Appendix 4 – Flood Risk Assessment, prepared by Hafren Water (March 2013)
Flood Risk Assessment

Proposed construction of a Pipeline Inspection Gauge compound

Patford Bridge, Great Brington, Northamptonshire

Final
March 2013

Report prepared for:

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Flood Risk Assessment

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Patford Bridge, Great Brington, Northamptonshire

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March 2013

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1 INTRODUCTION

1.1 Background

CEMEX UK Cement Limited is proposing to construct a compound to service a chalk slurry pipeline which connects Kensworth Chalk Quarry to Rugby Cement Plant at Patford Bridge, near Great Brington, Northamptonshire. The proposed compound consists of a Pipeline Inspection Gauge (PIG) launch station, vehicle turning area and lagoon.

The site is located within Flood Zone 3 on the Environment Agency Indicative Flood Map, which is defined as having an annual probability of fluvial flooding greater than 1 in 100 (>1%). The proposed development is classified as ‘less vulnerable’ in the National Planning Policy Framework (NPPF). ‘Less vulnerable’ development is permitted within Flood Zone 3 subject to the submission of a suitable Flood Risk Assessment (FRA).

1.2 Scope of the assessment

The flood risk to and from the completed site has been assessed and quantified and potential mitigation measures outlined.

1.3 Site location

The Application Area is located some 2.5 km northwest of Great Brington, Northamptonshire. The site is located around National Grid Reference (NGR) SP 647 664 and is shown on Figure 1. Access is via Brington Road immediately north of the Application Area.

1.4 Site description and elevations

The Application Area is situated within a cropped field. It is bounded to the west by a track and footpath, to the north by Brington Road, to the south by railway embankments and to the east by fields.

The Application Area is broadly flat and situated some 105 metres Above Ordnance Datum (mAOD). There is a slight fall in elevation from westwards towards an adjacent river.

1.5 Hydrology

The Whilton Branch of the River Nene rises at Buckby Folly some 2.3 km north of the Application Area and flows to the west of the site in a southerly direction. The confluence of the Whilton Branch and an unnamed tributary is located immediately north of Patford Bridge. This watercourse rises some 1.5 km to the north-northwest of the Application Area at Long Buckby.

1.6 Climate change

Within the UK projections of future climate change indicate that there will be more frequent, short duration, high intensity rainfall events and more frequent periods of long duration rainfall. The NPPF recommends that the effects of climate change are incorporated into Flood Risk Assessments and suggests precautionary sensitivity ranges for peak rainfall intensities and peak river flows.

1.7 Ground conditions

The solid geology in the region of the Application Area comprises Jurassic age Upper Lias mudstones and Middle Lias ironstones, limestones and mudstones. Superficial deposits of alluvium are confined to the river channel west of the Application Area.
Soils within the vicinity of the site are identified as slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey (National Soils Resources Institute).

1.8 Proposed development

The proposed compound consists of a PIG launch station, vehicle turning area and lagoon. The site will be unmanned, therefore welfare facilities will not be required. Areas of landscape planting and installation of security fencing are also planned. The Application Area covers some 0.35 Hectares (Ha).

The site layout is presented in Appendix 1.
2 FLOOD RISK TO THE SITE

2.1 Background

The risk of flooding at the site has been assessed by examining the likelihood of flooding, the hazard caused if it were to flood and its vulnerability. The assessment has been undertaken for a variety of mechanisms using both quantitative and qualitative methods. Details of how these assessments were made are included within Appendix 2.

The Environment Agency has indicated that new development in the Upper Nene catchment should be assessed against the 1 in 200 (0.5%) annual probability event including an allowance for climate change. This is above the standard required within the NPPF and designed to afford greater protection from flooding to Northampton. Therefore the 1 in 200 (0.5%) annual probability rainfall flood event has been considered at this site.

2.2 Fluvial flooding

2.2.1 Historical flooding
The Environment Agency does not hold any data on historic flooding at this location.

2.2.2 Environment Agency Flood Map
The proposed development is classified as ‘less vulnerable’ in the NPPF and is situated within Flood Zone 3. This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) and ‘less vulnerable’ uses of land are appropriate in this zone.

2.2.3 Flood defences and structures
There are no flood defences in operation at the site.

2.2.4 Modelled flood levels
The Environment Agency does not hold any data on detailed modelled flood levels at this location, however flood depth information is available from generalised models (J-FLOW). Flood depth information is provided in Appendix 3, however this is based on generalised modelling data and is only provided as a guide to flood depths.

Water depths during a flood event with an annual probability of 1 in 100 (1%), plus additional climate change, range from 0.25–0.5 m in small parts of the west of the Application Area to <0.25 m further east.

There are no modelled depth outputs for the 1 in 200 (0.5%) plus climate change annual probability event. Therefore the estimation of the flood depths has been based on the 1 in 1000 (0.1% annual probability flood event, excluding climate change). Water depths during this event range from between 0.25–0.5 m along the western fringes of the Application Area, decreasing to <0.25 m in the east. This is likely to provide a conservative estimation of flood depths during the 1 in 200 (0.5%) plus climate change annual probability event.

2.2.5 Mitigation measures
The site will be unmanned therefore welfare facilities will not be required, effectively limiting the number of structures vulnerable to flooding. However, it is recommended that any personnel accessing the site are made aware of flood risks when on-site and that suitable health and safety procedures are in place with clear egress routes indicated. The site access would be located in the northeast of the compound which is the area of the least flood risk. This would facilitate safe egress if any personnel were on-site during a flood event. Brington Road continues east away from the floodplain to Great Brington.
2.2.6 Overall fluvial flood risk
Due to the site's proposed use the overall flood risk is considered to be 'moderate'. The mitigation measures outlined above are considered to be appropriate and will allow the flood risks to be managed.

2.3 Surface water run-off
The Application Area is situated on an area of generally flat agricultural land, therefore the majority of rainfall leaves the site via infiltration.

Due to the subdued topography there is very limited potential for surface water run-off to adversely affect the site. Therefore the overall risk from flooding from this source is considered to be 'very low'.

2.4 Groundwater flooding
Due to the proximity of the Application Area to the Whilton Branch of the River Nene, groundwater and fluvial flooding are likely to occur simultaneously. Therefore the overall risk of groundwater flooding in isolation is considered to be 'low'.

2.5 Flooding from water mains or sewers
Owing to the rural location of the proposed development, flooding from water mains or sewers is not considered to be a risk to the site. Therefore the overall risk of flooding from this source is 'negligible'.

3 FLOOD RISK TO THE SURROUNDING AREA

3.1 Background

The proposed development has the potential to increase flooding to the surrounding area through changes to the surface water run-off regime and to floodplain storage. The proposals have been assessed against these criteria to ensure that there is no detrimental impact on flood risk in the surrounding area.

The development is classified as 'less vulnerable' in the NPPF.

3.2 Surface water run-off

3.2.1 Concrete areas

The only impermeable surfaces proposed will be a concrete apron at the site entrance and an area around the pigging station which amounts to some 350 m$^2$. The concrete apron at the site entrance is proposed to drain to the adjacent grass where it will be allowed to infiltrate to ground. Surface water within the area around the pigging station will flow by gravity to a pit where it will be pumped into the lagoon from where it will be periodically injected into the pipeline. The pit will have a capacity of some 30 m$^3$ and the lagoon will have a capacity of some 2,000 m$^3$. The lagoon is proposed to be kept empty the majority of the time and will therefore have capacity to hold storm rainfall events.

Run-off rates from the development have been calculated to determine the volume of storage required to attenuate flows, including the increase attributed to climate change. This has been undertaken to ensure there is no increase in flood risk downstream of the site from increased future run-off rates. Further details on these calculations can be found in Appendix 4.

The peak run-off rates ($Q_p$) for the post-completion site have been estimated for a range of storm durations using the Rational Method, which is of the form:

$$Q_p = 2.78C_iA$$

Where:

- $C$ = run-off co-efficient (dimensionless)
- $i$ = rainfall intensity (mm/hr)
- $A$ = catchment area (Ha)

The co-efficient of run-off, $C$, varies for different surfaces. The value of $C$ used for the concrete areas has been taken as 0.9 as the majority of rainfall will run-off. The volume of storage required for the 1 in 200-year event for the 6-hour storm (which is the recommended duration for small catchments – HR Wallingford 2004, ‘Drainage of development sites’) is some 34 m$^3$.

It is recommended that a volume of 34 m$^3$ is available at all times to accommodate the 1 in 200-year plus climate change rainfall event.

3.2.2 Lagoon

The lagoon covers a surface area of some 784 m$^2$. Rainfall from this area will not have the potential to reach the adjacent river and therefore this will further reduce the impact of the development on flood risk to the surrounding area.

3.3 Floodplain storage and flow

The proposed development is situated partially in the floodplain of the Whilton Branch of the River Nene. However, the site will contain minimal structures and will therefore allow flood water...
to pass through it with no effect on the flood levels in the surrounding area. Similarly, as there are only minor buildings proposed there is considered to be no potential for detrimental impact on floodplain storage.
4 SUMMARY AND CONCLUSIONS

4.1 The proposed development is classified as 'less vulnerable' in the NPPF and is situated within Flood Zone 3.

4.2 Fluvial flooding from the Whilton Branch is considered to be the main source of flood risk in the vicinity of the Application Area.

4.3 The site will be unmanned but personnel on-site should be made aware of flood risk and egress routes maintained and kept clear.

4.4 Due to the site's proposed use the overall flood risk is considered to be 'moderate'. The mitigation measures outlined above are considered to be sufficient to allow the flood risks to be managed.

4.5 There is not considered to be a significant flood risk to the site of flooding from surface water, groundwater or water mains and sewers sources.

4.6 The volume of storage required for the 1 in 200-year event for the 6-hour storm is some 34 m³.

4.7 Due to the relatively small footprint of the development there is not considered to be an increased flood risk on land downstream of the Application Area.
Main rivers

Flooding from rivers or sea without defences
Extent of extreme flood
Flood defences
Areas benefiting from flood defences
Main rivers

Adapted from Environment Agency website (2012)
APPENDIX 1

Development plans
APPENDIX 2

Flood Risk Assessment details
Assessment of Flood Risk

Assessment of flood risk is undertaken following the requirements outlined in the National Planning Policy Framework (NPPF). Although each assessment is specific to the site and mechanism of flooding in question a general method is followed when making all assessments. This method is outlined below.

The assessment of flood risk is undertaken by considering the likelihood of flooding and the consequence of flooding as outlined in Table 1.

### Likelihood of Flooding

Likelihood of flooding is outlined in Table 1 of the NPPF Technical Guide. For some fluvial sources i.e., main watercourses, the Environment Agency's flood maps are used to determine the likelihood of flooding. For other mechanisms of flooding assessment is made using other sources of data such as historical information, flow data, etc. In some situations, it may be necessary to undertake monitoring or modelling to determine likelihood of flooding. In others, a more qualitative approach can be taken.

### Consequence of Flooding

The assessment of flood consequence is undertaken by considering the vulnerability of the site and the hazard of flooding at the site as outlined in Table 2.

### Flood Hazard

Assessment of flood hazard is undertaken for each possible flooding mechanism and specific to the site in question. An outline of the considerations taken into account when determining the hazard categories used within this report are outlined below:

- **Very high**: High depths of inundation (>600 mm). High velocities of floodwater entering the site (>0.15 m/sec for residential, >0.3 m/sec for commercial). Restricted access/egress to the site.

- **High**: Depths of inundation up to 600 mm. Floodwater flowing across site at speeds of >0.15 m/s. Access/egress possible but may be through floodwaters.
Medium  Inundation of the site below 600 mm. Slack floodwaters with either very low velocities or on the edge of the floodplain. Easy access and egress.


Negligible  No flooding on-site.

**Vulnerability of Site**

Vulnerability of the site is determined using classifications outlined in Table 2 of the NPPF Technical Guide.
APPENDIX 3

J-FLOW flood depth outputs
APPENDIX 4

Surface water run-off calculations
Patford Bridge - Surface water run-off - Proposed - Impermeable surfaces

Parameters

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Climate change (% rainfall increase)

Rainfall data

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The Rational Method to give peak flow $Q_p$ is in the form:

$$Q_p = 2.78 CiA$$

Where:

- $C$: co-efficient of run-off (dimensionless)
- $i$: rainfall intensity (mm/hr)
- $A$: catchment area (Ha)

- Obtained from FEH CD-ROM version 3
- Climate change factored into rainfall intensity at this stage
Appendix 5 – Essential requirements for a suitable site for cleaning activities and summary analysis of alternative sites considered