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1. Introduction

Description of the Site

- 1.1.1 This Flood Risk Assessment has been produced on behalf of Lindsay Construction Ltd. and refers to a site known as Braeside Yard, located at Slamannan Road, Limerigg, Falkirk, hereafter referred to as 'the site'.
- 1.1.2 The site is a housing development comprising two dwelling houses.

Requirement for flood risk assessment

- 1.1.3 A watercourse known as Culloch Burn flows adjacent to the site. It is understood that a Flood Risk Assessment is required for the site due to potential flooding issues identified at the site.
- 1.1.4 Based on the Flood Risk Framework as set out in Scottish Planning Policy: Planning and Flooding (2014), a Site-specific Flood Risk Assessment is required because the proposed development site (or parts thereof) lie within or are located in close proximity to areas considered at risk of flooding.
- 1.1.5 This Flood Risk Assessment considers the risks to the site. Additionally, it will assess flood risk elsewhere that may arise following site development. If necessary, potential mitigation measures are suggested.

2. Methodology – Flood Risk Assessment

Introduction

- 2.1.1 This assessment identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed, taking the potential effects of climate change into account. The report identifies opportunities to reduce the probability and consequences of flooding.
- 2.1.2 The FRA is considered proportionate and appropriate for the proposed scheme in its current context and demonstrates that the proposed scheme is sustainable in terms of flood risk.

Planning Policy and Legislation

- 2.1.3 The assessment has been carried out in accordance with Scottish Planning Policy (SPP). The document states that "Planning authorities must take the probability of flooding from all sources which includes coastal, fluvial (watercourse), pluvial (surface water), groundwater, sewers and blocked culverts and the risks involved into account when preparing development plans and determining planning applications" (Scottish Government, 2014).
- 2.1.4 The Flood Risk Management (Scotland) Act¹ sets in place a statutory framework for delivering a sustainable and risk-based approach to managing flooding. The main elements of flood risk management relevant to this assessment is assessing flood risk as well as undertaking structural and non-structural flood management measures.
- 2.1.5 Scottish Planning Policy: Planning and Flooding (SPP) states that properties should be protected from flooding up to the 1 in 200 year (0.5% AEP) event probability with a sufficient freeboard to finished floor levels, and should not contribute to flooding elsewhere.

Sources of Information and Consultation

- 2.1.6 The sources of information and guidance that have been consulted in producing this Flood Risk Assessment are presented in Table 1, below.

Table 1: Sources of Information and Search Results

Source	Results
Lindsay Construction Ltd	Has provided information about the current site.
Scottish Government.	Scottish planning policy: Planning and Flooding (SPP) 2014.
Falkirk Council	The Local Development Plan; Flooding and Sustainable Urban Drainage Systems: Supplementary Planning Guidance Note.
The Scottish Environmental Protection Agency (EA).	SEPA's website has been consulted for information on flooding using their new Flood Map for Scotland. The new flood extent map shows potential groundwater flooding areas, surface water flooding, rivers flooding and more.
British Geological Survey (BGS).	BGS 1:50,000 scale Geological Map No. Sheet 31E (Bedrock & Superficial Deposits edition) was consulted for geological information relating to the site and surrounding area.

¹ Scottish Government (2009), The Flood Risk Management (Scotland) Act 2009

3. Development Description and Location

Site location

- 3.1.1 The site is approximately 0.16 hectares (1,600m²) in area and is situated off Slamannan Road, in Limerigg, Falkirk. Figure A1, Appendix A shows the location of the site, which centres on National Grid Reference 285526, 671655. The proposed site layout of the site is shown in Figure A2, Appendix A.

Current site condition

- 3.1.2 The site comprises a roughly rectangular shaped plot of land, located to the west of Slamannan Road. The north east of the site is a disused workshop and store which includes a pad of raised concrete.
- 3.1.3 The east of the site is an external gate and a front wall which will be demolished.
- 3.1.4 To the west of the site is Culloch Burn which bounds the western edge of the site and flows north towards Slamannan.

Proposed development

- 3.1.5 Lindsay Construction Ltd. is submitting an application for planning permission to Falkirk Council for a residential development. The proposed development includes two residential properties including mono-blocked driveways and turning areas.

Topography

- 3.1.6 The site topographic survey is included in Appendix C. The levels included in the survey have been converted to meters above Ordnance Datum (m AOD) to allow for more accurate interpretation. Based on this, the elevations across the site range between approximately 176.01 – 176.91m AOD. The elevation of the kerb adjacent to the current gate location is approximately 175.97 m AOD and the water level of the Culloch Burn was 174.07m AOD at time of survey.
- 3.1.7 Cross sections across Culloch Burn indicate that the bank level located at the western site boundary is between 176.01 - 176.69 m AOD.

Geology

- 3.1.8 A review of the 1: 50,000 BGS geological map for the area, and the BGS Geology viewer of Britain website², indicates that the site is underlain by Scottish Lower Coal Measures Formation- Sedimentary Rock Cycles, Coal Measures Type. This sedimentary bedrock formed approximately 312-313 million years ago in the Carboniferous Period in a local environment previously dominated by swamps, estuaries and deltas.
- 3.1.9 The site is underlain by superficial deposits of Till, Devensian - Diamicton and formed up to 2 million years ago in the Quaternary period in a local environment previously dominated by ice age conditions.

Hydrogeology

- 3.1.10 Review of the BGS UK Hydrogeology viewer³ shows that the site is underlain by a moderately productive aquifer. This is a regional, cyclic multi-layered aquifer with low yields from sandstones. Higher yields where mined but poor water quality, including high iron and fluoride. Based on the FEH CD-ROM⁴ the soil classification for the site

² BGS, 2014. <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> [Accessed 9th January 2015]

³ BGS, 2014. <http://mapapps.bgs.ac.uk/hydrogeologymap/hydromap.html> [Accessed 9th January 2015]

⁴ NERC (CEC) 2008, *Flood Estimation Handbook CD ROM*

is Soil Type 3 indicating low permeability.

Hydrology

- 3.1.11 The site lies within the SEPA Flood Map⁵ coverage and there is one watercourse in the vicinity of the site, Culloch Water, which is located immediately west of the site and based on the FEH CD-ROM, has a catchment size of approximately 3.4km² at the point where it bounds the site.
- 3.1.12 There is also a small unnamed burn to the east of the site which drains areas of forestry located to the south east. This flows north past the site and passes under the B8022 (Slamannan Road) via a culvert 97m downstream of the site at NGR 285586, 671709 before joining Culloch Burn at NGR 285521, 671745.
- 3.1.13 The SEPA Flood Map indicates that the site is not at risk from any source of flooding. However, considering the close proximity of the watercourse additional analysis has been undertaken to assess potential risk.

⁵ SEPA, 2014. <http://map.sepa.org.uk/floodmap/map.htm> [Accessed 9th January 2015]

4. Definition of Flood Hazard

- 4.1.1 Flooding can occur from a range of sources including flood waters from rivers and the sea, surface waters arising from overland flow, rising groundwater and overwhelmed sewers and drainage systems; these potential sources of flooding are summarised in Table 2, below.
- 4.1.2 Table 2 also gives a brief summary of whether each potential source may actually pose a risk to the site, based on a preliminary review of available information. This probability is discussed in detail in Section 5, below.
- 4.1.3 Where the information presented in Section 5 indicates that the risk of flooding from a particular source cannot be immediately discounted, further assessment is carried out in Section 6.

Table 2: Potential Sources of Flooding

Source	Description	Site at Risk from this Source?
Fluvial (river)	Can occur through the inundation of flood plains, overtopping and breaching of defences and blockages of culverts of flood channels	Yes The site is bounded to the west by Culloch Burn and there is a small burn located east of the site
Tidal (sea)	Major flooding can occur when low-lying coastal areas are inundated by the sea, usually during exceptionally high tides and especially when these are combined with high waves, such as those produced by high winds and storms. High tides can also prevent rivers from discharging normally into the sea, causing higher river levels.	No The site is located approximately 4.6km from the nearest coastal area, the Firth of Forth. The nearby rivers are not tidally influenced.
Reservoirs	Sites can flood due to the failure of artificial reservoirs.	No The closest reservoir is Black Loch which is located approximately 1.5km south east of the site. Due to the topography of the area the site is unlikely to be at risk from this source.
Canals	Flooding can occur from man-made channels such as canals. This is usually due to the failure of canal embankments etc.	No There are no canals located in the vicinity of the site.
Sewers	During extreme rainfall events surface water and combined sewer systems can be overwhelmed and surcharge, potentially causing flooding in the vicinity.	No There are no sewers in the area which would pose a risk of flooding.

Source	Description	Site at Risk from this Source?
Groundwater	<p>Occurs when the water table rises after prolonged rainfall and emerges above the ground level. This is most likely to occur in low-lying areas that are underlain by permeable rock such as chalk or sandstone and are classified as regional aquifers.</p> <p>Groundwater flooding may also arise from localised sands and gravels in valley bottoms underlain by less permeable rocks. Generally, the water table rises in wet winter months and falls in summer months as the water migrates to the surface water courses.</p>	<p>No</p> <p>The site is underlain by a moderately productive aquifer and the site is relatively elevated so the risk is unlikely. This is substantiated by the SEPA Flood Map which does not indicate a risk in the vicinity of the site.</p>
Surface Water	<p>Surface water flooding occurs when drainage systems have insufficient capacity to deal with the volume of rainfall. The critical factors in surface water flooding are the volume and intensity of rainfall and the topography and permeability of the surface that the rainfall falls onto. As a result, surface water flooding can cause sheet run-off which can occur quickly and is often difficult to predict.</p>	<p>Flows generated off site: Yes</p> <p>There is no indication of risk from surface water flooding from off site sources based on the SEPA Flood Map. Discussions with Falkirk Council have highlighted that Slamannan Road can be prone to surface water accumulations.</p> <p>Flows generated on site: Yes</p> <p>As site development will decrease the available permeable surface areas, there will be an increase in the likelihood of flood risk from surface water flooding from on site sources.</p>