1.0 Civil & Structural

1.1 Site Background

Address: Forest Research
Bush Estate
Roslin
EH25 9SY

Grid Reference NT244636

The site comprises the grounds of Northern Research Station. The limited topographical survey indicates that parts of the developed site are generally flat but there appears to be a levels difference of approximately 2m across the site out-with the main development complex and extends beyond into the plantation areas.

The site generally slopes south east, generally at grade with surrounding neighbouring plots.

1.2 Design Status

Civil and Structural engineering input has been provided to inform the RIBA stage 0/1 feasibility. Further developments will largely depend on the option chosen.

The following report provides input into what further investigations and information are deemed necessary within the developing stages.

1.3 Development Proposals

The overall development includes the possible construction of;

- A new two storey office block
- All associated drainage and infrastructure
- New greenhouses at the East of the site to account for those displaced in Option 1.

All works are within the confines of the existing site boundary and will extend the existing building footprint within developed areas of the site.

Extension proposals occupy existing developed infrastructure therefore in order to construct the proposals, it will be necessary to deconstruct existing structures including their associated slabs / foundations. Existing services and drainage will require to be grubbed up and/or diverted.

It is anticipated that the existing drainage infrastructure will be investigated in its entirety to confirm its capacity, condition and trajectory.

There are no other major earthworks anticipated.

As far as practical the existing road infrastructure is maintained. It is the intention to leave existing drainage systems operating as they currently do and to add drainage for the new development. The existing infrastructure shall be surveyed to develop an understanding on depth, falls, condition and material.

No additional car parking or hardstanding enhancements are deemed necessary to satisfy the proposals. However, there is potential to increase car parking provision across the site to easily accommodate 10-15 spaces across the site and given that the intended building usage is increasing, provisions for additional disabled parking bays may be essential.

1.4 Existing Infrastructure

1.4.1 Introduction

The site is located at the base of Pentland hills with a significant rainfall catchment area likely to be tending towards the site. Within the proximity of the site there are surface water burns, tributaries and ditches that direct surface water away from the site boundary.

The nearest water courses are the Boghall burn to the north and Glencourse burn to the south. The site is considered to sit on a platform with an elevation above any potential flood zone.

A level 1 Flood risk assessment was undertaken for a previous feasibility study at this site and the SEPA indicative flood risk map has been consulted. The map illustrates the effects of a 1 in 200 year storm event. The map has highlighted that the site is Low risk of fluvial or pluvial flooding.

1.5 Existing Drainage Infrastructure

1.5.1 General

In principle, the proposed strategy is to leave the existing drainage to operate as it currently does and install a new system to serve the new office development. By default, the existing system may see some improvement as flows form current building and infrastructure (rainfall) are currently discharging into it. The drainage will be designed to manage and control surface water run off in order to mitigate any adverse impact associated with flood risk.

The Scottish Water asset plans shall also be procured to develop the detailed intersection between where the private network meets the Scottish Water network.

Drainage investigations are to be undertaken (CCTV survey) to provide a more in depth understanding of the existing drainage network and its condition, in the absence of any record drawings this will be required to determine where existing drainage discharges and to what extent (if any) the drainage network requires enhancement.

It is considered at this time that there should be sufficient capacity within the existing private network to service the development but depending on the option considered for design, Scottish water will likely require more in depth analysis on the surface water management strategy.

A Pre Development Enquiry will be submitted to Scottish Water to understand whether there will be any constraints within the surrounding network.

Given the buildings age it is likely that some drainage remediation will be required to fix and make good drainage defects that will likely have happened throughout the course of the buildings life.

1.5.2 Existing Drainage – Surface Water

There is surface water drainage serving the existing building roof via rain water down pipes. Drainage gullies are also positioned within the site to collect surface water run off from hardstanding areas. It is anticipated that this will be collected by a piped system and will discharge into an existing watercourse via a ditch.

No design information for the existing system has been provided. The existing drainage infrastructure shall be completely surveyed during design development.

1.5.3 Existing Drainage – Foul Water

It is anticipated that the foul drainage discharges into the Scottish Water network.

1.6 Proposed Drainage

1.6.1 Proposed Surface Water Drainage

Soakaway analysis has been carried out as part of the site investigation to ascertain infiltration rates of the underlying soils. There is a mandatory requirement stipulated by Scottish Water to develop proposals for surface water management prior to applying to connect to their existing system.

The soakaway test provided a negative result i.e. the underlying cohesive soils are not appropriate for infiltration.

The surface water drainage strategy will be developed with reference to current SUDS best practice.

The following strategies will be implemented.

Area subject to run off	Levels of treatment to be provided	Strategy
Car park (if required)	2	Treatment provided via permeable paving and granular bed beneath all weather pitch.
Roofs of new Buildings	1	Treatment provided via granular treatment trench.
Existing roads and infrastructure	N/A	Existing roads and pavilion design will be retained and not be augmented.

The final SUDs strategy will be clarified as part of the detailed design.

The pre development greenfield run off rates have been assessed to inform the likely permitted post development flows. The run off rate for the development will be attenuated to the 1 in 2 year greenfield release rate. All post development flows up to 1 in 200 year storm events plus 50% climate change will be attenuated below ground will no surface flooding.

Proposed new surface water drainage will be provided and act independently to the existing drainage infrastructure and connect at a point determined by design.

1.6.2 Proposed Foul Water Drainage

It is proposed that the foul drain will connect, via gravity, into the existing system.

A Pre development enquiry will be required for the additional loading, but given the scale of the development, Scottish Water approval is not considered a risk.

1.7 Ground Investigation

1.7.1 General

Based on results of previous ground investigation undertaken in 2013 by Pick Everard to satisfy the installation of a greenhouse building and an independent mechanical plant base, the underlying ground conditions are noted as firm brown sandy gravely firm clay at shallow depth.

British Geological Survey data is showing available investigatory boreholes within neighbouring sites which concur with the findings of the previous site investigation.

A specific site investigation for this proposal was carried out by Mason Evans in April 2021. Geo-environmental results are pending as of the writing of this report.

Initial results are reported in the following sections where available.

1.7.2 Objectives for Site Investigation

The investigations comprised 7No. trial pits and 3No soil bores across the three locations to determine specific and detailed information on the geotechnical and environmental conditions beneath the site.

The objective for the site investigation was to:

- Determine the presence and nature of made ground
- To determine the nature and engineering properties of the natural soils beneath the site
- To enable reliable foundation to be constructed
- To develop the conceptual site model and conduct a general quantitative risk assessment
- To ascertain whether contamination exists at the site
- To ascertain the concentration of ground gases emanating from beneath the site.

The below ground profile has been characterised by insitu targeted site investigation in each of the option locations.

The ground profile consists of made ground (approx. 1m thick) underlain by natural soft becoming firm clay, proven to approx. 4m depth, further underlain by medium dense sand, proven to 5m bgl.

1.7.3 Ground Gas

Ground gas monitoring in accordance with BS8485 is required to justify the inclusion or otherwise, of a ground gas remediation strategy. Monitoring is ongoing as of the writing of this report.

1.7.4 UKWIR Ground Investigation

It is noted that the Scottish Water approval process for potable water supply requires an additional ground investigation along the route of the proposed water supply pipe(s) in accordance with UKWIR Regulations and commissioned by the client.

1.7.5 WAC Testing / Soil Removal

Arising from site during earthworks are likely to be redistributed across the site, if deemed acceptable. Any material to be exported will require to undergo Waste Acceptance Criteria testing.

Topsoil is present across the site. If the topsoil is to be re-used it shall be tested in accordance with BS3382:2015. No new growth medium is required within the site. Unless otherwise specified by a landscape architect. This being the case, the National Building Specification Landscape guidance shall be followed.

The risk to human health of the proposed redevelopment is considered to be low.

The risk to the water environment once the site has been developed is considered to be low.

1.7.6 Mineral Stability

Pick Everard consider that the site is likely to be minerally stable.

The site is located on the boundary of mineral reporting area however the site appears to be out with the influence zone of any:

1. Development high risk areas
2. Mine entrys and their zone of influence
3. Fissures and breaklines
4. Coal outcrops

The mineral stability shall be concluded once the geotechnical assessment of the site is conducted, however it is considered low risk.

1.7.7 Foundation Solution

The site is underlain by firm clay that could be utilised to support the proposed building structure. It is reasonable at this stage to assume that standard pad footings will be utilised to support the proposed modular buildings. The safe bearing capacity of shallow soils likely to provide 75kN/m² at a depth of 1.5mbgl and a trench fill solution will may be adopted.

Foundation loads from the specialist modular building design will be required to confirm the foundation solution within the detailed design stage.

Depending on base details from the specialist supplier, there may be a requirement to ramp down to meet the existing ground floor slab level within the extent of the link corridor in Option 1.

Lift requirements are assumed to be a simple platform lift supported off the modular floor construction however should a conventional concrete lift be required, this is achievable within the shallow soils.

Should cladding be of masonry construction, a strip foundation will be required to supported the perimeter external walls.

1.7.8 Ground Floor Slab

The modular building features a ground floor within the structure and does not require a separate ground floor slab.

Lift requirements are assumed to be a simple platform lift supported off the modular floor construction.

A new ground bearing floor slab is required for the link corridor proposed within Option 1. This would be constructed on a raise platform of engineered fill to accommodate a ground bearing raft slab.

A new ground bearing floor slab is required for the new greenhouse locations. This would be constructed on a raise platform of engineered fill to accommodate a ground bearing raft slab.

Details will be progressed throughout the development of design.

1.7.9 Ground water

Given the depths of underlying clays, ground water should not pose any issues for the proposed development. However, the shallow clay material may tend to become saturated during ground works and become unworkable.

The contractor shall adopt a suitable surface water strategy to control overland flows during construction.

1.8 Off Site Works

The requirement for any off site works have not been identified and likely to be considered unnecessary. This shall be confirmed via consultation with the local authority. Therefore the provision of any off site works will only be known once the planning application process has been concluded.

Protection measures to existing roads during construction, need to be considered.

1.9 Proposed Structural Specification

The design of the structural elements will be carried out in accordance with the current Building Standards and utilising European Design Standards and UK National Annexes.

The design of the modular building will be carried out by a specialist designer in accordance with the current Building Standards and utilising European Design Standards and UK National Annexes.

For the design of the buildings there are three types of loading to consider

- Variable Action Loading
- Permanent Action Loading
- Environmental Loading (Snow and Wind)

1.9.1 Variable Action Loading

Imposed loading is the load assumed to be produced by the intended occupancy or use, including impact and inertia loads, but excluding wind. Imposed loading will occur on all floors and the roof. The following minimum loads are derived from BS EN 1991-1-1:2002 Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings.

The following structural imposed loadings will be used during the detailed design stage.

Area	Design Imposed load	
	UDL (kN/m2)	Point load (kN)
Offices	2.5 + 1.0 partitions	2.7
Plant rooms	7.5	7.0
Wind loading	As per BS EN 1991	
Roof loading	As per BS EN 1991	

1.9.2 Permanent Action loading

Loadings due to the permanent weight of construction including all finishes and services where known have been calculated utilising BS EN 1991-1-1:2002 Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings.

- Concrete density including reinforcement : 25.0 kN/m^3
- Typical screed finish (75mm thick) : 1.80 kN/m^2
- Typical value for ceiling and services : 0.50 kN/m^2

1.9.3 Wind Loading

The design wind loads will be derived in accordance with BS EN 1991-1-4:2005 Eurocode 1: Actions on structures - Part 1-4: General actions – Wind actions
Wind loads will be calculated separately for each building element. The procedure allows the wind loads to be calculated considering the size and form of each building element, its orientation to prevailing winds and proximity to the slope at the north of the site. If the architectural form of the building consists of complex geometrical boundaries specialist documentation will be consulted.

1.9.4 Snow Loading

Snow load calculations have been undertaken for all exposed roof areas and snowdrift load will be considered at interface junctions between buildings.
In accordance with BS EN1991-1-3:2003 Eurocode 1 – Actions on structures - Part 1-3: General actions -Snow loads. The minimum roof load adopted is 0.6kN/m2

1.10 Building structures – Modular Buildings

Modular buildings are a specialist design item and will therefore designed by an in-house engineer of the chosen building supplier. Details of modular building construction vary between supplier.

In general they are constructed of a bespoke galvanised hot rolled steel frame supported off pad foundations.

The roof is of cold-formed purlin construction with ply and insulation supported off the purlins.

The external perimeter walls are of timber construction, infilled between the steel frame. Internal partitions are generally of cold formed steel stud construction.

Ground and first floors are constructed from a thin composite steel and concrete deck.

These types of structures can generally provide a column free space of 12m.

There is a vast selection of cladding materials that can be accommodated in modular buildings i.e. timber, metal, glass, masonry etc. Should masonry be selected as a cladding material, additional design and detailing is required to support the walls and tie them into the modular building.

Design and details will be progressed throughout the development of the project in collaboration with the specialist designer.

1.11 Building structures – Option 1

With a view of providing recommendations on the most suitable structural solution for the development Pick Everard visited site to review the existing building condition and have undertaken a review of the architectural options under consideration.

This option seeks to alter the existing building by removing internal partitions to provide a different internal floor space.

From review of the Phase 1 opening up works, a number of the walls due for removal are likely load bearing and therefore structural intervention is required in the form of a transfer structure adjacent to the current library. This shall be verified by intrusive investigation and analysis.

This option includes the proposal of a glazed link corridor. It is envisaged that the corridor will be of steel frame construction, stabilised using beam to column moment connections to allow for clear glazed exterior panels i.e. no vertical bracing. The glazing is envisaged to be curtain walling supported off the steel frame and a ground floor slab (see 1.7.8). The roof of the link corridor is envisaged to be of cold formed purlin constructions, supported off the steel frame. The roof finishes are to be confirmed by the Architect, with potential for a sedum roof in this location.

All structures will be designed and detailed to suit robustness criteria as stipulated to meet technical standards.

This option requires the demolition of the existing greenhouses. It is proposed to locate new greenhouse structures to the East of the site.

Greenhouse buildings are a specialist design item and are therefore designed by an in- house engineer of the chosen supplier.

It is envisaged to replicate the existing support structure (a concrete raft slab) at the new locations (see 1.7.8). Retention may be required to form a level surface in this area. Further topographical survey is required to confirm.

1.12 Building structures – Option 2

With a view of providing recommendations on the most suitable structural solution for the development Pick Everard visited site to review the existing building condition and have undertaken a review of the architectural options under consideration.

This option includes for demolition of part of the current building in order to place the modular buildings. The link to the modular buildings is via a door created in the existing structure. The opening will be formed via a slapping in the existing masonry wall.

It is likely that internal columns are required in this version of the modular building due to the geometry of the proposals. These may be able to be 'hidden' within internal partitions.

Placement of the modular building foundation should take cognisance of the existing foundations which were exposed as part of the SI.

1.13 Next Steps

The next steps are considered necessary to develop the design.

- Review site investigation results when available to confirm any contamination and gas issues.
- A CCTV Drainage survey of the existing infrastructure is required.
- A further topographical survey is required in the proposed area of new greenhouses.
- Opening up works local to proposed downtakings within the buildings to determine structural competency of structure to be retained.
- Dialogue / co-ordination with potential specialist suppliers of modular and greenhouse buildings. Early contractor involvement preferred in order to select supplier and reduce design assumptions.

1.14 Applicable codes and standards

- BS EN 1991 – Eurocode 1 Actions on Structures
- BS EN 1992 – Eurocode 2 Design of Concrete Structures
- BS EN 1993 – Eurocode 3 Design of Steelwork Structures
- BS EN 1995 – Eurocode 5 Design of Timber Structures
- BS EN 1996 – Eurocode 6 Design of Masonry Structures
- Britpave concrete hardstanding design handbook
- Concrete society TR34 Concrete industrial ground floors
- BS EN 752 Drains and sewers outside buildings
- CIRIA C753 The Suds Manual
- SEPA WAT RM 08 Regulation of SUDs
- SUDs for Roads