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# 11.0 SOILS AND GEOLOGY

*Section 1 (Introduction), Section 6 (Site Setting) and Section 8 (Description of the Proposed Development) of the EIS should be referred to before reading this section.*

## 11.1 Introduction

This section of the EIS provides information on local geological conditions and assesses the likely impacts of the activities associated with the Application Site on the soils and geology.

A baseline description of the local soils and geological environment is made, and this is followed by an initial assessment of potential impacts assuming no mitigation measures are put in place. A discussion of appropriate mitigation measures ensues and then potential impacts are reassessed.

## 11.2 Methodology

Information for the assessment of the impacts to geology was obtained by means of:

- A desk-based review of the Geological Survey of Ireland (GSI) geological maps and records for the area with reference to geology (GSI, 1994). Soil classifications (as mapped under the Irish Forest Soils (IFS) project) were sourced from the GSI website, and soil characterisation descriptions obtained from the National Soil Survey of Ireland publication (Conry et al, 1970);

- A desk-based review of historic Cemex geological records, and the EIS relating to Planning Ref. No. 96/100;

- A Site visit carried out in June 2007 to establish and assess the geological environment in the vicinity of the Site; and

- A Site investigation conducted in late 2007 and May 2008.



## 11.3 Existing Environment

The following sections describe the existing soils and geological conditions in the Walshestown area. The regional area of study generally incorporates the land from Blessington in the southeast to the outskirts of Naas in the northwest. The local or Site-specific area of study incorporates the Site (ca. 68.0 ha) and the immediate surrounding lands.

### 11.3.1 Soils

According to mapping conducted by An Foras Talúntais in the late 1960s, most of the region under study is covered by Grey Brown Podzolics: the Elton Series in the western part, and on

the Site itself, and the Kennycourt Series further to the east. Brown Earth Group soils of the Hughstown Series, and Podzols of the Cupidstownhill Series are found on the hilltops which mark the county boundary, a little west of Blessington. Due south of the Site, an area of Athy Complex soils are found.

The Grey Brown Podzolics are, generally-speaking, some of the most inherently fertile soils in Co. Kildare; they are well drained to moderately well drained and are usually moderately acid to neutral in reaction. They are defined by a B horizon which has higher clay content than either the A or C horizon. Soils of the Elton Series of this Group are derived from calcareous glacial till composed mainly of limestone with some shale and sandstone. The soils are deep, well-drained and have a loam texture. Depth of the A horizon varies from 25-43 cm; the profile has a dark greyish brown loamy A11 horizon over a lighter coloured, brown to dark brown sub-surface A12 horizon. The A2 horizon is generally very weakly developed in this series. The B2 horizon, a brown to dark brown sandy loam, with pockets of B2t, normally shows little or no clay increase over the A or C horizon, thus the soils are classified as minimal Grey Brown Podzolics (Conry et al, 1970: 12). The total soil profile varies from ca. 63.5 – ca. 127 cm in thickness.

In more recent times an Irish Forest Soils (IFS) project has mapped the soils of the region. A soils map for the Site and environs, obtained from the Geological Survey of Ireland (GSI) website, is presented as Figure 11.1. The major area of the Site has been mapped as being ‘shallow, well-drained mineral soil derived from mainly basic parent materials (BminSW)’, which is in general agreement with the description above. A small area on the northwest boundary of the Site is designated as ‘peaty shallow poorly drained mineral soil derived from mainly basic parent materials (BminSPPT)’.



The Site was historically used for sand and gravel extraction so much of the natural soil cover has been stripped. The only remaining parts of the Site with any natural soil cover are a thin strip around the boundaries, and Site investigation works conducted in late 2007 indicate that approximately 2.6 m thickness of soils overlie the glacial deposits in these boundary areas. A report detailing the ground investigation works is presented in Appendix 6.

The southern part of the Site has been restored to agricultural grassland. The low-lying parts of this area are generally poorly drained and rushy, and remain soft during winter months.

### 11.3.2 Regional Geology

The region is covered by the GSI’s publication Geology of Kildare-Wicklow (GSI, 1994) and accompanying map Sheet 16. These documents report several lithologies in the area, which are summarised in Table 11.1.

The geology comprises Quaternary glacial deposits overlying bedrock comprised of Silurian-age (443 to 417 million years old) greywackes and shales of the Kilcullen Group which were

deposited primarily as turbidites. These turbidites fine upwards from the Pollaphuca to the Carrighill Formations.

No sites of geological interest or importance have been identified in the Kildare County Development Plan (2005-2011), and the GSI has confirmed that there are no proposed geological National Heritage Areas in the vicinity of the Site (pers. comm. 5 September 2008).

**Table 11.1 Summary of Geology (glacial deposits and bedrock)**

| Lithology | | Description | Maximum Thickness (m) |
|---|---|---|---|
| **Quaternary** | Fluvioglacial Sands and Gravels | | Variable. Over 30 m thick in parts of the Site. |
| | Glacial Moraine Deposits | Clayey to silty matrix with dispersed pebble clasts of **shale and siltstone**. | Variable, lensing. Up to 25 m thick in parts of the Site; not found in all boreholes on Site. |
| **Silurian - Kilcullen Group** | Carrighill Formation | Calcareous **greywacke siltstones** and **shales**, with occasional **sandstones.** | Not reported. Thickness on Site unknown. |
| | Tipperkevin Formation | Generally medium to fine-grained, but occasionally coarser, greywacke **sandstones**, and **shales.** | Not reported |
| | Glen Ding Formation | Dark green-grey feldspathic and chloritic greywacke **sandstones** and **shales.** | Not reported |
| | Slate Quarry Formation | Dark grey **slates** with rare brown silty laminae, and minor interbedded greywackes. | Not reported |
| | Pollaphuca Formation | Coarse, grey greywacke **sandstones** and **grits**, and dark grey **shales**. | Not reported |

*Source:* GSI, 1994



11.3.2.1 Quaternary Geology

This region was covered by ice during the last glaciation of the Pleistocene Epoch (ca. 10,000 years ago) and all of the surface deposits of the region were deposited during that time either directly from the ice itself (as unsorted moraine deposits, which include high clay content) or by melt water flowing from the ice sheets (as sorted sands and gravels, silts and clays).

The Quaternary deposits were derived from an ice sheet that most likely extended from the Irish midlands, southwards and eastwards across the region (GSI, 1994). As a result the clasts included in these deposits may have been transported for some distance. A map, prepared by

the GSI (GSI website), showing the Quaternary deposits at the Site and environs is presented as Figure 11.2.

#### 11.3.2.2 Bedrock

The bedrock geology of the area is shown on Figure 11.3 and summarised in Table 11.1. The area of the pit is underlain by the Carrighill Formation, considered the youngest of the Kilcullen Group. The Carrighill Formation consists of fine-grained greywacke siltstones and shales. The formation is poorly exposed.

Structurally, the GSI Sheet 16 identifies a major west-east trending fault structure starting 500 m east of the Site's eastern boundary. A major northeast-southwest trending fault, the Athgarrett Fault, which separates the Tipperkevin and Glen Ding formations, lies approximately 1.6 km to the east of the Site. A series of fold axes extend westward from the Athgarrett Fault, and run parallel to it.

### 11.3.3 Local Geology

#### 11.3.3.1 Quaternary

The local Quaternary geology corresponds with the regional picture outlined above. Exploration records held by Cemex show that, historically, glacial deposits found across the Site were typically lenses of 'hard silty boulder clay (sometimes with cobbles or boulders of quartzite, limestone and granite)' overlain by fluvioglacial sand and gravel deposits which varied in thickness and composition. The latter have since largely been worked out during quarrying operations.



Site investigations conducted in late 2007 concur with this picture; a Ground Investigation Report of those works is included as Appendix 6. In summary, eight rotary boreholes were drilled in the period October to December 2007; the locations of the boreholes are shown in Figure 11.4, and borehole logs are included as part of Appendix 6. Seven of the eight rotary boreholes were drilled around the edges of the Site, and one in a more central location. A summary of the thickness of glacial deposits encountered during drilling, and depth to waterstrike, are shown in Table 11.2.

The glacial deposits overlying the bedrock are, generally speaking, fluvioglacial, though in some locations unsorted till deposits directly overlie the bedrock. Figure 11.5 presents four geological sections through the Site. Till was not found in every borehole drilled, and it is considered that till (which has a high clay content) occurs only in lenses across the Site. The Site was historically used for sand and gravel extraction (the quarry is noted in the GSI records as No. 831), and the fluvioglacial sand and gravel deposits have now been largely extracted. The geological logs available for the Site (Appendix 6) confirm that the remaining quaternary deposits are largely sandy gravelly silts.

**Table 11.2 Thickness of glacial deposits at Site & depth to waterstrike**

| Borehole Reference | Total Depth (m) | Thickness of Glacial Deposits (m) | Depth to Bedrock (m bgl) | Depth to Waterstrike (m bgl) |
|---|---|---|---|---|
| **BH1-07** | 19.5 | 19.5+ | - | 12.4 |
| **BH2-07** | 46.0 | 37.5 | 37.5 | 16.2 |
| **BH3-07** | 35.85 | 15.1 | 15.1 | 29.9 |
| **BH4-07** | 38.0 | 38.0+ | - | - |
| **BH5-07** | 52.8 | 37.9 | 37.9 | - |
| **BH6-07** | 22.15 | 22.15+ | - | 17.0 |
| **BH7-07** | 37.0 | 31.5 | 31.5 | 29.0 |
| **BH8-07** | 22.0 | 22.0+ | - | 17.5 |

A line of geophysics (2-D resistivity) conducted in the area of the former silt lagoon during the ground investigation, indicates that soft silts (processed) range in thickness from ca 1.5 m to 8.0 m, and overlie natural ground (fine, sandy silts) which extend up to 30 m in depth (Figure GI 02 of the Ground Investigation Report in Appendix 6).

The exposed slopes around the ponds, the former extraction area and former silt lagoon in the northern part of the Site are prone to erosion, as evidenced by deep channels cut into the side slopes.



#### 11.3.3.2 Solid Bedrock

The bedrock beneath the Quaternary deposits at the Site comprises thinly bedded siltstones. These likely belong to the Carrighill Formation, as suggested by the GSI (GSI 1994), which comprises greywacke siltstones and shales. There is no Carboniferous-age limestone or other solution-prone bedrock within the study area, and no known karst solution features occur within the Site or local area.

No bedrock is exposed on the Site. Boreholes BH3-07 and BH5-07 were drilled through approximately 20 m and 15 m of bedrock respectively, with no change in strata type being observed in either borehole (Appendix 6).

## 11.4 Assessment

### 11.4.1 During Construction

It is noted that the Application Site is a worked-out sand and gravel pit which requires restoration, therefore the Site has previously been impacted in terms of soils and geology. Notwithstanding this, the construction works necessary to construct the proposed infrastructure will have little or no direct impact on quality of the soils, glacial deposits and

bedrock. The potential impacts on the geological environment from the construction works for the proposed development could derive from accidental spillage of fuels, oils or concrete to the environment.

Mitigation measures outlined in the following section 11.5 will ensure that any potential impact to the soil and geological environment is addressed.

### 11.4.2 During Operation

A strategic and key element of the overall conceptual design of the Restoration Plan is to return the Application Site to its former landscape character, i.e. Kildare Eastern Uplands (transition). If the Application Site is not restored and remains 'derelict', it may become the subject of unauthorised disposal/fly-tipping of waste.

During the restoration works, dry windy weather could lead to dust rising from exposed soils. This is more likely to happen during summer months. This is discussed more in Section 14 of the EIS (Air).

Erosion of the exposed slopes around the ponds, the former extraction area and former silt lagoon in the northern part of the Site could lead to fines being transported off-Site with surface water run-off.



Due to the nature of the development, there will be vehicles accessing the Site during the hours of operation, including trucks, waste vehicles and service vehicles. This may lead to vehicle emissions, leaks or accidental spills of hydrocarbons (fuels or oils), which could potentially cause contamination of the soil/glacial deposits environment via surface water runoff and infiltration.

Provided the mitigation measures described in the following section 11.5 are implemented, it can be expected that the proposed ongoing operation at the Application Site will have negligible effects on the underlying geological environment.

## 11.5 Mitigation

### 11.5.1 General

In order to reduce the risk of localised erosion and potential dust emissions, the area of exposed soils will be kept to a minimum during construction and operation phases. Temporary vegetation cover shall be encouraged on exposed slopes awaiting final restoration.

### 11.5.2 During Construction

To minimise any impact on the soils and geological environment from potential material spillages, all oils, solvents and paints used during construction will be stored within

appropriately designed and bunded containers. Site operatives will be trained in the proper use of such containers.

All plant will be regularly maintained and inspected for leaks of fuels, oils or other potential contaminating substances. Maintenance will be undertaken either within a bunded area or off-Site to minimise the risk of uncontrolled spills of potential pollutants.

Oil and fuel storage tanks shall be stored in a designated hardstand bunded area on the Application Site. Filling and draw-off points will be located entirely within this bunded area, where run off is first collected by an oil interceptor prior to discharge into the Application Site's drainage system.

Waste residuals generated during construction activities, such as hydrocarbons, paint and solvent containers, will also be stored within temporary bunded storage areas prior to removal by an appropriate Local Authority or EPA approved waste management contractor for off-Site treatment/recycling/disposal.

The combined application of these measures will ensure that there will be a negligible effect on the underlying soils and geological environment during the construction phase.



### 11.5.3 During Operation

#### 11.5.3.1 Inert Waste Processing Area

In order to minimise the risk of introducing contaminated soils to the Site, both during construction and operation phases, management systems will be put in place to confirm in advance the source of imported materials and that they are in compliance with the Waste Licence. Multiple-level soil testing regimes will be put in place:

- Basic characterisation testing covering a wide range of parameters to determine the leaching behaviour of soils imported to the Site;
- Compliance testing covering a limited range of key soil parameters; and
- Comprehensive on-Site verification, comprising visual inspection and recording of all imported soil unloaded at the Site.

During construction, all surfaces in the Inert Waste Processing Area (IWPA) will be graded to direct run-off to infiltration trenches around the perimeter of the IWPA (Figure 8.5). Surfaces between the berm around the IWPA and the entrance gate will be graded to direct run-off to Pond C.

Refuelling of vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated hardstand bunded refuelling area, where run off is first collected by an oil interceptor prior to discharge into the Application Site's drainage system.

Spill kits and hydrocarbon adsorbent packs will be stored in the refuelling area. Site operators will be fully trained in the use of this equipment, and the appropriate certification records will be retained on Site.

#### 11.5.3.2 Main Area of Restoration

The backfilling and restoration of the Application Site will prevent further soil-erosion and the potential loss of soils off-Site, and the risk of potential slope instability in the northern part of the Site.

As the land is restored on a phased basis the surface will be capped, graded and re-vegetated in such a way as to further encourage rainfall run-off to the infiltration trenches around the boundaries. This will protect the soils, geological and groundwater environment into the future.



## 11.6 Cumulative Impacts

As this development is a restoration plan, designed to improve the existing environmental conditions, it is expected that the cumulative impacts on soils and geology will be positive in the long term. By restoring the Site, in accordance with the Strategic Objective of the KCC Development Plan (pg 215, Pit No. 9), the environmental setting will improve with time. Bare soil patches which are scattered throughout the Site at present will be restored thus reducing the potential for dust blow, erosion and the landscape setting will dramatically improve (Section 16).

## 11.7 Residual

### 11.7.1 During Construction

Any predicted negative impacts during the construction phase will be short term and temporary in nature.

Implementation of the mitigation measures described in the previous section will ensure no long term impact on the soils and geological environment during the construction stage of the project.

### 11.7.2 During Operation

Provided the mitigation measures outlined in the previous section are implemented, there will be a neutral long term impact on the soil and geological environment during the operational phase of the development.

The restoration activity will serve to integrate the bare worked-out sand and gravel pit into the surrounding landscape, in a manner sensitive to the visual amenity of the area. The Application Site will be restored under the terms of an EPA Waste Licence. Backfilling of the Site will occur in the worked-out areas using inert materials, and the lands will be capped so as to protect the soils, geological and groundwater environment into the future. Finished restoration contours will be in keeping with the surrounding landscape.

Ultimately the Site will benefit as the currently disturbed soils (i.e. worked out sand and gravel pit) will be returned to beneficial uses including species-rich grasslands which will enhance biodiversity for the surrounding area (Section 10).

## 11.8 Monitoring

Inspections will be conducted on the silt traps and oil interceptors at regular intervals.

Groundwater monitoring will be carried out at the Application Site in accordance with the conditions attached to the current Waste Permit and any future EPA Licence. Groundwater levels have been monitored on a monthly basis between November 2007 and August 2008 at the Application Site, and have been sampled twice for water quality. Data relating to this monitoring is included in Section 12.0.



Details of proposed monitoring at the Site are included in Section 19.

## 11.9 References

Summary Report on Ground Investigations at Walshestown Pit, Co. Kildare. Golder Associates Ireland Ltd. (September 2008).

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