEL -	AJP -	XX -	00 -	DR -		C - 0950	P01

SCALE @ A0:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
1:500	LS	LS	KOB	KOB	JAN 2023

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