Hamble Airfield Quarry - Flood Risk Assessment

24 November 2021

Hamble Airfield Quarry - Flood Risk Assessment

Prepared for

CEMEX UK Operations Ltd
CEMEX House
Evreux Way
Rugby
CV21 2DT

Report reference:

66650R2, November 2021

Report status:

Final

CONFIDENTIAL

New Zealand House, 160-162 Abbey Foregate,
Shrewsbury, Shropshire
SY2 6FD

Telephone: +44 (0)1743 276 100

Registered Office:
Stantec UK Ltd
Buckingham Court
Kingsmead Business Park
Frederick Place, London Road
High Wycombe HP11 1JU
Registered in England No. 1188070

Hamble Airfield Quarry - Flood Risk Assessment

Report Reference: 66650R2

Report Status: Final

	Name	Signature
Author	Kate Bradey, Lucy Janus & Henry Kelly	
Checked by	Kelvin Limbrick	
Reviewed by	Kelvin Limbrick	

Revision record:

Issue	Date	Status	Comment	Author	Checker	Reviewer
1	07/09/2021	Draft	For client review	KLB, LXJ, HJK	KJL	KJL
1	24/11/2021	Final	Final version	KLB, LXJ, HJK	KJL	KJL

Contents

1	INTRODUCTION	1
1.1	Background	1
1.2	Scope of Work	1
1.3	Data Sources	1
1.4	Report structure	2
2	SITE DESCRIPTION	3
2.1	Site setting and surrounding area	3
2.2	Geology & hydrogeology	3
2.3	Hydrology	3
2.3.1	Rainfall	3
2.3.2	Surface water features	3
2.3.3	Surface water flow and levels	4
3	PROPOSED DEVELOPMENT	5
3.1	Proposal	5
3.2	Phasing Plan	5
3.2.1	Pre-extraction	5
3.2.2	Extraction	5
3.2.3	Post Extraction Infilling and Final Restoration	5
4	PRE-APPLICATION OPINION OF THE ENVIRONMENT AGENCY	7
4.1	Flood Zone 1	7
4.2	Surface Water Aspects of the Proposal (flood risk)	7
4.3	Pollution Prevention	7
4.4	Surface Water	8
5	FLOOD RISK TO THE SITE	9
5.1	Flood map for planning	9
5.2	Flood defences	9
5.3	Groundwater flooding	9

5.4	Surface water (pluvial) flooding	10
5.5	Flooding in the event of reservoir failure	10
5.6	Historical Flooding	10
5.7	Climate change	10
6	PLANNING PRACTICE GUIDANCE	12
6.1	Proposed land use vulnerability classification	12
6.2	Exception and Sequential Tests	12
7	FLOOD RISK FROM THE PROPOSED DEVELOPMENT TO THE SURROUNDING AREA	13
7.1	Nearby Receptors	13
7.2	Climate change	13
7.3	Surface Run-Off Calculations	14
7.3.1	Run-off calculation methodology	14
7.3.2	Runoff destinations	15
7.3.3	Predicted Run-off - greenfield	19
7.3.4	Predicted run-off – operational & restored sites	20
7.4	Flood Risk during operational phase	21
7.5	Flood risk post-restoration	22
8	DRAINAGE STRATEGY	23
8.1	Performance requirements	23
8.2	Operational phase	23
8.2.1	Proposed drainage strategy – operational phase	23
8.2.2	Performance calculations	25
8.2.3	Exceedance flows	28
8.2.4	Residual flood risk	28
8.2.5	Water quality	28
8.3	Restoration phase	29
8.3.1	Proposed drainage strategy – post restoration	29
8.3.2	Performance calculations	31
8.3.3	Exceedance flows	34

8.3.4 Residual flood risk 35

8.3.5 Water quality 36

8.4 Maintenance 36

8.4.1 Plan details – operational phase 36

8.4.2 Contact information 36

8.4.3 Plan details - post restoration 36

8.5 Biodiversity and amenity 37

9 CONCLUSIONS 38

10 REFERENCES 39

FIGURES

Figure 1.1 Map of area surrounding the Site 2
Figure 2.1 Surface water features 4
Figure 5.1 Flood risk – rivers and the sea 9
Figure 5.2 Risk of flooding from surface water 11
Figure 7.1 Runoff catchments – current 15
Figure 7.2 Runoff catchments – operational 16
Figure 7.3 Surface water runoff catchments – Restored phase 18
Figure 9.1 Proposed drainage strategy (operational phase – phase 4 24
Figure 9.2 Potential exceedance flow routes 35
Figure 9.3 Proposed drainage strategy (restored phase) 30

TABLES

Table 6.1 Flood risk vulnerability and flood zone compatibility 12
Table 7.1 Climate change allowances for rainfall intensity 14
Table 7.2 Hydrological catchment descriptors (CEH, 2021) 14
Table 7.3 Site catchment areas over time 19
Table 7.4 Greenfield runoff (1 in 1 year event) 20
Table 7.5 Greenfield runoff (1 in 30 year event) 20
Table 7.6 Greenfield runoff (1 in 100 year event) 20
Table 7.7 Predicted future runoff (1 in 1 year event) 21
Table 7.8 Predicted Predicted future runoff (1 in 30 year event) 21
Table 7.9 Predicted Predicted future runoff (1 in 100 year event) 21
Table 9.1 Dimensions of principal SUDS features (Operational phase). 26
Table 9.2 Performance of SuDS features under a 1 in 100 year + 10% storm event. 28
Table 9.3 Dimensions of principal SUDS features (Restored phase). 32
Table 9.4 Performance of restored phase SuDS features under a 1 in 100 year + 40% storm event. 34

APPENDICES

Appendix A Topographical site survey

Appendix B Site development plans

Appendix C Site restoration plans

Appendix D RefH2 runoff calculations

Appendix E MicroDrainage calculations

1 Introduction

1.1 Background

Hamble Airfield (the Site) is owned by Persimmon plc. (Persimmon). The Site location is shown on Figure 1.1.

CEMEX UK Operations Limited (CEMEX) is proposing to extract sand and gravel from the Site. Following the completion of the sand and gravel extraction, it is proposed to restore the site with in-situ overburden and soils, and imported restoration materials to grassland and grazing land with areas for drainage. The north-eastern part will be restored to parkland, used as public open space.

1.2 Scope of Work

This report constitutes a Flood Risk Assessment (FRA) that has been prepared on behalf of CEMEX in support of the planning application for mineral excavation at the Site and subsequent restoration. A Hydrogeological Impact Assessment (HIA) also supports the application and is included within Chapter 8 of the Environmental Statement for this application (CEMEX, 2021).

This FRA has been written in line with the National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2021) and the Planning Practice Guidance (PPG) (Department for Communities and Local Government, 2021) to satisfy both the Environment Agency (EA) and the lead local flood authority (Hampshire County Council) that all potential flood risks to and from the proposed development have been considered.

This assessment includes site-specific calculations to estimate surface water runoff for the restored Site to ensure the proposed restoration plans remain viable. These calculations also account for the effect of climate change using appropriate advice given in the PPG.

1.3 Data Sources

The principal sources of data used in this assessment are summarised below:

- Current topographical site survey provided by CEMEX (Appendix A);
- Proposed Phasing Plan provided by CEMEX (Appendix B);
- Proposed Site restoration plans (Appendix C);
- EA flood risk data;
- South Hampshire Strategic Flood Risk Assessment (Eastern Solent Coastal Partnership, 2016);
- Eastleigh Surface Water Management Plan (Hampshire County Council, 2012);
- Ordnance Survey mapping;
- Rainfall and catchment characteristics/rainfall data from the Centre for Ecology and Hydrology (CEH, 2021); and
- British Geological Survey (BGS) mapping for desk studies of geology and ground conditions (BGS, 2021).

1.4 Report structure

This FRA includes the following sections:

- a description of the site conditions and proposed development (Section 2);
- an outline of the proposed development (Section 3);
- a summary of pre-application discussions for the Site with regards to flood risk (Section 4);
- an assessment of flood risk to the development (Section 5);
- an assessment of the site's suitability for the development with regards to planning policy (Section 6);
- an assessment of flood risk from the development to the surrounding area (Section 7); and
- The proposed drainage strategies for the Site to alleviate any potential increase in flood risk (Section 8).

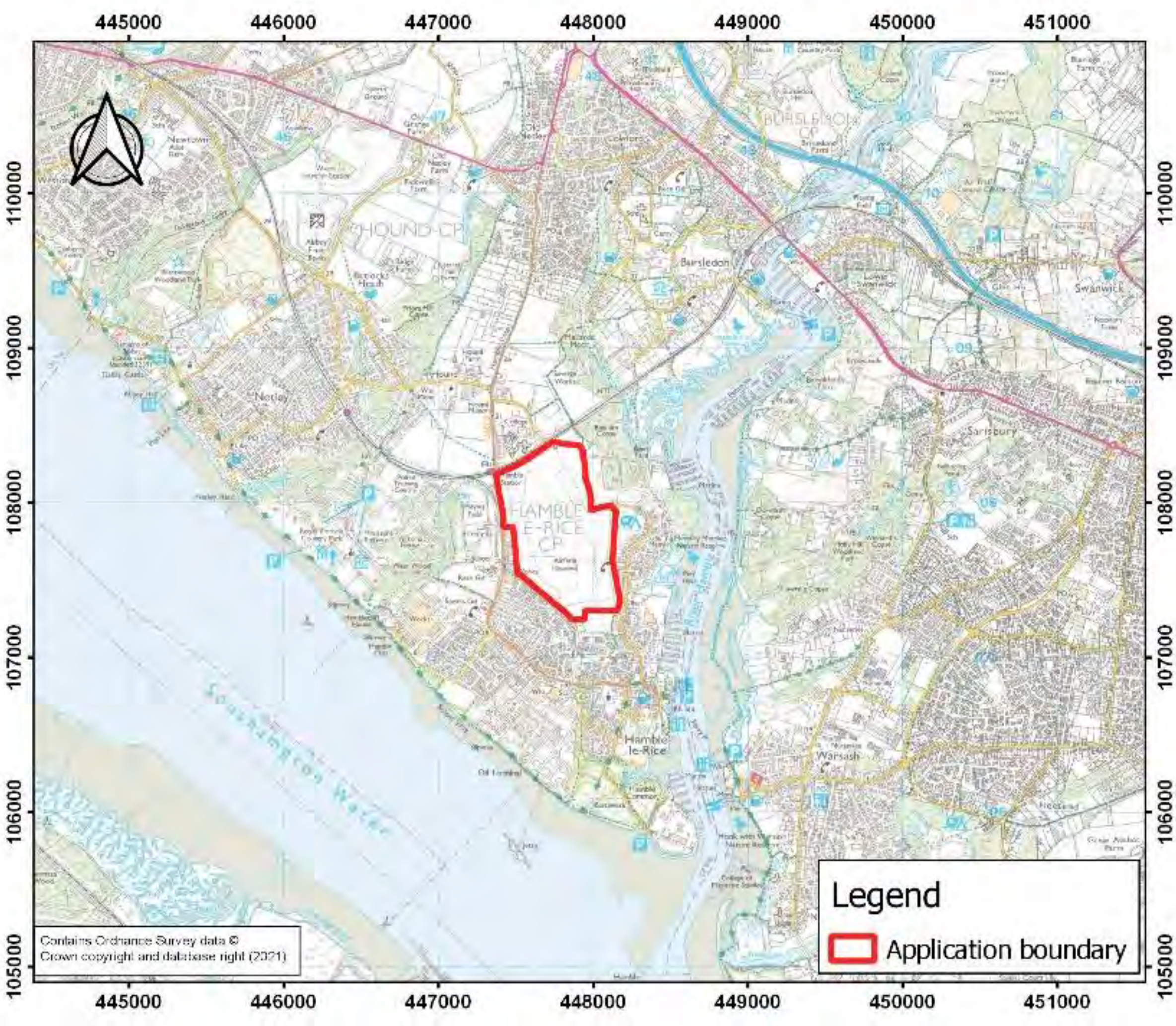


Figure 1.1 Map of area surrounding the Site

2 Site description

2.1 Site setting and surrounding area

The Site location can be seen on Figure 1.1 and the Site layout with topography data is shown in Appendix A.

The Site is a former grassland airfield. It is currently vacant and covered with grass. The Site area extends to c.62 ha and is located on an elevated area of land between Southampton Water and the River Hamble. Ground elevations at the Site range from c.23.9 mAOD to 13.3 mAOD with a topographical divide running approximately north to south through the centre.

Runoff from the Site currently flows down topographical gradients to the eastern, western and southern margins of the Site, towards the River Hamble, Southampton Water and other minor surface water courses. Combined sewers carry runoff from the roads which bound the Site, namely Hamble Road and Satchell Lane.

The Site is bounded to the east by housing and the River Hamble and to the south by housing, an oil terminal and Southampton Water. To the east lie playing fields and recreation grounds together with allotments and a school.

2.2 Geology & hydrogeology

The solid geology at the Site comprises the Selsey Sand Formation (SSF), Marsh Farm Formation (MFF) and Earnley Sand Formation (ESF). These are underlain by clays from the Wittering Formation. These formations are within the Bracklesham Group.

The superficial geology comprises River Terrace Deposits (RTD) (3^{rd} Terrace). Refer to HIA (CEMEX, 2021) for a more detailed description.

The RTD consist of brown sandy gravel, with clay lenses and localised areas where clay dominates. This is underlain by the more permeable SSF across the majority of the Site (CEMEX, 2021). The RTD vary in thickness across the Site between 0.8 and 7.7 m, with an average thickness of 4.3 m.

Groundwater is around 3-5 m below the ground surface across most of the Site on average (CEMEX, 2021).

2.3 Hydrology

2.3.1 Rainfall

The Standard Average Annual Rainfall (SAAR) for the Site is 767 mm (CEH, 2021). The Meteorological Office reports an annual average rainfall of 779.4 mm at Southampton Weather Centre (WC) rain gauge, about 6 km to the northwest of the Site, for the period 1981-2010.

2.3.2 Surface water features

Surface water features are shown in Figure 2.1. The two main water features are the River Hamble, located c.300 m east of the Site at its closest approach and Southampton Water, located c.900 m to the south west. Southampton Water is a tidal estuary and the River Hamble flows from north to south into Southampton Water; both ultimately discharging into The Solent. The River Hamble is a Main River as defined by the EA. Badnams Creek and Spear Pond Gully are also classified as Main Rivers and are located to the north east and north west of the Site respectively.

There is a small water feature that lies within a steeply incised valley to the west of the Site. This is fed from a spring that lies just beyond the Site's north western corner and discharges into Southampton Water. Refer to CEMEX (2021) for a more detailed description.

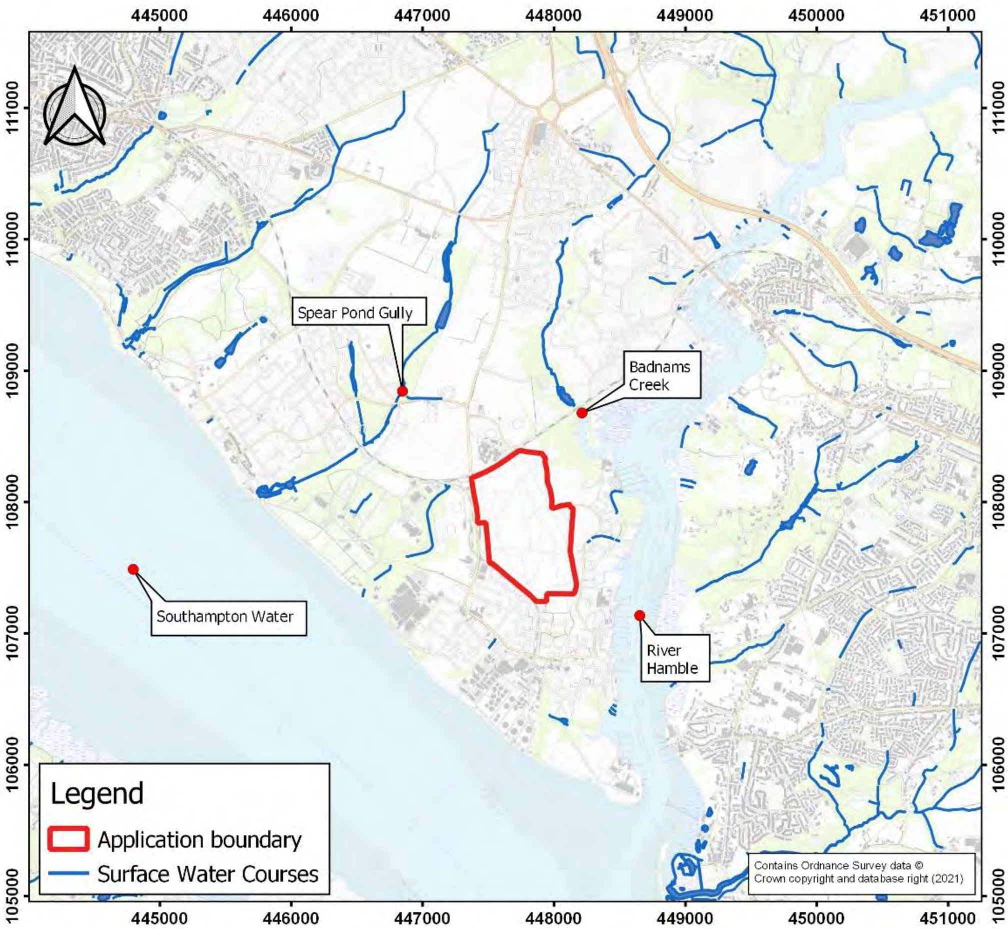


Figure 2.1 Surface water features

2.3.3 Surface water flow and levels

Southampton Water and the River Hamble are tidal watercourses. Flows are not measured anywhere within close proximity to the Site. Water levels are measured by the Environment Agency at Hamble (Station ID 9200, approximate location SU 48756 05662). The tidal range is approximately between 2.5 mAOD and -2 mAOD. The highest level on record is 2.8 mAOD (06 December 2013). This is significantly below the level of the Site at between 23.9 mAOD to 13.3 mAOD.

3 Proposed development

3.1 Proposal

The proposal is to extract c.1.7 Mt of sand and gravel from the 62 ha Site, with restoration to grassland and grazing land with some public access in the north-eastern corner, using a combination of in-situ overburden and soils and imported restoration materials. The development is expected to take around 12 years in its entirety.

3.2 Phasing Plan

A phased working plan (Appendix B) and restoration scheme (Appendix C) have been prepared to ensure that the minerals are recovered in an efficient and systematic manner enabling the continued phased working and restoration of the Site in accordance with good practice. The scheme has been designed to take into account the best practice guidance detailed in the Development and Implementation Supplementary Planning Guidance (SPG) adopted by the MPA. The capacity and context of the environs surrounding the Site have been considered at all times of the design leading to an iterative process that is considerate of the setting. The Site is expected to be worked in seven phases, as shown on the phasing drawings (included as Appendix B).

3.2.1 Pre-extraction

Prior to the commencement of extraction operations within the proposed extension, it will be necessary to undertake a number of pre-extraction operations. These comprise:

- Installation of groundwater monitoring points and collection of baseline data to continue to inform the setting of the Site ;
- Establishment of plant area and haul road(s) to accommodate the importation of inert restoration material using road-going heavy goods vehicles; and
- Establish the water management regime for the Site. This includes installation of the freshwater lagoon (for water supply) and silt lagoon (for water treatment) in the north of the Site.

3.2.2 Extraction

Once the above infrastructure has been established, this will then allow the commencement of sand and gravel extraction operations. By reference to the plans in Appendix B, it can be seen that the mineral resource will be recovered in seven phases of working. Progressive working and restoration techniques will be used to ensure the timely restoration of preceding areas of extraction.

3.2.3 Post Extraction Infilling and Final Restoration

Post extraction, and in accordance with the phasing plans, the Site will be progressively restored (using a combination of in-situ overburden and imported restoration materials) to original ground levels over a further c.4 year period to provide local biodiversity and landscape enhancements.

On completion of filling, the stripped soils will be carefully replaced using appropriate soil handling and storage techniques followed by a 5 year restoration and aftercare period. Following completion of restoration, the surface of the Site will be inspected within 12 months and any localised settlement features that are found will be filled using suitable soils. Settlement when inert restoration materials are used is usually insignificant so it is envisaged that these operations will be minimal.

4 Pre-application opinion of the Environment Agency

A preliminary opinion was obtained from the Environment Agency (EA) in June 2016. The following comments were received from the EA:

4.1 Flood Zone 1

EA Comment: The site is located in Flood Zone 1, defined by the National Planning Policy Framework (NPPF) as having a low probability of flooding from rivers or the sea.

It is a requirement of the NPPF that any planning application submitted for development that is over 1 hectare in size in Flood Zone 1 is accompanied by a Flood Risk Assessment (FRA). Guidance on the requirements for undertaking an FRA can be found online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311502/LIT_9193.pdf

Our response: This report provides the FRA for the development as requested.

4.2 Surface Water Aspects of the Proposal (flood risk)

EA comment: Amendments to the Development Management Procedure Order (DMPO) came into effect on 15 April 2015. As a result, we are no longer a statutory consultee on 'development of land over 1 hectare' (Para zf of DMPO 2010, Schedule 5) and will therefore no long provide comment on the surface water aspects of these proposals in relation to flood risk.

Hampshire County Council as the Lead Local Flood Authority (LLFA) are now statutory consultee for 'Major development with Surface Water Drainage' in terms of flood risk, we therefore recommend that you consult them.

Our response: This report provides the FRA that the LLFA will require for assessment.

4.3 Pollution Prevention

EA comment: We recommend you incorporate pollution prevention measures to protect ground and surface water. We have produced a range of guidance notes which can be viewed at:

https://www.gov.uk/government/collections/pollution-prevention-guidance-ppg

Should the works propose any intrusive works that go below the water table and/or dewatering processes we would require detailed assessment of the potential impacts on the hydrology of the area to ensure that there is no detrimental impact on the water environment.

Our response: There is no significant dewatering proposed (see CEMEX, 2021 - small quantities of water would need to be pumped from one part of the Site to another in order to facilitate construction of a basal geological barrier / attenuation layer when needed. There will be no off-site pumped discharge).

Risks to groundwater quality are considered separately in the Water Environment and Flood Risk chapter of the Environmental Statement (CEMEX, 2021).

4.4 Surface Water

EA comment: We would also recommend that a clear surface water management system is put in place to ensure that water discharging from this development does not impact receiving waters and cause an increase in suspended solids within the receiving waterbody as this could have a significant impact on the quality of the receiving waterbody.

We would recommend that you refer to the CIRIA SuDS manual for further guidance:

http://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

Our response: This report includes a drainage strategy for the operational phase of the development and post restoration. SuDS features providing water quality treatment are included in each scheme. Full details are provided in Section 8 of this report.

5 Flood Risk to the Site

5.1 Flood map for planning

The Site is located in Flood Zone 1 (see Figure 5.1) which means it has a low probability of flooding from rivers or the sea.

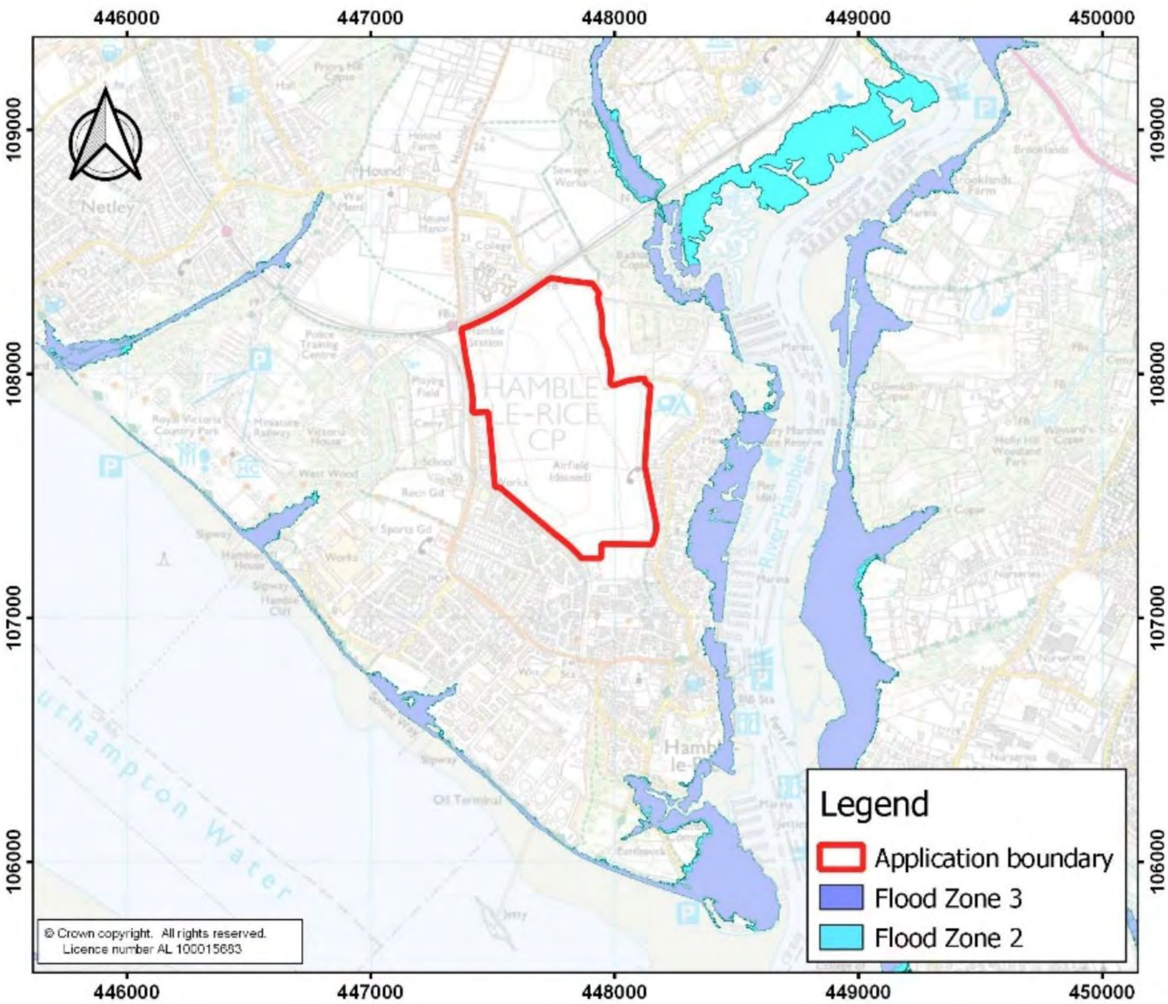


Figure 5.1 Flood risk – rivers and the sea

5.2 Flood defences

There are no flood defences recorded on the River Hamble according to the Environment Agency data for the area.

5.3 Groundwater flooding

Groundwater flooding occurs when the water table rises above the ground surface or into man-made ground.

Groundwater flood risk at the Site is considered to be low given the depth of groundwater below the surface (CEMEX, 2021).

Operations at the Site may be undertaken partly below the water table within parts of the quarry void (although no significant dewatering will be employed). Health and safety measures will be designed for the operational Site, for working below the water table and working near water (such as barriers, signage and site induction material) to mitigate the risk posed by any open water bodies or from flooding by returning groundwater.

5.4 Surface water (pluvial) flooding

Surface water (pluvial) flooding is usually associated with intense rainfall events but may also occur when rain falls on land that is already saturated or has a low permeability. Rainfall that is unable to infiltrate into the ground generates overland flow which can lead to flooding or 'ponding' in localised topographical depressions before the runoff is able to enter the drainage system or watercourse.

The risk of surface water flooding for the Site is demonstrated to be low, as shown in Figure 5.2 where no flooding is anticipated even in the 1 in 1000 year flood event aside from two small depressions near the centre of the Site.

5.5 Flooding in the event of reservoir failure

The Site is not at risk of flooding as a result of reservoir failure.

5.6 Historical Flooding

The Site is not thought to have experienced flooding historically according to EA data.

5.7 Climate change

The minimum ground elevation of the Site is c. 13.3 mAOD – in the south-western corner. The estimated elevation of Flood Zone 2 at the most proximal location is 3.22 mAOD (estimated from LiDAR data). This gives over 10 m elevation between the minimum Site elevation and flood levels from rivers and the sea at present. This is well above any expected rise in sea level rise, extreme wave height of peak river flow in the area over the duration of the development (13/14 years) as defined in the EA guidance for climate change allowances (EA, 2021).

The impacts of climate change on rainfall intensity and surface water runoff is considered in Section 7.3.

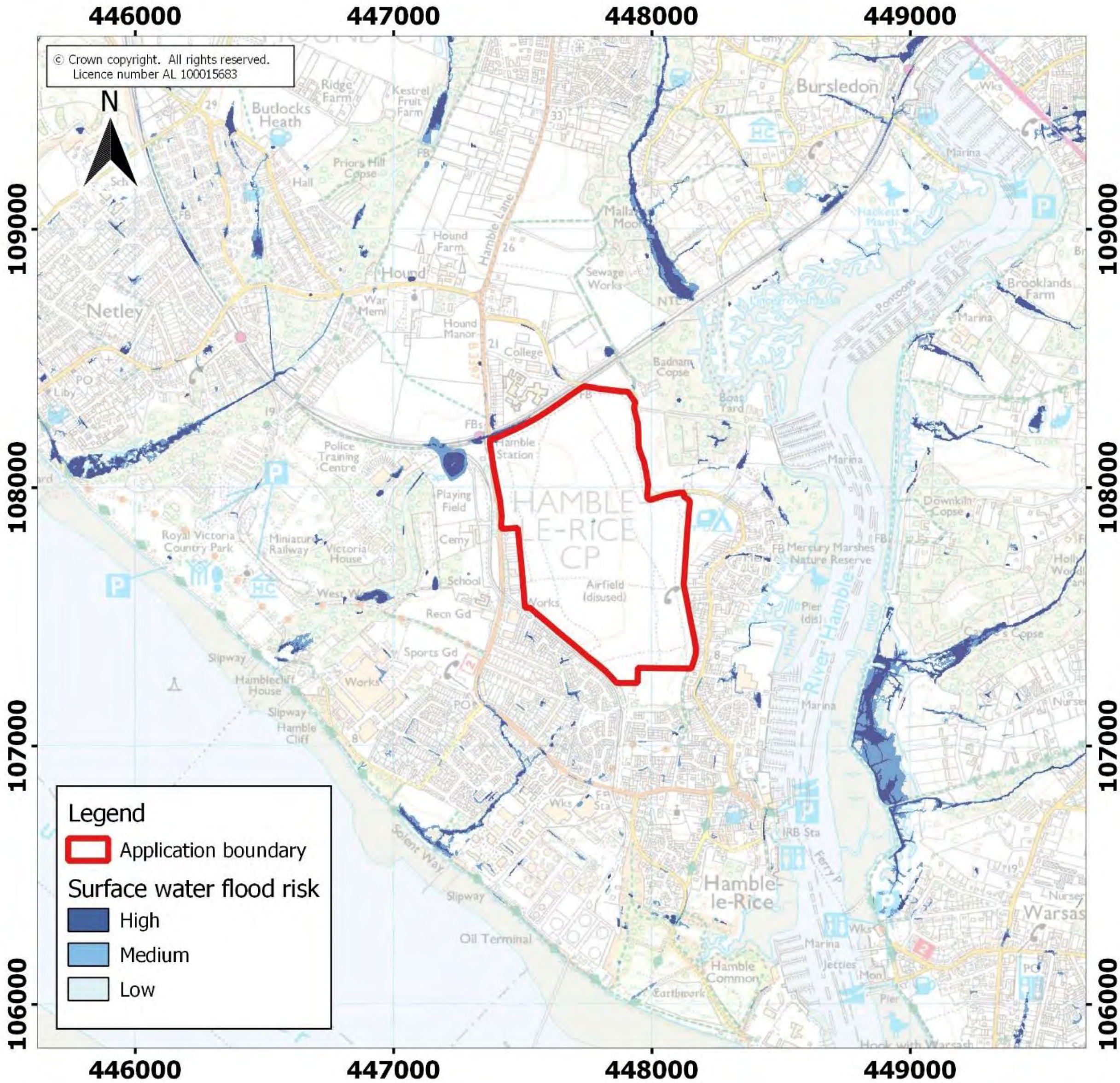


Figure 5.2 Risk of flooding from surface water

6 Planning Practice Guidance

6.1 Proposed land use vulnerability classification

Sand and gravel working is considered by the PPG as a “Water Compatible” land use and the proposed development is considered to be appropriate for this location, as shown in Table 6.1.

6.2 Exception and Sequential Tests

The Sequential Test, outlined in the PPG (DCLG, 2021), identifies that development should be directed to areas at the lowest probability of flooding. The Site is classified by the Environment Agency as being located within Flood Zone 1 and is therefore an appropriate location for the proposed development with regards to flood risk.

Table 6.1 Flood risk vulnerability and flood zone compatibility

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone	Zone 1	✓	✓	✓	✓	✓
Flood zone	Zone 2	✓	✓	Exception Test required	✓	✓
Flood zone	Zone 3a	Exception Test required	✓	x	Exception Test required	✓
Flood zone	Zone 3b functional floodplain	Exception Test required	✓	x	x	x

✓Development is appropriate.
x Development should not be permitted.
Data source: National Planning Policy Guidance (NPPG) (DCLG, 2021).

7 Flood risk from the proposed development to the surrounding area

7.1 Nearby Receptors

Potential receptors in the vicinity of the Site are given below. The proposed development must not increase flood risk to any of the receptors identified.

Property

- Residential properties to the east of the Site along Satchell Lane and cul-de sacs from it.
- Residential properties to the south of the Site.
- The Roy Underdown Pavillion and adjacent facilities to the south.
- Residential properties to the west along Hamble Lane and associated access roads.
- Hamble Sports Complex and The Hamble School and associated facilities to the north.
- Hamble Primary School to the southwest.
- Business premises to the southwest along Hamble Lane; and
- Hamble Sea Scouts Headquarters to the west along Hamble Lane.

Infrastructure

- A passenger train line lies on the north-western boundary and Hamble station is located at the intersection with Hamble Lane.

Water features

- River Hamble east of the Site.
- Small water feature within a steeply incised valley to the west of the Site.

7.2 Climate change

Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRAs (Department for Communities and Local Government, 2021). Projections of future climate change in the UK suggest that short-duration, high-intensity rainfall and periods of long duration rainfall will become more frequent. This needs to be accounted for when considering the impacts of a given development on off-site flood risk.

Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows have been calculated (Environment Agency, 2021). The recommended national precautionary sensitivity ranges for peak rainfall intensity are shown in Table 7.1. The operational period of the proposed development is anticipated to be around 12 years commencing in 2023 (expected to be complete by 2029 followed by a further 4-year phase for final restoration tasks) (CEMEX 2021).

Table 7.1 Climate change allowances for rainfall intensity

Return Period (yrs)	2015-2039	2040-2069	2070-2115
Central band	5%	10%	20%
Upper end	10%	20%	40%

Climate change allowances for peak river flow or sea level rise are not applicable in this assessment given that the Site is defined as being "Water Compatible" (see Section 5.7) and is not within a floodplain.

Future climate change has been accounted for in runoff calculations with an increase of +10% applied to the rainfall in accordance with the Technical Guidance of the NPPF for an anticipated duration of mineral extraction until 2029 (7 year duration). Following the restoration phase, where the quarry void will be filled to the original formation level, future climate change has been accounted for with an increase of +40% applied to the rainfall. Runoff calculations are set out below.

7.3 Surface Run-Off Calculations

7.3.1 Run-off calculation methodology

The proportion of rainfall converted to overland flow is a function of several key factors including slope gradient, soil type, and land cover type. There are numerous methodologies for calculating runoff rates and volumes for a given catchment and the suitability of each depends upon the catchment characteristics. The Revitalised Flood Hydrograph (ReFH2) method is considered appropriate for establishing runoff rates and volumes for both greenfield and developed sites (CIRIA, 2015).

The ReFH2 program generates a total runoff hydrograph (i.e. the summation of surface runoff and baseflow) for a given storm event based upon the catchment descriptors. This allows total runoff volumes and peak runoff rates to be calculated.

The values of Standard Annual Average Rainfall (SAAR) SAAR and Base Flow Index (BFI) used in the runoff calculations have been taken from the hydrological point descriptors for the Site (Table 7.2).

Table 7.2 Hydrological catchment descriptors (CEH, 2021)

Descriptor	Value
NGR	SU 47816 07820
BFI (HOST 2019)	0.622
PROPWET	0.33
SAAR	760 (mm)

7.3.2 Runoff destinations

Current

Figure 7.1 shows surface elevation (LiDAR data and OS Contours) data across the Site and includes inferred surface water flow directions and sub-catchment areas under the current conditions, which have been labelled for identification in the following rainfall runoff calculations (the existing catchments have the prefix 'C').

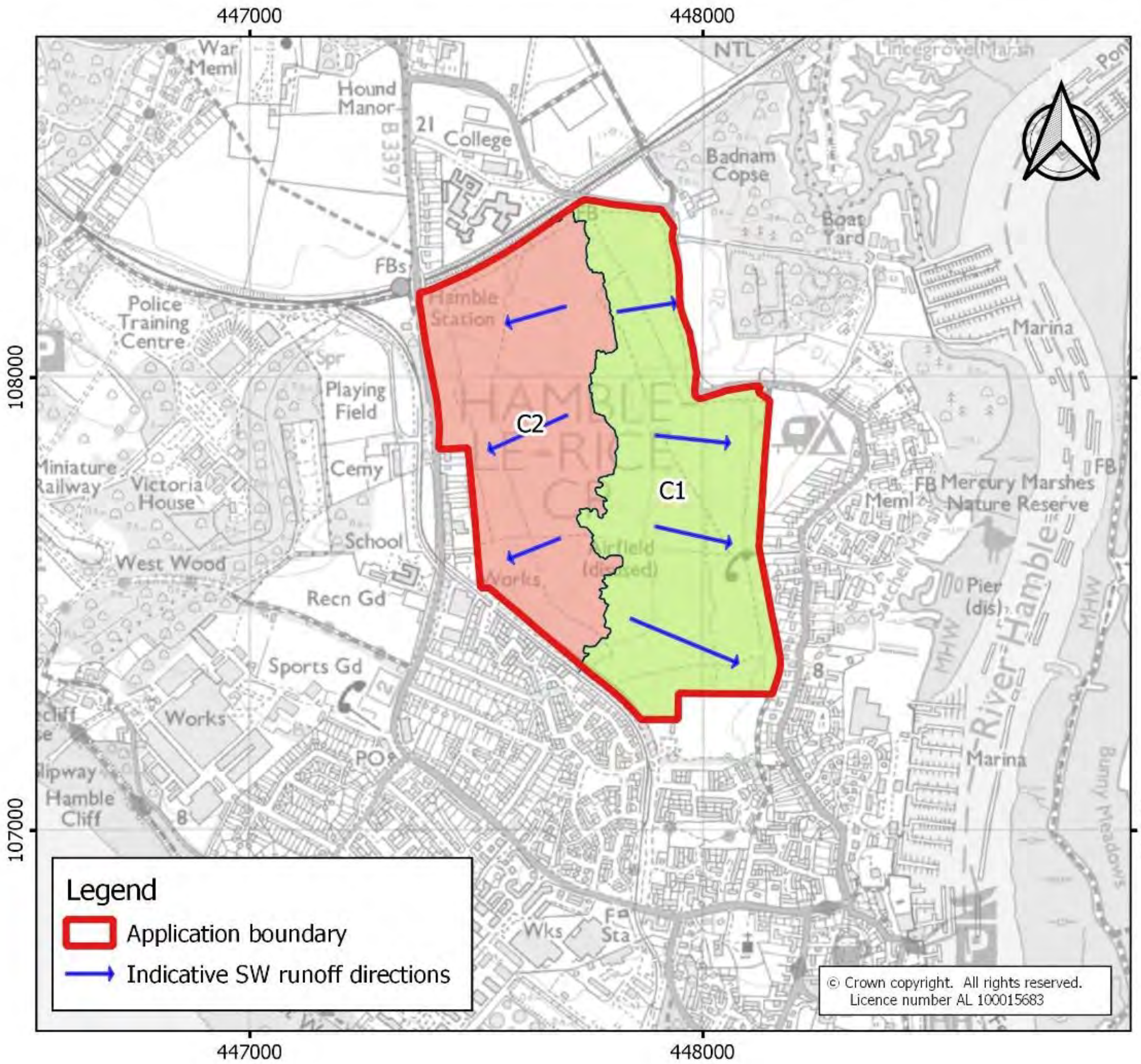


Figure 7.1 Runoff catchments – current

As previously discussed, a surface water divide exists along the centre of the Site, with runoff being directed to the lower elevation ground to the east and west. These current surface water catchment areas have been termed C1 and C2 in this assessment.

Operational Phase

Once development of the Site commences (i.e. the 'operational phase' begins) the topography will be altered as excavations are expanded and bunds are created. The runoff regime of the

Site will be in a state of change as it is progressively developed and restored. Sub-catchments associated with the excavations will be enlarged over this time.

At the start of the operational phase, runoff will be directed to new lagoons created in the northern part of the Site (the details of which are discussed further below). Through phases 1 to 7, runoff from the southern part of the Site will be directed to the active quarry void (which will migrate around the Site as operations continue). Once runoff enters the voids and lagoons, it will infiltrate to the sand and gravel aquifer below the Site. Existing catchments C1 and C2 will reduce in size considerably to the periphery of the Site, outside of the bunded area.

The operational runoff catchment areas (prefixed 'O') are presented in Figure 7.2. The figure shows expected catchment areas at phase 4, which has been used as a snapshot to represent the Site in a reasonably advanced state of the operational phase (i.e. with some areas having been restored and some with active excavations).

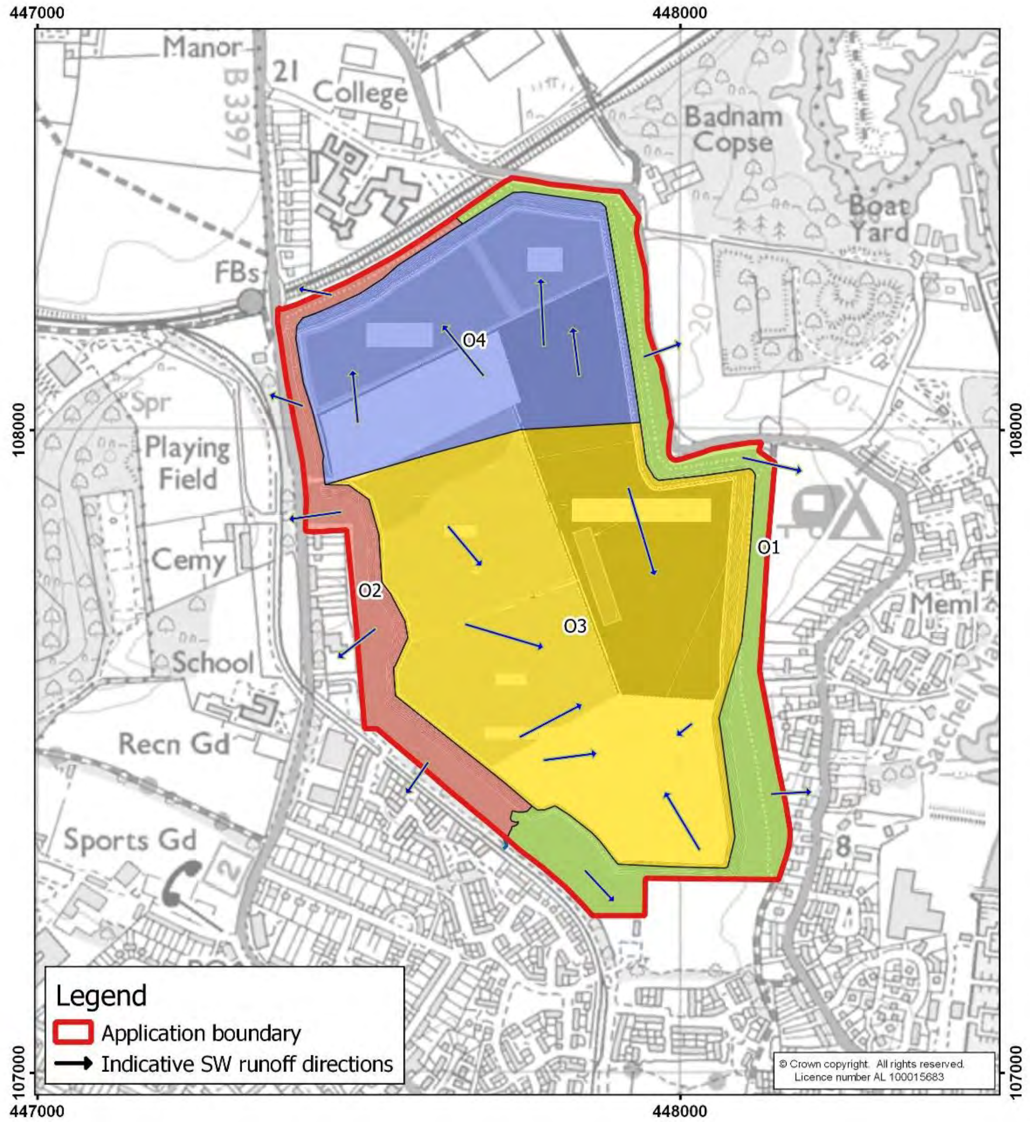


Figure 7.2 Runoff catchments – operational

Restoration Phase

As shown in the restoration plan (Appendix C), a shallow valley will be created in the northern part of the Site, including a wetland area and pond. Losses from this sub-catchment will be mainly via evapotranspiration, with limited infiltration to ground owing the lower permeability fill material utilised for the restoration phase. Overflows from the pond and wetland will convey surplus water to infiltration features located outside the fill material (as described in Section 8) but no off-site runoff is expected from this area. A second pond is also included in the southeast of the Site and will be drained in a similar fashion to the northern pond and wetland described above.

A new infiltration basin will be sited in the northwest of the Site, on the edge of the proposed fill area. Two-thirds of this feature will be located on the fill (with limited infiltration). For this reason an infiltration trench has also been included to join this feature and maximise the infiltration potential in this area.

All features are shown in Figure 8.2. Infiltration trenches also be installed around the periphery of the Site to intercept and infiltrate runoff from the remaining catchment areas to prevent any increase in off-site runoff that could arise as a result of using less permeable fill material for the Site restoration (see Section 8).

The runoff catchment areas for the restored site (prefixed 'R') are shown in Figure 7.3.

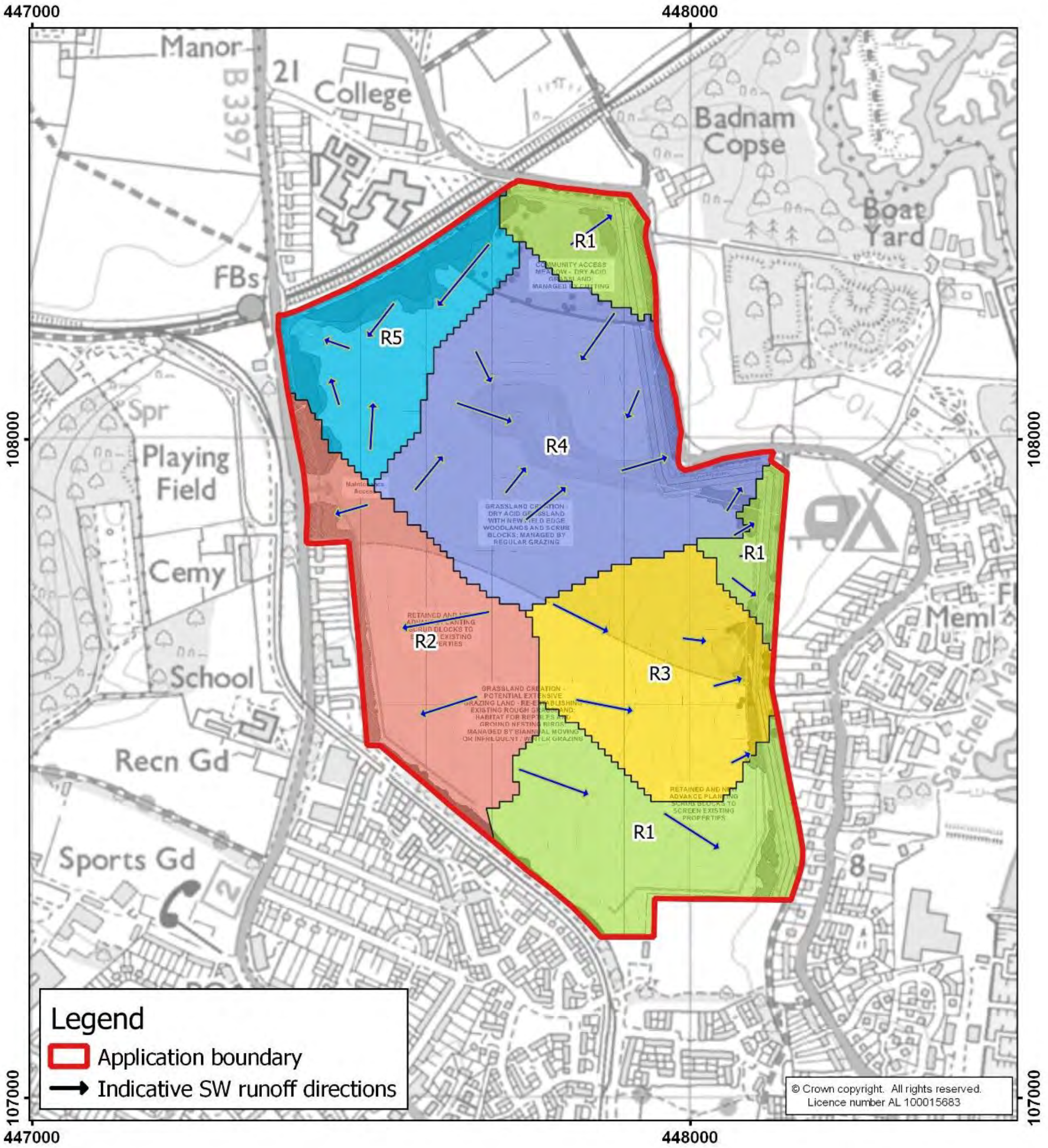


Figure 7.3 Surface water runoff catchments – Restored phase

Summary

A summary has been provided below of the catchment areas over the lifetime of the development and post restoration. A prefix of 'C', 'O' and 'R' has been used to denote catchment areas within the current, operational, and restored phases of the development, respectively.

As evident from a review of Table 7.3, catchments C1 and C2 (which contribute to direct off-Site runoff to the east and west respectively), reduce in size over the operational phase and post restoration. This is owing to the introduction of the new on-site sub-catchments during the operational and restored phases (catchments 3 to 5).

Table 7.3 Site catchment areas over time

Phase	Catchment	Area (ha)	Notes
Greenfield/ Current	C1	32.21	Eastern catchment
	C2	28.89	Western catchment
Operational	O1	8.31	Eastern catchment
	O2	6.10	Western catchment
	O3	30.62	Southern catchment draining to active void
	O4	16.06	Northern catchment draining to lagoons
Restored	R1	14.17	Eastern catchment (draining to infiltration trenches)
	R2	11.44	Western catchment (draining to infiltration trenches)
	R3	10.19	Catchment draining to southern water feature
	R4	17.95	Catchment draining to large central water feature
	R5	7.31	Catchment draining to north-western infiltration basin and trench

7.3.3 Predicted Run-off - greenfield

Table 7.4 to Table 7.6 give the calculated greenfield run-off for catchments C1 and C2 for a 6hr storm duration event. These are output data from ReFH2, with raw data included in Appendix D.

The DEFRA (2015) non-statutory guidance for SuDS design stipulates that the greenfield runoff rates and volumes for the 1 in 1 and 1 in 100 year storm events should not be exceeded post development, with an appropriate allowance for climate change over the lifetime of the proposed development.

Table 7.4 Greenfield runoff (1 in 1 year event)

Catchment	6 hour rainfall (mm)	Site peak rate (l/s)	Total runoff volume (m^3)
C1	21.61	61.27	815
C2	21.61	53.09	706

Table 7.5 Greenfield runoff (1 in 30 year event)

Catchment	6 hour rainfall (mm)	Site peak rate (l/s)	Total runoff volume (m^3)
C1	46.16	148.88	2,064
C2	46.16	129.02	1,789

Table 7.6 Greenfield runoff (1 in 100 year event)

Catchment	6 hour rainfall (mm)	Site peak rate (l/s)	Total runoff volume (m^3)
C1	56.82	194.38	2,713
C2	56.82	168.47	2,351

7.3.4 Predicted run-off – operational & restored sites

The attenuation storage volume is the required storage to manage additional runoff caused by a development compared with the greenfield scenario.

Table 7.7 to Table 7.9 compare the predicted runoff for the operational and restored phases with the greenfield runoff for the 1 in 1 year, 1 in 30 year and 1 in 100 year, 6 hour storm event plus 10% (operational phase) and 40% (restoration phase) climate change allowances.

It is important to note that this covers direct runoff only from catchments 1 and 2 during the operational phase (i.e. catchments O1 and O2). Catchments O3, O4 and all restored catchments will drain to SuDS and separate calculations have been undertaken for these features using MicroDrainage software in Section 8.

As catchments O1 and O2 will be undeveloped, the variables used in the runoff calculations (see Table 7.2) have been retained as per the greenfield calculations. A 10% increase in rainfall intensity was included to account for climate change.

Table 7.7 Predicted future runoff (1 in 1 year event)

Catchment	Scenario	Peak runoff rate (l/s)	Change in rate (l/s)	Runoff volume (m^3)	Change in volume (m^3)
C1	Greenfield Runoff	61.27	N/A	815	N/A
O1	Operational inc. CC (10%)	13.32	-47.94	167	-648
C2	Greenfield Runoff	53.09	N/A	706	N/A
O2	Operational inc. CC (10%)	12.41	-40.68	171	-536

Table 7.8 Predicted future runoff (1 in 30 year event)

Catchment	Scenario	Peak runoff rate (l/s)	Change in rate (l/s)	Runoff volume (m^3)	Change in volume (m^3)
C1	Greenfield Runoff	148.88	N/A	2,064	N/A
O1	Operational inc. CC (10%)	32.81	-116.07	411	-1,653
C2	Greenfield Runoff	129.02	N/A	1,789	N/A
O2	Operational inc. CC (10%)	28.13	-100.89	404	-1385

Table 7.9 Predicted future runoff (1 in 100 year event)

Catchment	Scenario	Peak runoff rate (l/s)	Change in rate (l/s)	Runoff volume (m^3)	Change in volume (m^3)
C1	Greenfield Runoff	194.38	N/A	2,713	N/A
O1	Operational inc. CC (10%)	42.75	-151.63	535	-2177
C2	Greenfield Runoff	168.47	N/A	2,351	N/A
O2	Operational inc. CC (10%)	35.90	-132.57	519	-1832

The results above show that off-site runoff is expected to decrease over the operational phase, as expected given the large reduction in contributing runoff areas. The SuDS strategies for the operational and restored phases are included in Section 8.

7.4 Flood Risk during operational phase

Given that off-site runoff rates and volumes are predicted to decline during the operational phase, for the reasons stated above, there will be no increase in off-site flood risk over this time.

The introduction of the quarry voids and lagoons provides a significant reduction in off-site storm runoff rates and volumes. The performance of these features during storm events is assessed in Section 8.

7.5 Flood risk post-restoration

The restoration of the Site has the potential to increase runoff relative to the greenfield scenario. This is mainly due to the use of less permeable fill material for the restoration stage. This effect is mitigated by the restoration phase SuDS strategy described below.

8 Drainage Strategy

8.1 Performance requirements

Runoff rates and volumes from the Site under the greenfield, developed/operational and restored scenarios have been calculated above (Section 7.3). These calculations are based on a six-hour storm duration storm as recommended in the national guidance for quantifying stormwater runoff volumes.

The total runoff from the Site (i.e. the sum of outflow from features included in the SuDS strategy and direct rainfall runoff) must not exceed the greenfield scenario runoff rates in order to avoid increasing flood risk.

8.2 Operational phase

8.2.1 Proposed drainage strategy – operational phase

An illustrative design has been provided in Figure 8.1 demonstrating an outline strategy for management of surface water on the Site, following the principles of the DEFRA non-statutory guidance and the SuDS manual.

It is proposed that water (rainfall runoff) will be allowed to collect in the active quarry void during each operational phase, allowing settlement to occur before infiltrating to ground. There will be no significant dewatering occurring over the lifespan of the quarry. Calculations of the performance of the voids under the design storm event are provided in Section 8.2.2.

Runoff from the processing plant area and undeveloped northern part of the Site will be directed to the northern lagoons (Freshwater Lagoon and Silt Lagoon). Water will either infiltrate to ground or be abstracted for use in the processing plant.

Further details of the SuDS features and layout will be provided in the detailed drainage design phase.

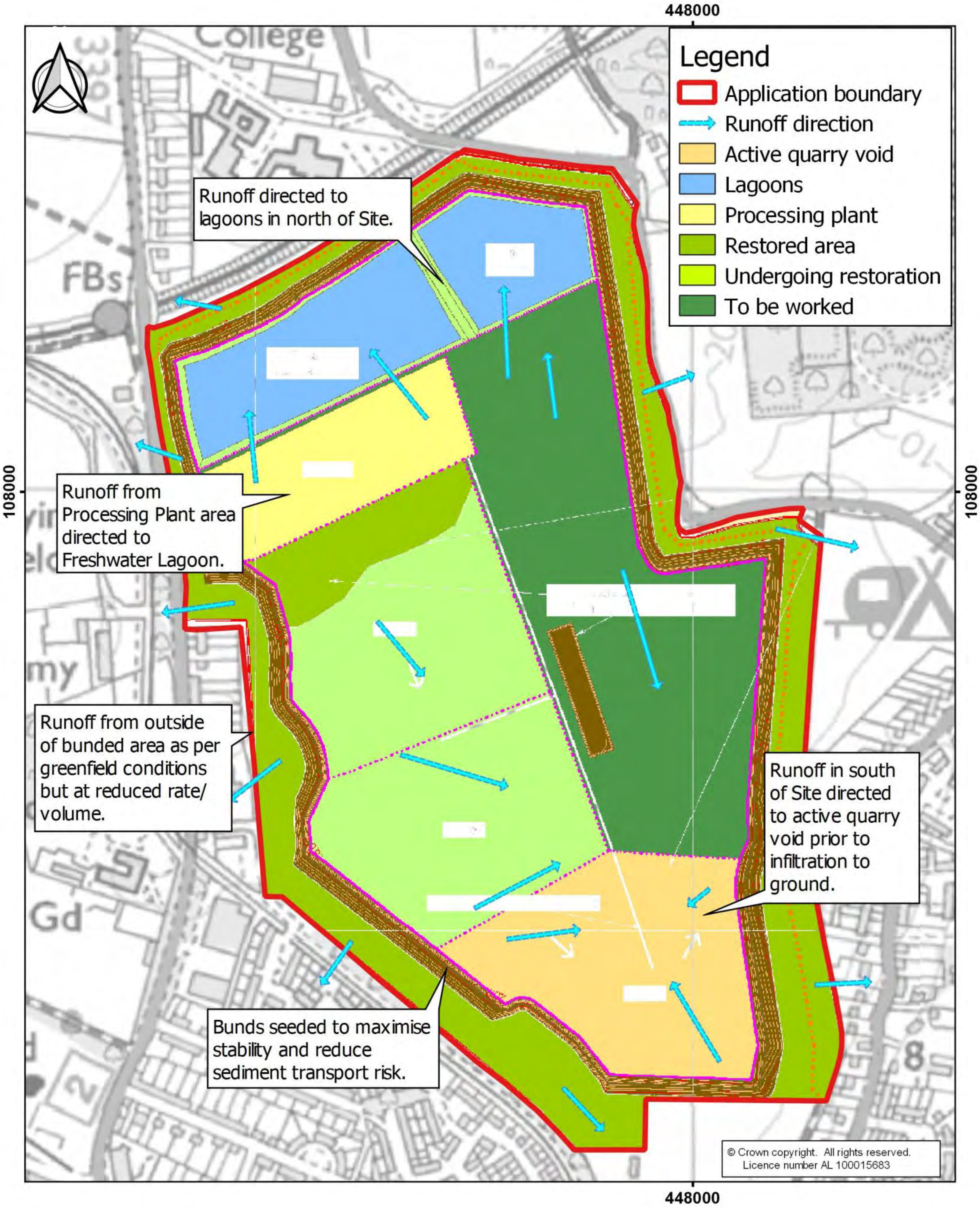


Figure 8.1 Proposed drainage strategy (operational phase – phase 4)

8.2.2 Performance calculations

To demonstrate the feasibility of the proposed operational phase drainage scheme, MicroDrainage models have been created to represent the features in the SuDS scheme. The methodology and results are presented below.

The scenario used for the calculation is phase 4 of the development (see Appendix B) which represents the Site at a moderately advanced stage of development and is considered a representative snapshot of the operational lifespan of the development. The overall SuDS strategy during other phases will follow the same principles, utilising the large storage capacity in the active quarry void and allowing infiltration to ground.

For simplicity, only the Freshwater Lagoon has been modelled as the receiving SuDS feature for the northern part of the Site. In reality both the Freshwater Lagoon and Silt Lagoon will share this runoff, but these calculations demonstrate that there is ample storage capacity on Site for stormwater.

Geometry

The geometry of the phase 4 void and the Freshwater Lagoon has been established from the phasing plans in Appendix A and additional information provided by CEMEX. This information is summarised in Table 8.1.

Table 8.1 Dimensions of principal SUDS features (Operational phase).

Feature	Catchment area (ha)	Imp. area (ha)*	Bank elevation (m AOD)	Feature invert level (m AOD)	Feature Depth (m)	Area of base (m^2)	Surface area at bank (m^2)	Total volume (m^3)	Outfall type
Phase 4 void	30.62	4.65	c. 20	c. 17**	3	46,515	63,314	155,635	None, infiltration only
Freshwater Lagoon	16.06	6.55	c. 20	c. 17**	3	35,609	44,321	119,657	None, infiltration only

** Includes large open water bodies (in lagoons and active void)*

*** Invert level set as rest water level in feature. Inferred groundwater level in feature is shallow (3 mbgl) to represent high winter levels. Based on observed GW levels discussed in CEMEX (2021)*

Inflows

Given that some of the southern part of the Site will have been restored (using a lower permeability fill material), the BFI value used in the runoff calculations was reduced from 0.62 (greenfield value) to 0.48 for catchment O3. This was achieved using a weighted mean approach using the 0.62 values for the undeveloped part of the catchment and a value of 0.312 for the restored part of the catchment. The BFI value of 0.312 represents soil HOST Class 24 (Institute of Hydrology, 1995) – "Slowly permeable, seasonally waterlogged soils over slowly permeable substrates with negligible storage capacity" which has been utilised to represent the restored Site surface conditions in this instance.

Given the presence of the plant area in the northern part of the Site, an impermeable area of 33,765 m^2 was included in the runoff calculations for catchment O4. The lagoons in catchment O4 were also treated as impermeable areas (a total area of 65,490 m^2) to represent the increase in runoff volume entering these features as direct rainfall input, as was the base of the phase 4 void (46,515m^2).

The ReFH method was used via the MicroDrainage additional hydrograph module to generate storm hydrographs for the phase 4 catchments (O3 and O4) under the 1 in 100 year event for a range of storm durations including a 10% uplift in rainfall intensity for climate change. Simulations were run for storm durations from 15 minutes to 10,080 minutes. The RefH2 method cannot currently be utilised within MicroDrainage to include climate change uplifts.

Infiltration

An infiltration coefficient of 1 m/hr has been applied for the River Terrace Deposits in line with industry standard values (Innovyze, 2021).

Infiltration via the base of the void is assumed to be zero in this instance given that the water table will be exposed in the base of the void (note that the base of the feature has been set at the maximum expected groundwater water elevation).

Results

The MicroDrainage results for this scenario are presented in Appendix E. A maximum water level of 17.20 mAOD is calculated in the phase 4 void (i.e. a depth of just 20 cm in the base of the void).

A maximum water level of 17.11 mAOD is calculated in the Freshwater Lagoon (i.e. 11 cm depth in total).

Given the large remaining freeboard, no requirement for a high-level overflow from the quarry void or Freshwater Lagoon is anticipated.

Table 8.2 Performance of SuDS features under a 1 in 100 year + 10% storm event.

Feature	Critical duration (mins)	Max. water level (m AOD)	Min. freeboard remaining (m)	Half drain times (min)
Freshwater Lagoon	2,160	17.11	2.89	1,130
Phase 4 void	2,880	17.20	2.80	719

8.2.3 Exceedance flows

As can be demonstrated by the MicroDrainage calculations above, there is a significant depth of freeboard remaining even under the 1 in 100 year + 10% climate change allowance and an exceedance of the capacity of the features seems highly unlikely. If this were to occur, the bunds around the periphery would prevent runoff offsite around the majority of the Site perimeter.

8.2.4 Residual flood risk

The calculations above demonstrate that the on-site features (quarry voids and lagoons) are easily capable of storing stormwater runoff prior to infiltration. On site flood risk will therefore be negligible over the operational phase. Given that the runoff from catchments 1 and 2 (which contribute to offsite runoff) will reduce relative to the greenfield/current scenario, the development will provide betterment with regards to off-site flood risk.

8.2.5 Water quality

This section provides details of the potential of the proposed development to cause a reduction in water quality and the measures proposed mitigate this.

SuDS techniques can be used by way of a treatment train process to effectively manage the quality of surface water flowing across a site. Different methods can be used to intercept pollutants and allow them to degrade or be retained in situ without impacting the quality of water further downstream.

The proposed development will see some stockpiles of overburden and sand and gravel around the Site. Although the Site runoff will infiltrate to ground via the open voids and lagoon, the CIRIA SuDS manual (CIRIA, 2015) qualitative indices approach to designing a SuDS scheme has been applied to quantify the influence of the proposed SuDS features on Site runoff.

Suspended solids are the only pollutant specifically considered in this assessment given the nature of the development, although other pollutants and best practice measures are included in the scheme (see below). Based upon the nature of the development, using the index methodology for water quality assessment, a pollution index of 0.7 – 0.8 for Total Suspended Solids would seem appropriate (Chapter 4 of CIRIA, 2015).

The following measures are included in the operational (construction) phase drainage strategy to mitigate any potential increase in sediment loads within on-site runoff. Removal indices are included in the brackets.

- Ponds (0.7) – the quarry voids and lagoons.

Water used in mineral washing at the processing plant will be discharged to the Silt Lagoon for settlement and infiltration to ground.

Sediment collecting in the lagoons will be periodically removed from the base of the features and utilised in the site restoration process.

Bunds and stockpiles will be seeded with grass to prevent erosion and minimise sediment transportation.

8.3 Restoration phase

8.3.1 Proposed drainage strategy – post restoration

An illustrative design is shown in Figure 8.2 demonstrating an outline strategy for management of surface water at the Site post restoration. The restored site will eventually be covered with vegetation (trees and grassland) and two drainage ponds.

Much of the Site will drain to two new pond features within the site boundary (see Section 7.3.2). Infiltration to ground is unlikely to be feasible in these areas given the likely low permeability of the fill material. Flow control devices will allow discharge from these features to linear infiltration trenches along the boundary of the Site (outside of the excavation/infilled zone). These will be square section channels, around 2 m deep by 1 m wide, lined with a permeable membrane and filled with gravel.

An infiltration basin will be positioned in the northwest of the Site, outside of the fill area, to attenuate and discharge runoff from this part of the Site to ground.

In-situ soakaway testing is recommended in due course to validate the water balance calculations undertaken in this assessment. This can be undertaken as part of the detailed drainage design work.

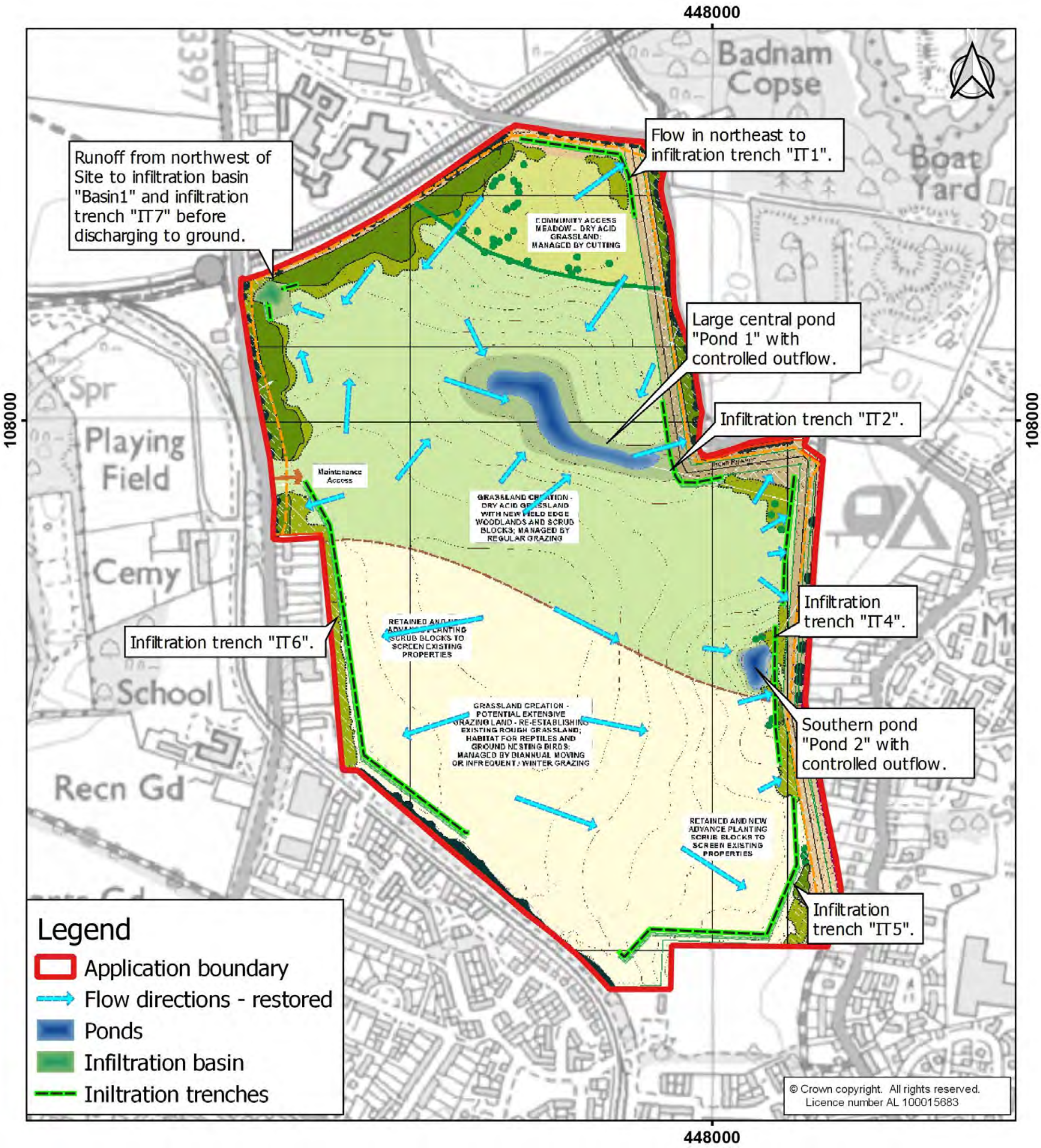


Figure 8.2 Proposed drainage strategy (restored phase)

8.3.2 Performance calculations

Further MicroDrainage models have been created to represent the features in the restored site SuDS scheme. The methodology and results are presented below.

A separate model was created for each SuDS feature. Where the proposed ponds/basins (Pond 1, Pond 2 and Basin 1) flow into the downgradient infiltration trenches (IT2, IT4 and IT7) the cascade functionality was applied to link the output hydrographs from the features to the trenches.

Geometry

The geometry of the proposed SuDS features and other pertinent information used in the MicroDrainage calculations is summarised in Table 8.3. The infiltration trenches have been modelled as fairly level single features for simplicity at this stage. They will likely be staggered along their reach, with check dams to maximise storage, given the topography of the restored Site.

Hydro-Brake® discharge rates have been set to maximise the use of available storage in the upgradient features.

Table 8.3 Dimensions of principal SUDS features (Restored phase).

Feature(s)	Catchment area (ha)	BFI*	Bank elevation (m AOD)	Feature invert level (m AOD)	Feature Depth (m)	Area of base (m^2)	Surface area at bank (m^2)	Storage volume (m^3)	Outfall
Infiltration trench "IT1"	4.28	0.46	21.7	19.7	2	215	215	430	None
Pond 1	25.13	0.35	18.5	17**	1.5	4619	6930	8,604	Hydro-Brake ® Invert: 17 mAOD Design flow 125 l/s
Infiltration trench "IT2"	0 (cascade from Pond1)	n/a	18.3	15.3	3	244.5	245	734	None
Infiltration trench "IT3"	1.71	0.51	19.0	17	2	168	168	336	None
Pond 2	25.13	0.36	16.5	15**	1.5	487	1270	1,272	Hydro-Brake ® Invert: 15 mAOD Design flow :175l/s
Infiltration trench "IT4"	0 (cascade from Pond 2)	n/a	16.3	13.3	3	177	177	531	None
Infiltration trench "IT5"	9.41	0.48	17.7	15.7	2	402	402	804	None
Infiltration trench "IT6"			21	19	2	545	545	1,090	None
Infiltration Basin "Basin 1"	7.31	0.38	18.5	17	1.5	164	643	571	Overflow weir set at 18.10 mAOD
Infiltration trench "IT7"	0 (cascade from Basin1)	n/a	18.5	15.5	3	108	108	324	None

** Calculated using weighted mean approach*
*** Invert level set to outfall invert (i.e. base of usable storage)*

Inflows

The ReFH method was used via the MicroDrainage additional hydrograph module to generate storm hydrographs for the restored catchments under the 1 in 100 year event for a range of storm durations including a 40% uplift in rainfall intensity for climate change. Simulations were run for storm durations from 15 minutes to 10,080 minutes.

The BFI value used in the runoff calculations was reduced using a weighted mean approach using the 0.62 values for the undeveloped part of the catchment and a value of 0.312 for the restored part of the catchment as per the operational phase calculations. Utilised BFI values are included in Table 8.3.

Infiltration

An infiltration coefficient of 1 m/hr has been applied for the River Terrace Deposits in line industry standard values (Innovyze, 2021). This was applied to the walls and bed of the infiltration trenches. This value was reduced by 30% for the infiltration basin as it will be partially underlain with fill material.

Infiltration via the ponds is assumed to be zero in this instance given the presence of the underlying restoration fill.

Results

The MicroDrainage results for this scenario are presented in Appendix E and have been summarised in in Table 8.4

Table 8.4 Performance of restored phase SuDS features under a 1 in 100 year + 40% storm event.

Feature/catchment	Critical duration (mins)	Max. water level (m AOD)	Min. freeboard remaining (m)	Half drain times (min)
Lake 1	960	18.20	0.8	c.300
Lake 2	480	16.18	0.32	c. 250
IT1	360	20.81	0.89	6
IT2	4320	17.60	0.70	9
IT3	360	18.08	0.92	6
IT4	600	15.97	0.33	10
IT5	360	17.04	0.66	8
IT6	360	20.28	0.72	7
IT7	480	17.88	0.67	3
Infiltration Basin 1	360	18.12	0.38	35

8.3.3 Exceedance flows

In the event that the capacity of the SuDS features described here are exceeded, exceedance flows would be eastwards and westward, radially from the Site, as per the greenfield runoff regime. This is illustrated in Figure 8.3

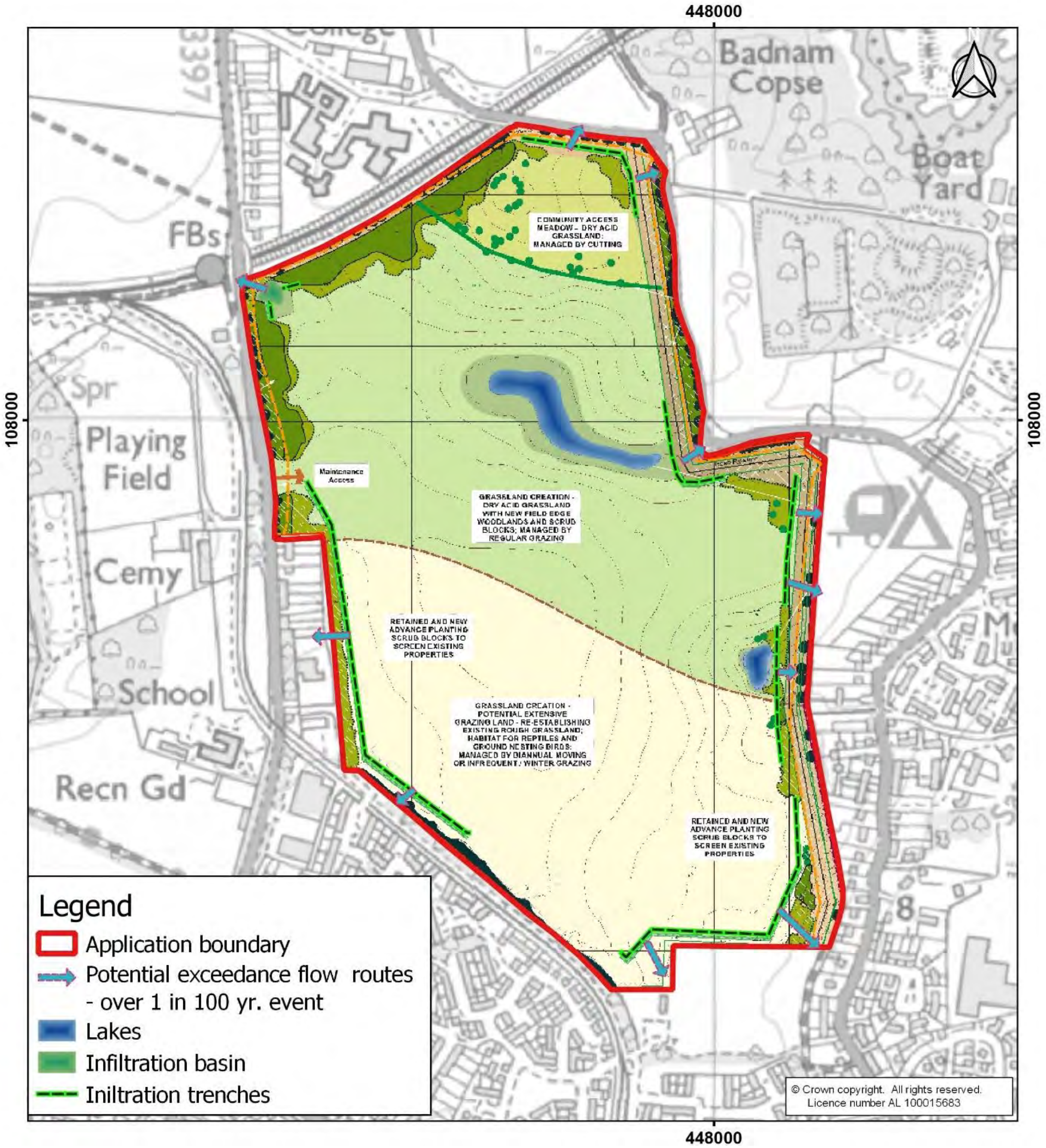


Figure 8.3 Potential exceedance flow routes

8.3.4 Residual flood risk

The residual flood risk is that remaining after taking into consideration the measures set out in the SuDS scheme. The performance calculations for the SuDS features demonstrate that they would be capable of attenuating all incoming runoff from a 1 in 100 year plus 40% storm event without surcharging water off-site. Off-Site runoff would therefore be limited to the small residual areas around the SuDS features – the trenches are not immediately adjacent to the Site boundary. This residual catchment area is far smaller in extent and would result in a large net reduction in runoff rates and off-Site flood risk.

8.3.5 Water quality

Post-restoration there will be no pollution sources at the Site and therefore, no risk posed by the Site for water quality deterioration. The SuDS features included in the restoration phase SuDS scheme (see below) are largely for water quantity management as well as biodiversity and amenity benefits, although they do offer this potential as demonstrated below.

The following measures are included in the restored phase SuDS strategy to mitigate any potential increase in sediment loads within on-site and off-site runoff. Removal indices are included in the brackets adjacent to each feature type.

- Ponds (0.7).
- Infiltration Basin (0.5)
- Infiltration trench (0.4)

A combination of ponds, infiltration trenches and an infiltration basin have been included in the restored Site SuDS strategy which will provide some water treatment functionality to the restored Site.

8.4 Maintenance

8.4.1 Plan details – operational phase

The drainage strategy for the operational Site is simple and does not include many complicated features. As such, the maintenance requirements for the Site will be low. The proposed requirements for the scheme are set out below for the operational life of the quarry. Note that the quarry void is not included in this section as its geometry will be changing throughout the operational phase of the development and will be managed as per the normal good management techniques for a sand gravel quarry site.

Lagoons

- Inspect and clear out – quarterly
- Vegetation management - quarterly
- Remove sediment from bed – annually or as required

Sediment would be utilised as part of the restoration process.

8.4.2 Contact information

The quarry manager or operational manager for the Site will be responsible for the SuDS scheme. Exact contact details will be provided when the quarry is operational.

8.4.3 Plan details - post restoration

The proposed requirements for the scheme are set out below for the restored Site SuDS features:

Hydro-Brake ®

- Check Hydro-Brake for signs of damage/blockages/wear – annually or as per manufacturers recommendation

Ponds & infiltration basin

- Inspect and clear out – quarterly
- Vegetation management - quarterly
- Remove sediment from bed – annually or every three years

Infiltration trenches require negligible maintenance once installed. An annual inspection to ensure the top of the feature is not becoming covered with debris should be undertaken.

An easement around the features will be maintained to allow access for maintenance. Invasive maintenance work such as vegetation removal would only be required intermittently, but it should be sympathetic to the requirements of wildlife in the ponds.

8.5 Biodiversity and amenity

The restoration schemes present an opportunity to enhance habitat for wildlife on-site and with the aim of improving biodiversity in the vicinity. Lakes and infiltration basins are landscape assets that have amenity value and improve the aesthetics more than conventional drainage systems. Ecological diversity will be maximised through the restoration strategy for creating a range of habitat types.

9 Conclusions

CEMEX is proposing to extract sand and gravel from the former Hamble Airfield Site near Southampton, Hampshire. The Site would be progressively worked and restored back to levels comparable with the current topography. The Site would be worked wet, with no dewatering employed.

The Site is currently vacant and covered with grass - now effectively a greenfield site.

Stantec has reviewed the potential flood risk to the Site and from the proposed development to neighbouring receptors. The Site lies within Flood Zone 1 and is therefore not at risk of flooding from rivers or the sea. Sand and gravel extraction is considered by the NPPF to be a water compatible land use and the proposed development is therefore appropriate for this location with no Exception Test required.

The risk of surface water flooding for the Site is demonstrated to be low. No flooding is anticipated even in the 1 in 1000 year flood event aside from two small depressions near the centre of the Site.

The Site is not at risk of flooding as a result of reservoir failure and the risk of groundwater flooding in the area is low.

A drainage scheme has been proposed which principally includes the large quarry void and northern lagoons over the operational phase of the quarry, which provide a very large stormwater attenuation capacity. Attenuated water will discharge to ground. Runoff and water balance (MicroDrainage) calculations have been undertaken for phase 4 of the development to demonstrate the validity of the scheme, although the principles of the SuDS scheme apply to all phases of the operational phase of the development (the location of the active void will move around the Site during the operational life of the quarry).

Following restoration, runoff will attenuate in some newly formed SuDS features (ponds and an infiltration basin) distributed across the Site. From the ponds, water would infiltrate to the sand and gravel aquifer (where it remains around the Site perimeter), via some infiltration trenches. Discharge to ground from the infiltration basin will be via the bank and base of the feature directly. Calculated off-site discharge (runoff and discharge from SuDS features) is well below the calculated greenfield rates and volumes with all SuDS features able to attenuate and discharge receiving runoff to ground. This illustrates that the SuDS schemes would provide some betterment with regards to off-site flood risk. Further in-situ soakaway testing is recommended in due course to validate the water balance calculation undertaken in this assessment.

10 REFERENCES

British Geological Society, 2021. GeoIndex - online geological mapping. http://www.bgs.ac.uk/GeoIndex/

Centre of Ecology and Hydrology, 2021. Flood Estimation Handbook Website

Department for Communities and Local Government , 2021. National Planning Policy Framework (NPPF)

Department for Communities and Local Government, 2021. National Planning Policy Guidance (NPPG)

Eastern Solent Coastal Partnership, 2016. South Hampshire Strategic Flood Risk Assessment

Eastleigh Borough Council, 2018. Eastleigh Local Plan.

Environment Agency, 2021. Flood risk assessments: climate change allowances.

Hampshire County Council, 2012. Eastleigh Surface Water Management Plan

Hampshire County Council, 2013. Hampshire Minerals and Waste Plan

Innovyze 2021. Literature values of infiltration rates for geological strata. MicroDrainage accompanying literature.

CEMEX, 2021. Environmental Statement – Hamble Quarry

APPENDICES

Appendix A

Topographical Site Survey

Appendix A
Hamble Site Survey - Feb 2007

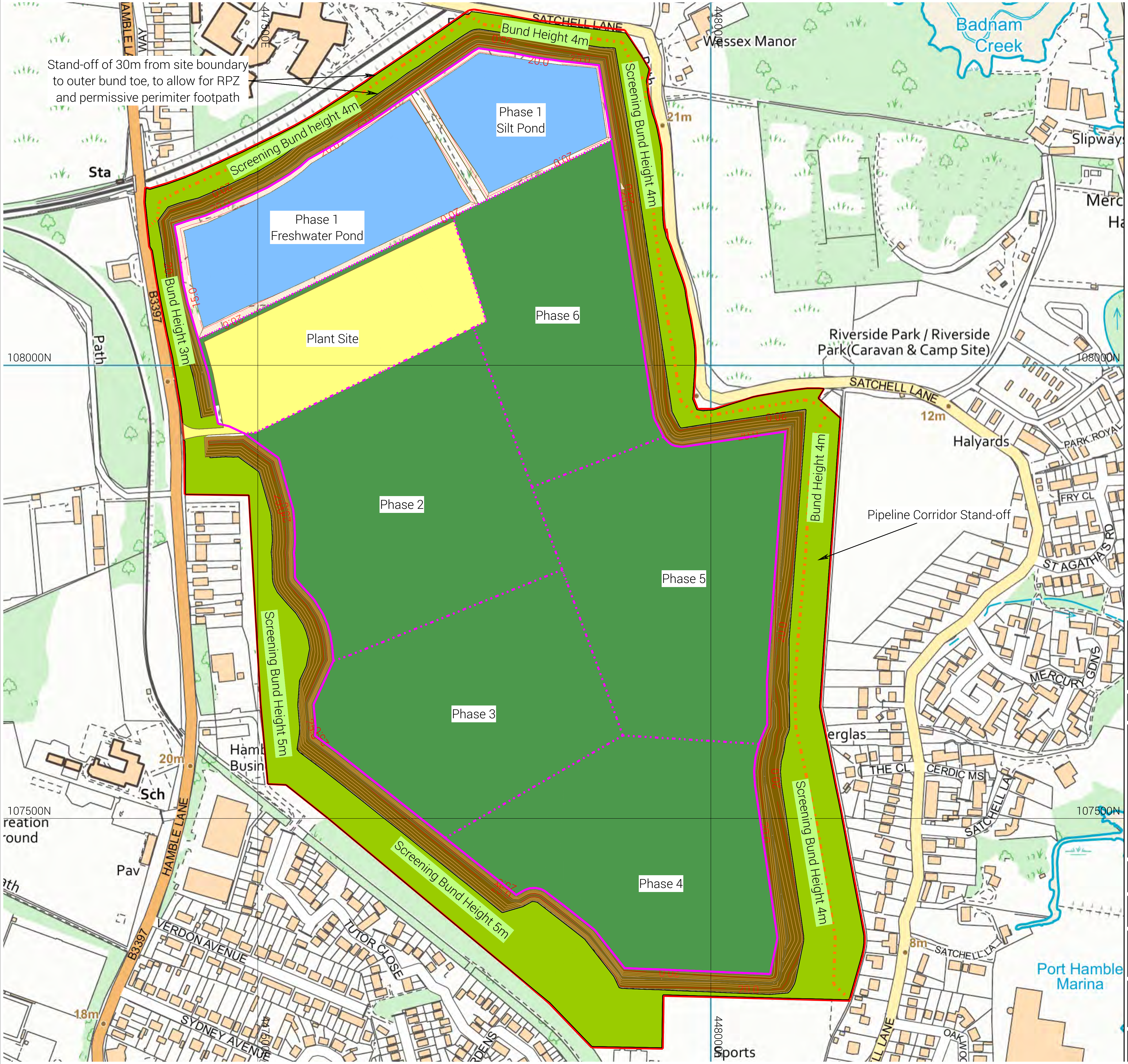
Date	Drawn
Jan 2020	HJK
Scale	Checked
NTS	RCS
Original	Revision
A3	1

File Reference
O:\66650 Hamble Airfield\Reports\66650R2\Appendices

Stantec

Appendix B

Site Development Plans



Legend

- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

N

Models		
	Drawn from	21-10_HAMBLE_PHASING OVERVIEW.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phasing Overview
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASING OVERVIEW.LSS

Legend

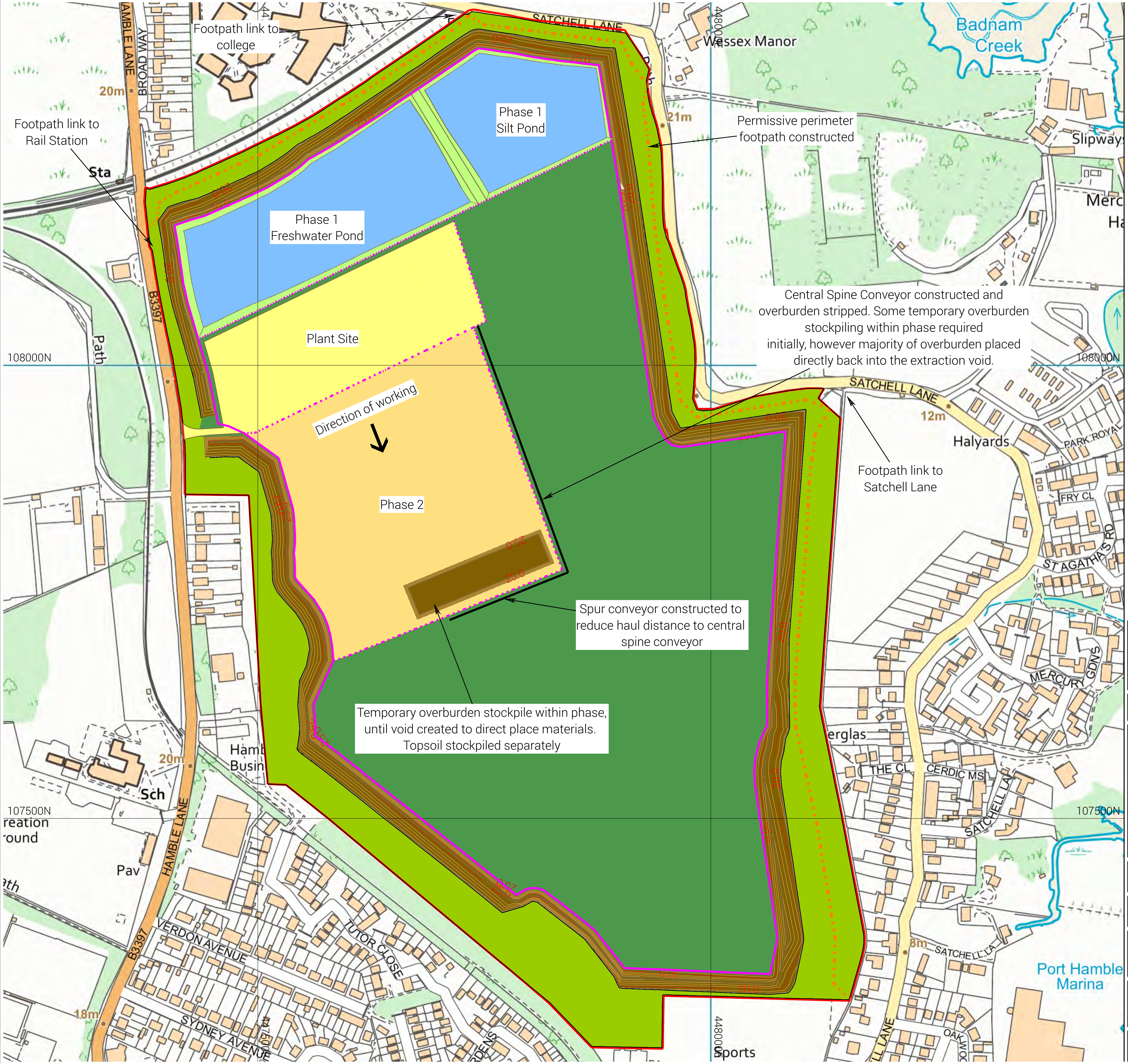
- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

Models		
	Drawn from	21-10_HAMBLE_PHASE 1.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 1
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 1.LSS



Legend

- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

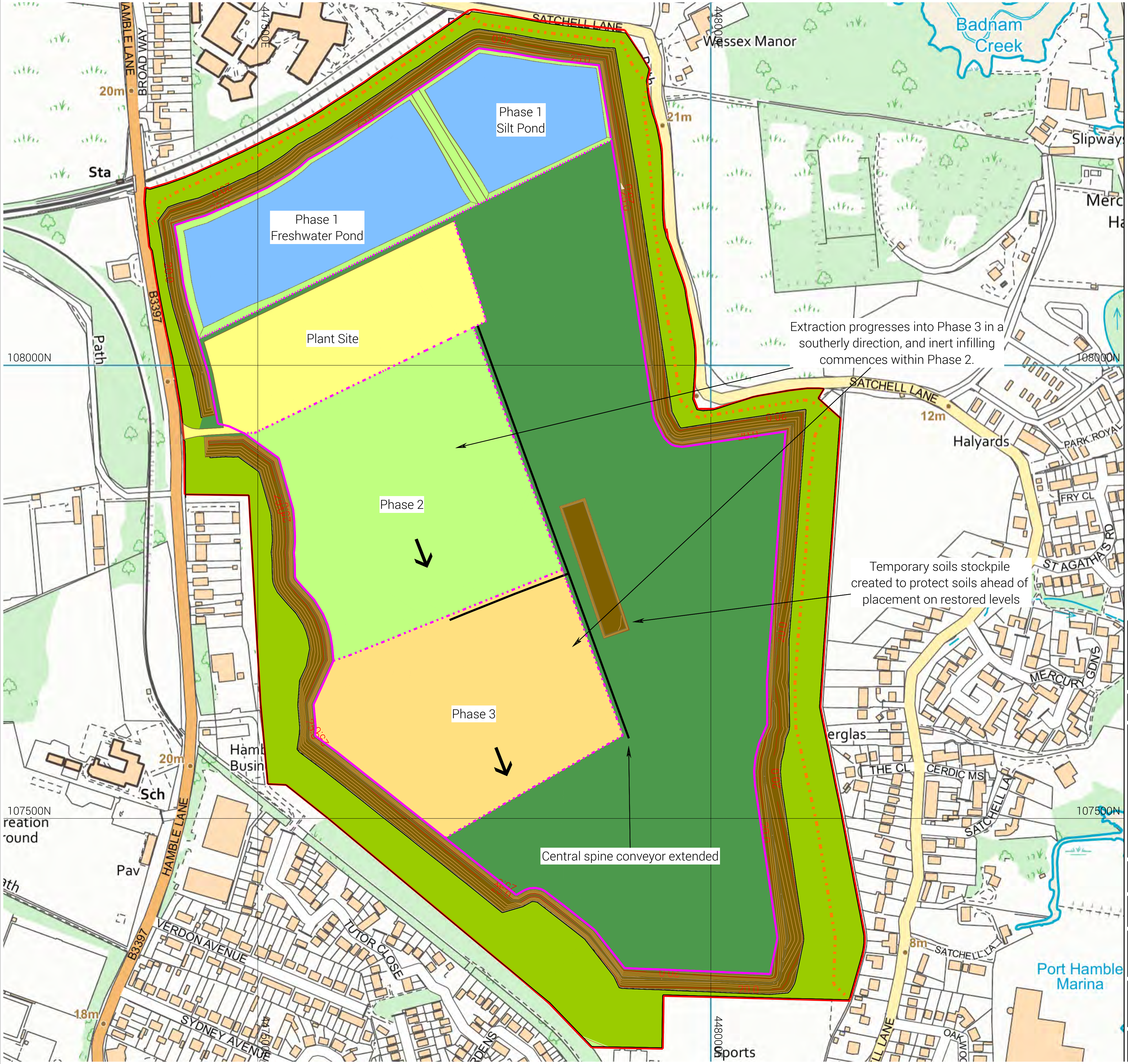
N

Models		
	Drawn from	21-10_HAMBLE_PHASE 2.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 2
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 2.LSS



Legend

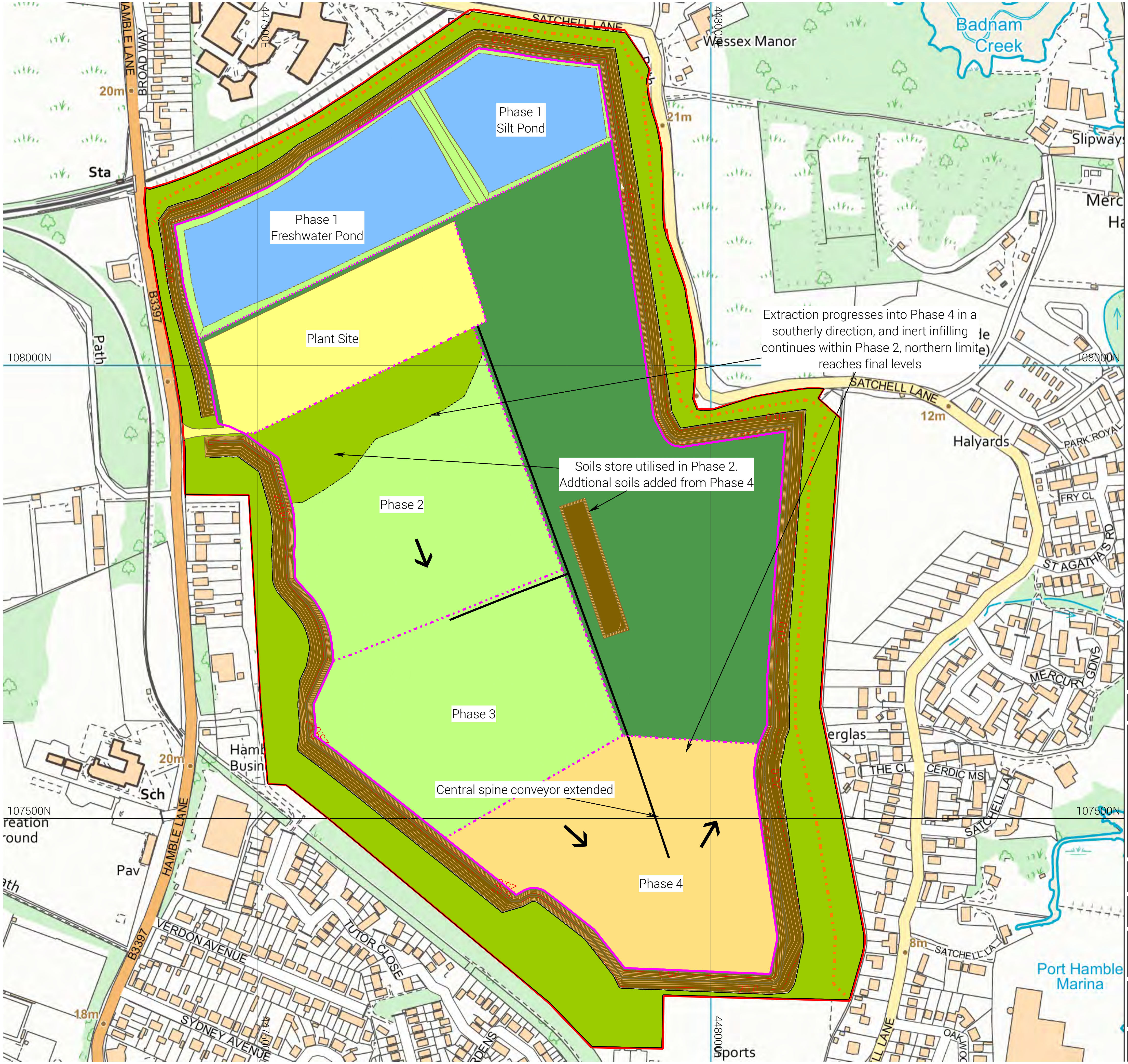
- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

Models		
	Drawn from	21-10_HAMBLE_PHASE 3.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 3
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 3.LSS



Legend

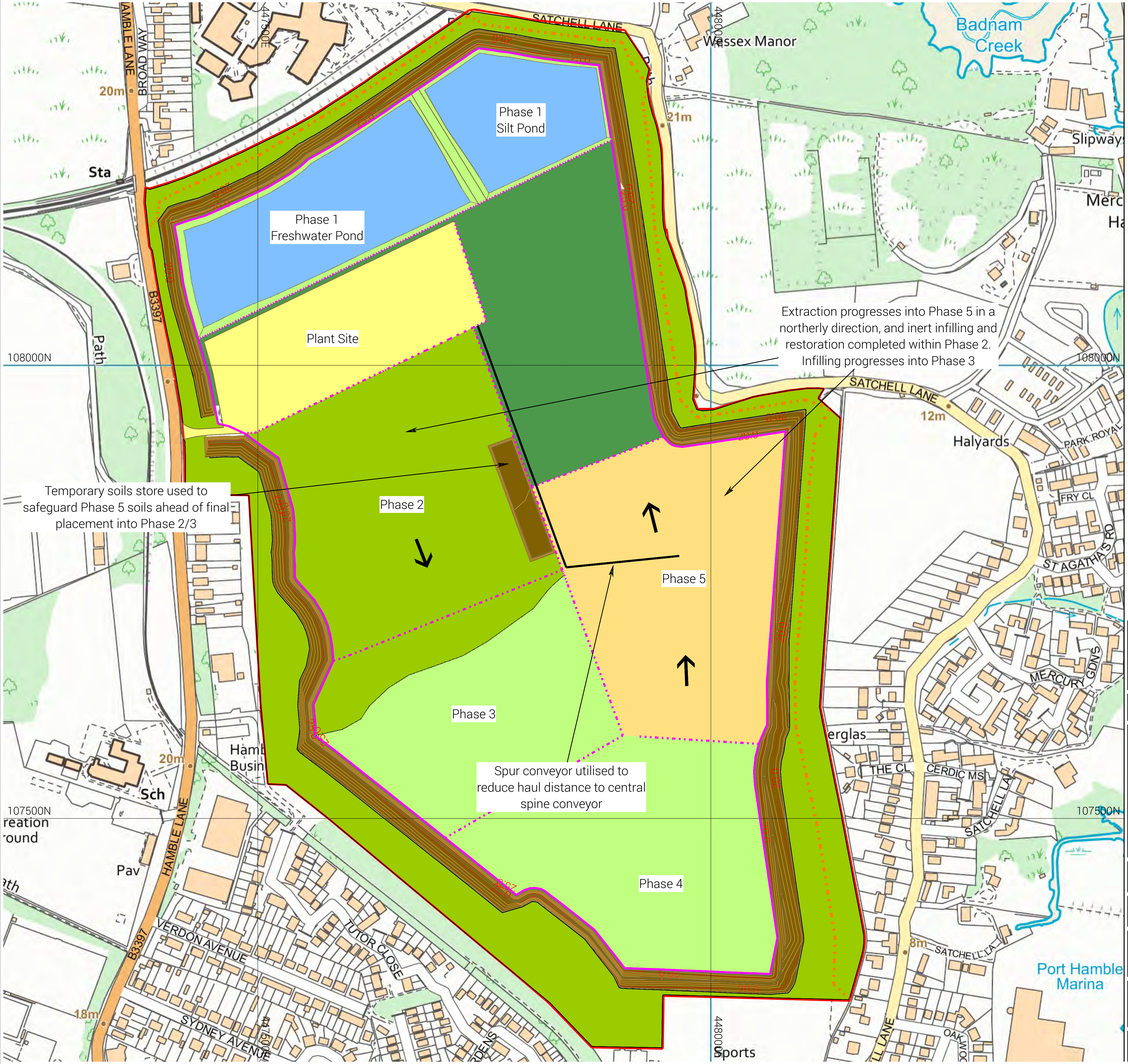
- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

Models		
	Drawn from	21-10_HAMBLE_PHASE 4.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 4
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 4.LSS



Legend

- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

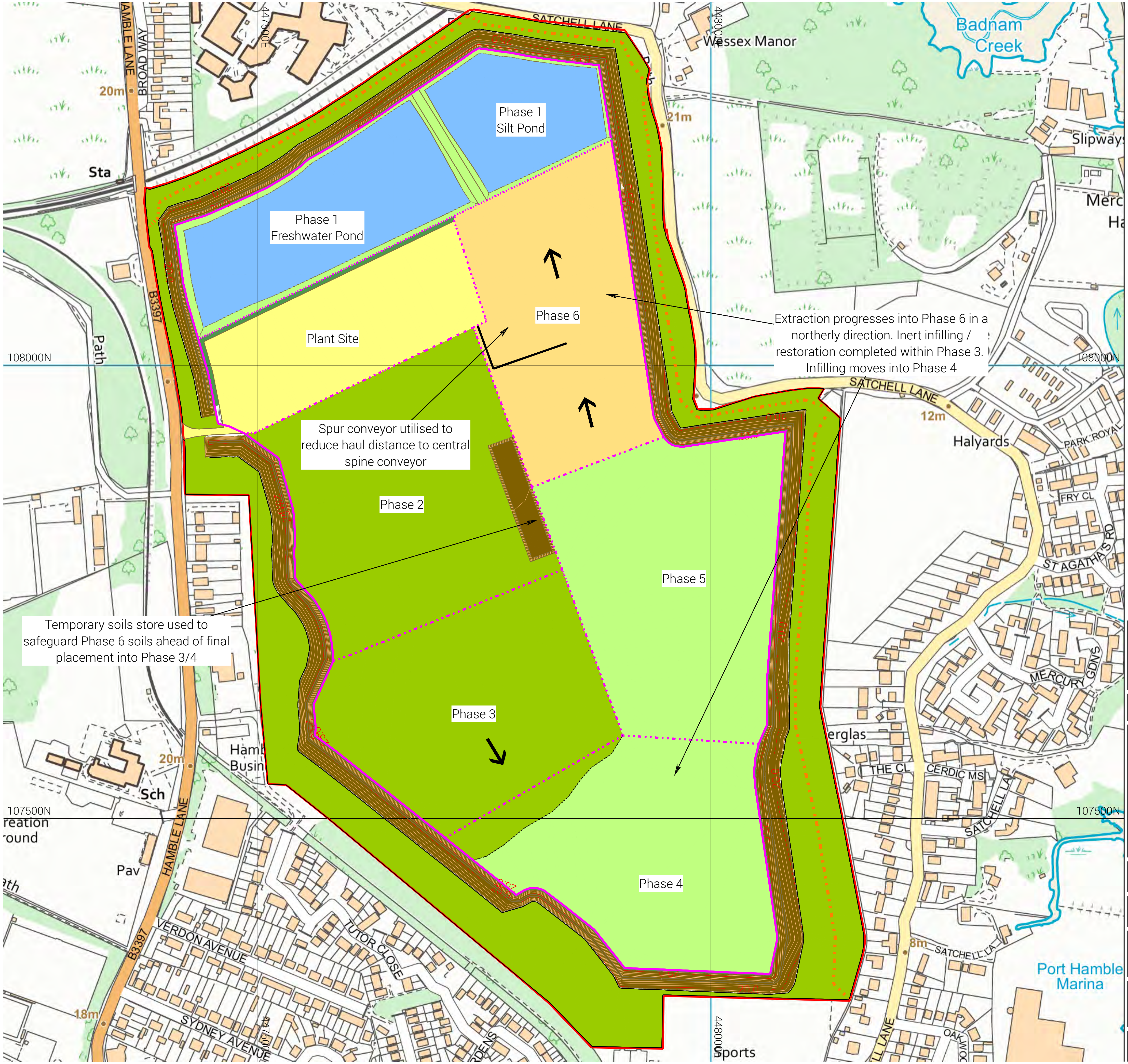
N

Models		
	Drawn from	21-10_HAMBLE_PHASE 5.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 5
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 5.LSS



Legend

- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

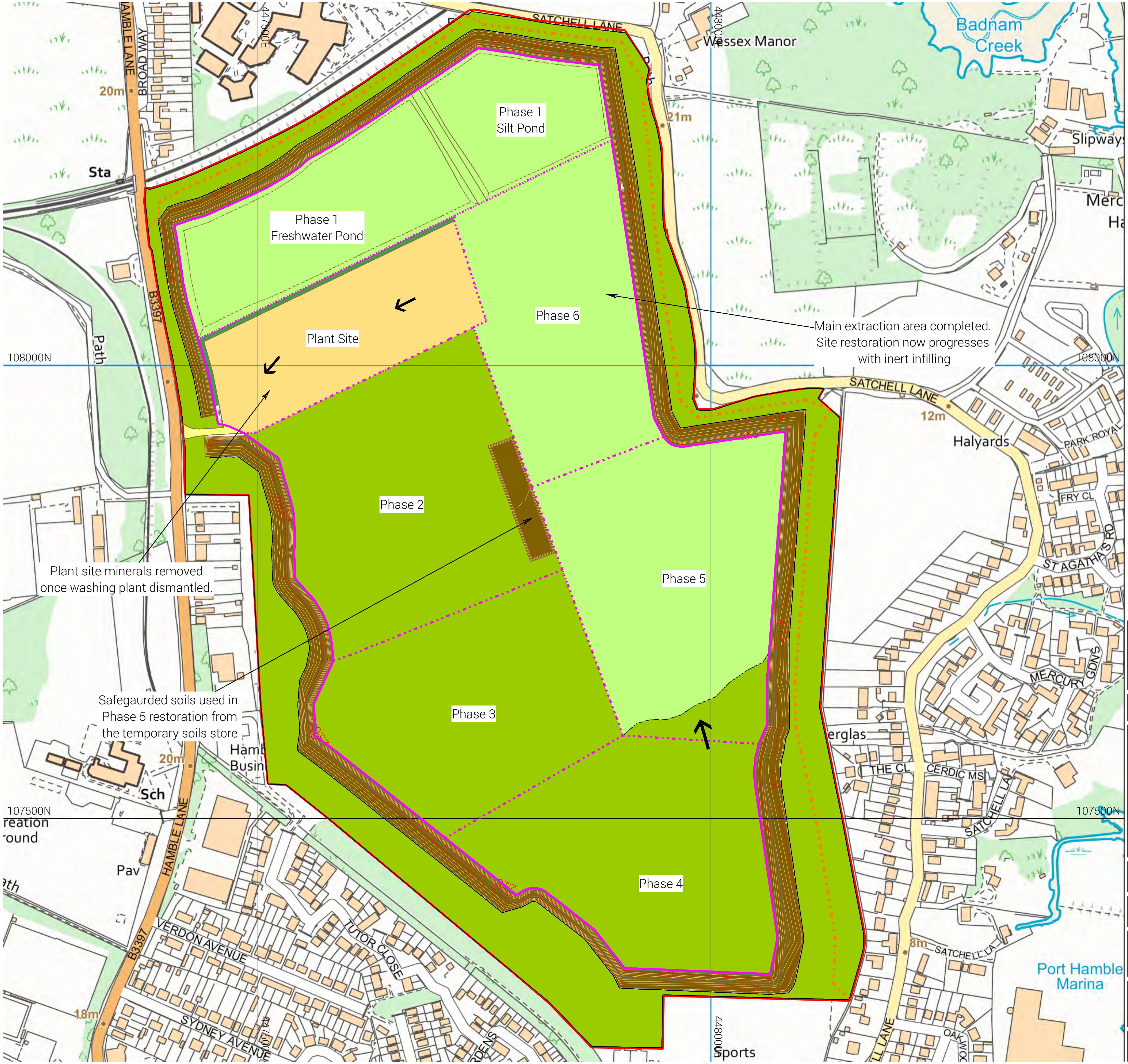
N

Models		
	Drawn from	21-10_HAMBLE_PHASE 6.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 6
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 6.LSS



Legend

- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

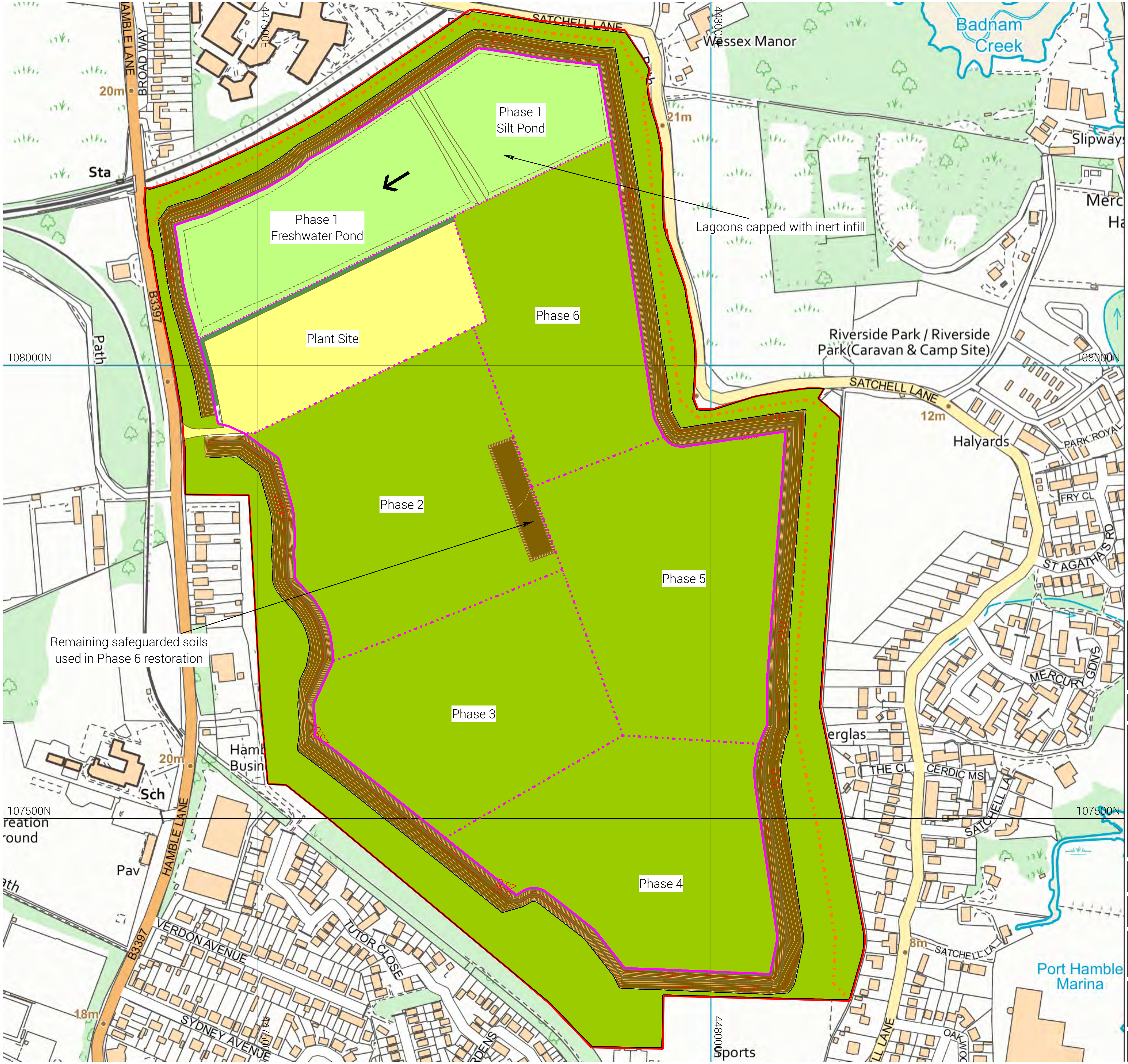
N

Models		
	Drawn from	21-10_HAMBLE_PHASE 7.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By Tom Giddings	Client CEMEX UK Operations Ltd
Date 27.10.21	Site Land at Hamble Airfield
Scale(S) 1:4000 A3	Project Sand & Gravel Extraction
Chkd/Model(s) FP 129936-028	Title Extraction Designs Phase 7
Site Ref. HAM	Drawing No. 21-10_HAMBLE_PHASE 7.LSS



Legend

- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

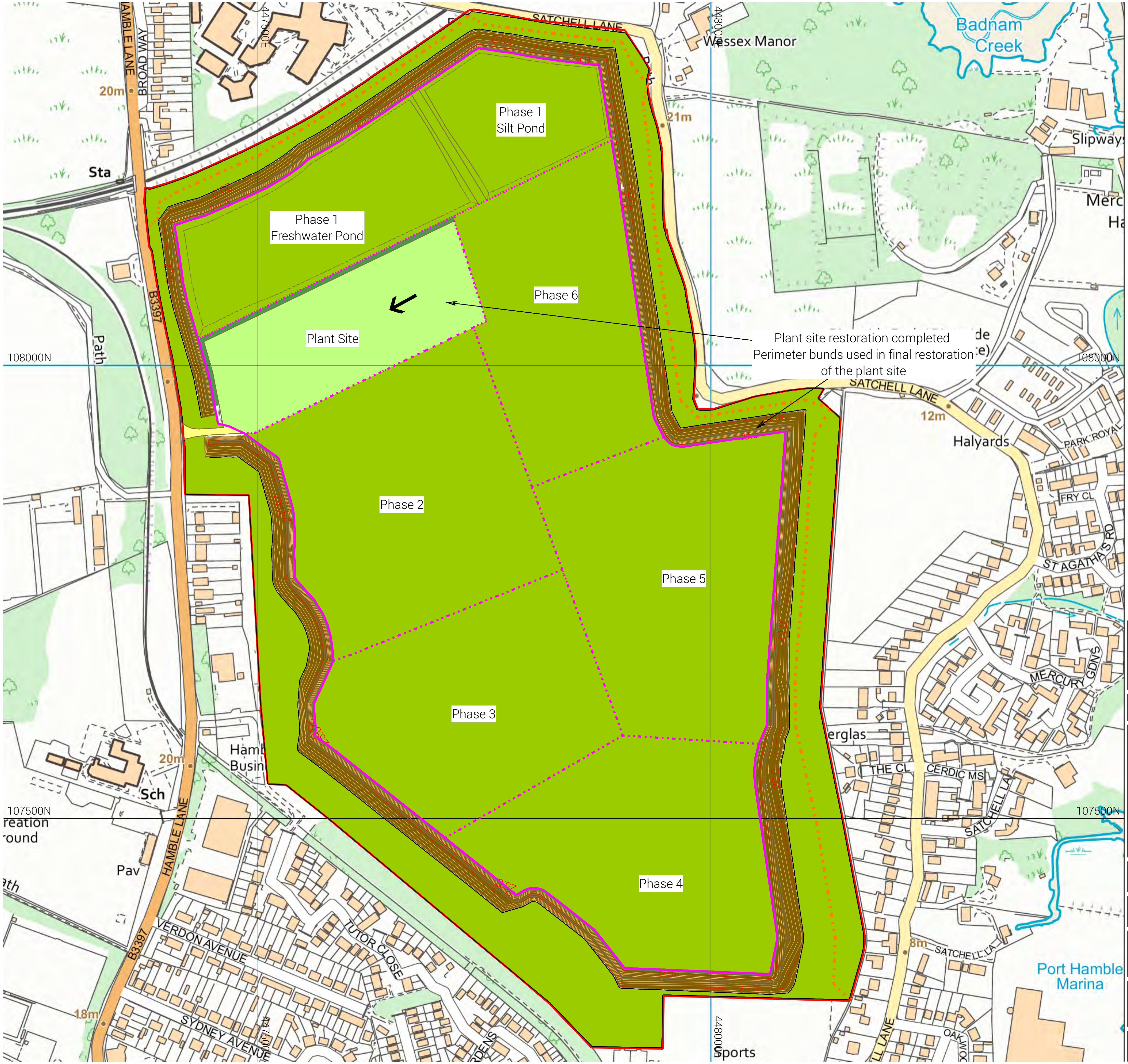
N

Models		
	Drawn from	21-10_HAMBLE_PHASE 7B.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By Tom Giddings	Client CEMEX UK Operations Ltd
Date 27.10.21	Site Land at Hamble Airfield
Scale(S) 1:4000 A3	Project Sand & Gravel Extraction
Chkd/Model(s) FP 129936-028	Title Extraction Designs Phase 7b
Site Ref. HAM	Drawing No. 21-10_HAMBLE_PHASE 7B.LSS



Legend

- Site Boundary
- Extraction Boundary
- Phase Boundary
- Conveyor Alignment
- Perimeter Path
- Area To Be Extracted
- Plant Site
- Undergoing Extraction
- Undergoing Restoration Infilling
- Restored / Final Levels
- Soils Storage Screening Bunds

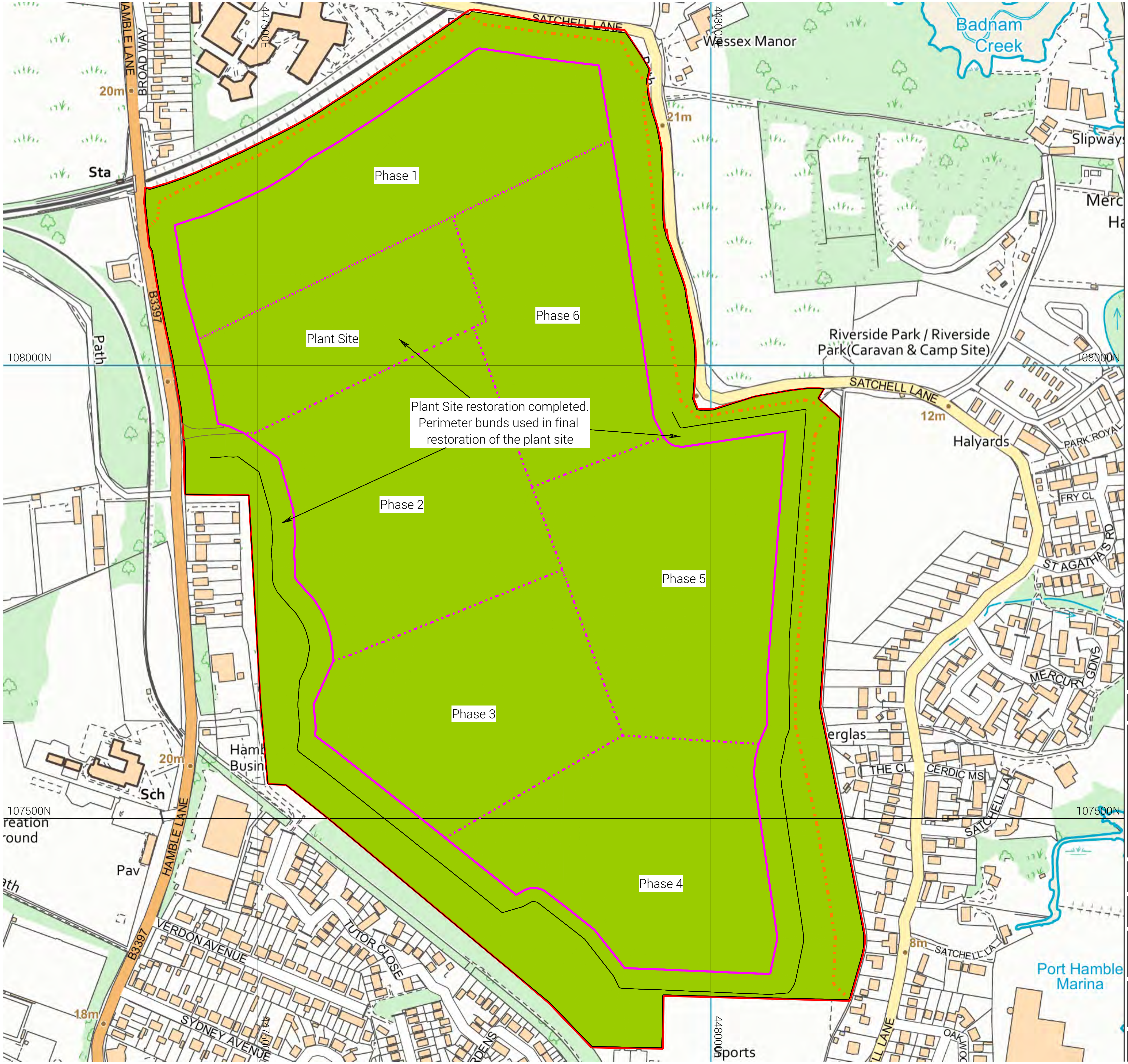
N

Models		
	Drawn from	21-10_HAMBLE_PHASE 8.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 8
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 8.LSS



Legend

Site Boundary	
Extraction Boundary	
Phase Boundary	
Conveyor Alignment	
Perimeter Path	
Area To Be Extracted	
Plant Site	
Undergoing Extraction	
Undergoing Restoration Infilling	
Restored / Final Levels	
Soils Storage Screening Bunds	

Models		
	Drawn from	21-10_HAMBLE_PHASE 9.LSS
	Overlay 1	OS Landline.LSS
	Overlay 2	
	Overlay 3	
	Overlay 4	
	Revision Notes	Method of Working : Version 4

FISHER GERMAN

Minerals Department
Fisher German LLP
The Estate Office, Norman Court
Ivanhoe Busniess Park
Ashby de la Zouch, LE65 2UZ
Telephone 01530 412821

Drawn By: Tom Giddings	Client: CEMEX UK Operations Ltd
Date: 27.10.21	Site: Land at Hamble Airfield
Scale(S): 1:4000 A3	Project: Sand & Gravel Extraction
Chkd/Model(s): FP 129936-028	Title: Extraction Designs Phase 9
Site Ref.: HAM	Drawing No.: 21-10_HAMBLE_PHASE 9.LSS

Appendix C

Site Restoration Plans

Broad Habitat Type	HABITAT TYPE	HABITAT POST RESTORATION (ha)
Woodland and forest	Lowland mixed deciduous woodland (including retained woodland areas)	2.80
Heathland and shrub	Mixed scrub	3.42
Grassland	Other lowland acid grassland - south of site	22.80
Grassland	Other lowland acid grassland - Enhancement to unworked margins	6.70
Grassland	Other lowland acid grassland - north of site	22.83
Lakes	Temporary lakes, ponds and pools	0.75
Wetland	Fens (upland and lowland)	0.74
Urban	Urban Tree	0.15
		HABITAT POST RESTORATION (linear km)
Hedgerow	New Native Species Rich Hedgerow	0.68
Hedgerow	Enhancement of Native Species Rich Hedgerow with trees	0.18
Hedgerow	Enhancement of Native Species Rich Hedgerow with trees	0.55

KEY :

- APPLICATION BOUNDARY
- EXISTING VEGETATION
- PROPOSED CONTOURS m.A.O.D (1.0m INTERVALS)
- EXISTING Public Right of Way
- PROPOSED PERMISSIVE PATH - grassed surface
- DENOTES PLANTING WHICH CAN BE CARRIED OUT AS WORKS AT START OF OPERATIONAL PHASE
- NEW NATIVE HEDGEROW (Hawthorn, Hazel, Blackthorn, Holly) Includes a proportion of Feathered trees to provide shade for grazing animals
- WOOD EDGE / DRY HEATH SHRUB SCRUB - Hawthorn, Blackthorn, Holly, Gorse, Broom; to deter access, to direct path users. Planted as small 10-100m² clumps within designated areas to give an overall 50% cover
- WOOD AND WOOD EDGE - Oak, Rowan, Birch, Hawthorn; Planted as medium 100-1000m² clumps within designated areas to give an overall 75% cover
- PROPOSED DRAINAGE INFILTRATION ZONE (Trench backfilled with permeable material)
- DENOTES GRASSLAND RETAINED AND MANAGED DURING THE OPERATIONAL PHASE; SOURCE FOR NATURAL RECOLONISATION OF ADJACENT GRASSLAND AREAS
- FOOTPATH CORRIDOR - EXISTING AND NEW HEDGEROW WITH WILDFLOWER GROUND FLORA RETAINED AND EXTENDED BY NATURAL COLONISATION
- LAND RESTORED TO GRASSLAND PADDOCK BY NATURAL COLONISATION FROM ADJACENT RETAINED GRASSLANDS OR SEEDING WITH AN APPROPRIATE MIX
- LAND RESTORED TO DRY ACID GRASSLAND BY NATURAL COLONISATION FROM ADJACENT RETAINED GRASSLANDS OR SPREADING GREEN HAY OR SEEDING WITH AN APPROPRIATE MIX
- SPECIES RICH ACID GRASSLAND - PARKLAND For Community Access
- SHALLOW POND (UP TO 1.5-2.0m) For surface water drainage - periodically dry. Marginal vegetation to establish by natural colonisation, seeding and plug planting
- FEN / MIRE ACROSS LOW LYING RESTORED AREAS (SEASONALLY WET, NATURAL COLONISATION eg: Sedges and Rushes); Microtopography - Localised Scrapes and Shallows +/- 0.3-1.0m to create additional habitat
- PROPOSED POST AND RAIL FENCING (For Main Field Areas) - Timber or Metail Estate Fencing; NB all planting and hedgerows to be timber post and stockproof wire fenced on the field side

Appendix D

ReFH2 runoff calculations
Catchment C1

UK Design Flood Estimation

Generated on Friday, January 10, 2020 12:32:11 PM by hekelly
Printed from the ReFH2 Flood Modelling software package, version 3.0.7257.30020

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: 36FD-1C7F

Site name: FEH_Point_Descriptors_447816_107820

Easting: 447816

Northing: 107820

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.32 [0.03]*

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 1 year

Summary of results

Rainfall - FEH 2013 model (mm):	22.29	Total runoff (ML):	0.82
Total Rainfall (mm):	21.60	Total flow (ML):	2.77
Peak Rainfall (mm):	1.48	Peak flow (m³/s):	0.06

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	06:05:00 [02:45:00]*	Yes
Timestep (hh:mm:ss)	00:05:00 [00:15:00]*	Yes
SCF (Seasonal correction factor)	0.98	No
ARF (Areal reduction factor)	0.99	No
Seasonality	Summer [Winter]	Yes

Loss model parameters

Name	Value	User-defined?
Cini (mm)	55.38	No
Cmax (mm)	564.32	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.9 [1.68]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	45.7 [44.18]	Yes
BR	2.4	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

UK Design Flood Estimation

Generated on Friday, January 10, 2020 12:33:20 PM by hekelly
Printed from the ReFH2 Flood Modelling software package, version 3.0.7257.30020

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: 36FD-1C7F

Site name: FEH_Point_Descriptors_447816_107820

Easting: 447816

Northing: 107820

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.32 [0.03]*

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 30 year

Summary of results

Rainfall - FEH 2013 model (mm):	47.61	Total runoff (ML):	2.06
Total Rainfall (mm):	46.13	Total flow (ML):	7.00
Peak Rainfall (mm):	3.17	Peak flow (m³/s):	0.15

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	06:05:00 [02:45:00]*	Yes
Timestep (hh:mm:ss)	00:05:00 [00:15:00]*	Yes
SCF (Seasonal correction factor)	0.98	No
ARF (Areal reduction factor)	0.99	No
Seasonality	Summer [Winter]	Yes

Loss model parameters

Name	Value	User-defined?
Cini (mm)	55.38	No
Cmax (mm)	564.32	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.9 [1.68]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	45.7 [44.18]	Yes
BR	2.39	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

UK Design Flood Estimation

Generated on Friday, January 10, 2020 12:34:06 PM by hekelly
Printed from the ReFH2 Flood Modelling software package, version 3.0.7257.30020

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: 36FD-1C7F

Site name: FEH_Point_Descriptors_447816_107820

Easting: 447816

Northing: 107820

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.32 [0.03]*

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH 2013 model (mm):	58.59	Total runoff (ML):	2.71
Total Rainfall (mm):	56.78	Total flow (ML):	9.19
Peak Rainfall (mm):	3.90	Peak flow (m³/s):	0.19

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	06:05:00 [02:45:00]*	Yes
Timestep (hh:mm:ss)	00:05:00 [00:15:00]*	Yes
SCF (Seasonal correction factor)	0.98	No
ARF (Areal reduction factor)	0.99	No
Seasonality	Summer [Winter]	Yes

Loss model parameters

Name	Value	User-defined?
Cini (mm)	55.38	No
Cmax (mm)	564.32	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.9 [1.68]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	45.7 [44.18]	Yes
BR	2.39	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Catchment C2

UK Design Flood Estimation

Generated on Friday, January 10, 2020 12:41:26 PM by hekelly
Printed from the ReFH2 Flood Modelling software package, version 3.0.7257.30020

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: 24B8-BE94

Site name: FEH_Point_Descriptors_447816_107820

Easting: 447816

Northing: 107820

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.28 [0.03]*

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 1 year

Summary of results

Rainfall - FEH 2013 model (mm):	22.29	Total runoff (ML):	0.71
Total Rainfall (mm):	21.61	Total flow (ML):	2.40
Peak Rainfall (mm):	1.48	Peak flow (m³/s):	0.05

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	06:05:00 [02:45:00]*	Yes
Timestep (hh:mm:ss)	00:05:00 [00:15:00]*	Yes
SCF (Seasonal correction factor)	0.98	No
ARF (Areal reduction factor)	0.99	No
Seasonality	Summer [Winter]	Yes

Loss model parameters

Name	Value	User-defined?
Cini (mm)	55.38	No
Cmax (mm)	564.32	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.9 [1.61]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	45.68 [43.7]	Yes
BR	2.4	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

UK Design Flood Estimation

Generated on Friday, January 10, 2020 12:40:56 PM by hekelly
Printed from the ReFH2 Flood Modelling software package, version 3.0.7257.30020

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 24B8-BE94

Site name: FEH_Point_Descriptors_447816_107820

Easting: 447816

Northing: 107820

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.28 [0.03]*

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 30 year

Summary of results

Rainfall - FEH 2013 model (mm):	47.61	Total runoff (ML):	1.79
Total Rainfall (mm):	46.16	Total flow (ML):	6.06
Peak Rainfall (mm):	3.17	Peak flow (m³/s):	0.13

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	06:05:00 [02:45:00]*	Yes
Timestep (hh:mm:ss)	00:05:00 [00:15:00]*	Yes
SCF (Seasonal correction factor)	0.98	No
ARF (Areal reduction factor)	0.99	No
Seasonality	Summer [Winter]	Yes

Loss model parameters

Name	Value	User-defined?
Cini (mm)	55.38	No
Cmax (mm)	564.32	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.9 [1.61]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	45.68 [43.7]	Yes
BR	2.39	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

UK Design Flood Estimation

Generated on Friday, January 10, 2020 12:40:04 PM by hekelly
Printed from the ReFH2 Flood Modelling software package, version 3.0.7257.30020

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: 24B8-BE94

Site name: FEH_Point_Descriptors_447816_107820

Easting: 447816

Northing: 107820

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.28 [0.03]*

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH 2013 model (mm):	58.59	Total runoff (ML):	2.35
Total Rainfall (mm):	56.82	Total flow (ML):	7.96
Peak Rainfall (mm):	3.90	Peak flow (m³/s):	0.17

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	06:05:00 [02:45:00]*	Yes
Timestep (hh:mm:ss)	00:05:00 [00:15:00]*	Yes
SCF (Seasonal correction factor)	0.98	No
ARF (Areal reduction factor)	0.99	No
Seasonality	Summer [Winter]	Yes

Loss model parameters

Name	Value	User-defined?
Cini (mm)	55.38	No
Cmax (mm)	564.32	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.9 [1.61]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	45.68 [43.7]	Yes
BR	2.39	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Catchment O1

Catchment O2

Appendix E

MicroDrainage output
Operational phase

Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 1130 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	17.038	0.038	17.7	1797.5	O K
30 min Summer	17.044	0.044	20.4	2078.6	O K
60 min Summer	17.051	0.051	23.5	2381.4	O K
120 min Summer	17.059	0.059	27.4	2780.1	O K
180 min Summer	17.065	0.065	30.2	3054.6	O K
240 min Summer	17.070	0.070	32.2	3271.1	O K
360 min Summer	17.077	0.077	35.5	3607.5	O K
480 min Summer	17.082	0.082	38.0	3857.8	O K
600 min Summer	17.086	0.086	39.9	4053.0	O K
720 min Summer	17.090	0.090	41.5	4211.4	O K
960 min Summer	17.094	0.094	43.4	4411.6	O K
1440 min Summer	17.097	0.097	45.0	4569.5	O K
2160 min Summer	17.099	0.099	45.9	4655.7	O K
2880 min Summer	17.100	0.100	46.1	4685.8	O K
4320 min Summer	17.100	0.100	46.4	4711.1	O K
5760 min Summer	17.099	0.099	45.7	4632.1	O K
7200 min Summer	17.097	0.097	45.0	4581.2	O K
8640 min Summer	17.096	0.096	44.5	4519.4	O K
15 min Winter	17.041	0.041	19.1	1934.3	O K
30 min Winter	17.047	0.047	21.8	2225.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	184.560	0.0	266
30 min Summer	105.022	0.0	286
60 min Summer	59.761	0.0	306
120 min Summer	34.006	0.0	352
180 min Summer	24.453	0.0	392
240 min Summer	19.351	0.0	432
360 min Summer	13.915	0.0	514
480 min Summer	11.011	0.0	596
600 min Summer	9.184	0.0	686
720 min Summer	7.918	0.0	768
960 min Summer	6.371	0.0	962
1440 min Summer	4.690	0.0	1440
2160 min Summer	3.453	0.0	1812
2880 min Summer	2.779	0.0	2188
4320 min Summer	1.986	0.0	3024
5760 min Summer	1.565	0.0	3864
7200 min Summer	1.301	0.0	4688
8640 min Summer	1.118	0.0	5536
15 min Winter	184.560	0.0	235
30 min Winter	105.022	0.0	255

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	17.054	0.054	25.1	2556.7	O K
120 min Winter	17.064	0.064	29.7	3027.7	O K
180 min Winter	17.071	0.071	32.9	3344.0	O K
240 min Winter	17.077	0.077	35.5	3601.0	O K
360 min Winter	17.085	0.085	39.4	4016.1	O K
480 min Winter	17.091	0.091	42.2	4280.6	O K
600 min Winter	17.095	0.095	44.1	4487.2	O K
720 min Winter	17.099	0.099	45.9	4655.4	O K
960 min Winter	17.104	0.104	48.0	4884.2	O K
1440 min Winter	17.108	0.108	50.1	5085.3	O K
2160 min Winter	17.109	0.109	50.5	5132.0	O K
2880 min Winter	17.109	0.109	50.3	5122.1	O K
4320 min Winter	17.106	0.106	49.1	5000.1	O K
5760 min Winter	17.102	0.102	47.1	4774.3	O K
7200 min Winter	17.098	0.098	45.2	4587.1	O K
8640 min Winter	17.094	0.094	43.4	4405.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	59.761	0.0	280
120 min Winter	34.006	0.0	336
180 min Winter	24.453	0.0	380
240 min Winter	19.351	0.0	420
360 min Winter	13.915	0.0	506
480 min Winter	11.011	0.0	586
600 min Winter	9.184	0.0	674
720 min Winter	7.918	0.0	754
960 min Winter	6.371	0.0	952
1440 min Winter	4.690	0.0	1384
2160 min Winter	3.453	0.0	1796
2880 min Winter	2.779	0.0	2224
4320 min Winter	1.986	0.0	3148
5760 min Winter	1.565	0.0	4032
7200 min Winter	1.301	0.0	4904
8640 min Winter	1.118	0.0	5792

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 573600 157200 TQ 73600 57200
C (1km)	-0.024
D1 (1km)	0.297
D2 (1km)	0.355
D3 (1km)	0.282
E (1km)	0.315
F (1km)	2.546
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+10

Time Area Diagram

Total Area (ha) 4.690

Time (mins) From:	To:	Area (ha)
0	4	4.690

Model Details

Storage is Online Cover Level (m) 20.000

Infiltration Basin Structure

Invert Level (m) 17.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 1.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	46859.0	3.000	57065.0

Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 719 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	17.078	0.078	56.9	3657.1	O K
30 min Summer	17.088	0.088	63.8	4110.3	O K
60 min Summer	17.098	0.098	71.5	4592.3	O K
120 min Summer	17.113	0.113	82.4	5294.5	O K
180 min Summer	17.124	0.124	90.1	5803.8	O K
240 min Summer	17.132	0.132	96.3	6202.7	O K
360 min Summer	17.145	0.145	105.8	6805.7	O K
480 min Summer	17.154	0.154	112.4	7232.5	O K
600 min Summer	17.161	0.161	117.2	7551.7	O K
720 min Summer	17.166	0.166	120.8	7791.6	O K
960 min Summer	17.175	0.175	127.4	8203.8	O K
1440 min Summer	17.184	0.184	134.0	8622.8	O K
2160 min Summer	17.186	0.186	135.9	8746.5	O K
2880 min Summer	17.190	0.190	138.4	8927.2	O K
4320 min Summer	17.187	0.187	136.6	8810.9	O K
5760 min Summer	17.189	0.189	138.1	8899.4	O K
7200 min Summer	17.184	0.184	134.0	8640.9	O K
8640 min Summer	17.178	0.178	130.0	8368.8	O K
15 min Winter	17.072	0.072	52.5	3366.0	O K
30 min Winter	17.082	0.082	59.8	3852.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	113.582	0.0	203
30 min Summer	70.326	0.0	210
60 min Summer	43.543	0.0	228
120 min Summer	26.960	0.0	266
180 min Summer	20.368	0.0	308
240 min Summer	16.693	0.0	354
360 min Summer	12.611	0.0	452
480 min Summer	10.336	0.0	556
600 min Summer	8.858	0.0	664
720 min Summer	7.808	0.0	776
960 min Summer	6.193	0.0	990
1440 min Summer	4.467	0.0	1440
2160 min Summer	3.222	0.0	1788
2880 min Summer	2.556	0.0	2164
4320 min Summer	1.903	0.0	2972
5760 min Summer	1.543	0.0	3792
7200 min Summer	1.312	0.0	4608
8640 min Summer	1.149	0.0	5416
15 min Winter	113.582	0.0	203
30 min Winter	70.326	0.0	210

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	17.095	0.095	69.3	4443.1	O K
120 min Winter	17.118	0.118	85.7	5522.0	O K
180 min Winter	17.133	0.133	96.7	6213.9	O K
240 min Winter	17.145	0.145	105.5	6786.2	O K
360 min Winter	17.164	0.164	119.7	7719.1	O K
480 min Winter	17.174	0.174	127.1	8178.5	O K
600 min Winter	17.181	0.181	132.2	8518.9	O K
720 min Winter	17.187	0.187	136.2	8773.7	O K
960 min Winter	17.195	0.195	142.5	9175.8	O K
1440 min Winter	17.203	0.203	148.0	9548.6	O K
2160 min Winter	17.202	0.202	147.2	9490.7	O K
2880 min Winter	17.201	0.201	146.9	9454.4	O K
4320 min Winter	17.190	0.190	138.4	8921.0	O K
5760 min Winter	17.183	0.183	133.7	8617.4	O K
7200 min Winter	17.172	0.172	125.2	8056.3	O K
8640 min Winter	17.161	0.161	117.2	7550.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	43.543	0.0	226
120 min Winter	26.960	0.0	266
180 min Winter	20.368	0.0	306
240 min Winter	16.693	0.0	352
360 min Winter	12.611	0.0	446
480 min Winter	10.336	0.0	544
600 min Winter	8.858	0.0	648
720 min Winter	7.808	0.0	752
960 min Winter	6.193	0.0	960
1440 min Winter	4.467	0.0	1372
2160 min Winter	3.222	0.0	1728
2880 min Winter	2.556	0.0	2180
4320 min Winter	1.903	0.0	3068
5760 min Winter	1.543	0.0	3928
7200 min Winter	1.312	0.0	4760
8640 min Winter	1.149	0.0	5600

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+10

Time Area Diagram

Total Area (ha) 4.650

Time From:	(mins) To:	Area (ha)
0	4	4.650

Model Details

Storage is Online Cover Level (m) 20.000

Infiltration Basin Structure

Invert Level (m) 17.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 1.00000

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	46515.0	3.000	63314.0

Restored phase

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 6 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	20.488	0.788	19.7	9.3	O K
30 min Summer	20.586	0.886	23.3	11.8	O K
60 min Summer	20.616	0.916	24.5	12.6	O K
120 min Summer	20.697	0.997	27.8	14.9	O K
180 min Summer	20.734	1.034	29.4	16.0	O K
240 min Summer	20.753	1.053	30.2	16.6	O K
360 min Summer	20.771	1.071	30.9	17.2	O K
480 min Summer	20.776	1.076	31.2	17.4	O K
600 min Summer	20.776	1.076	31.2	17.4	O K
720 min Summer	20.773	1.073	31.0	17.3	O K
960 min Summer	20.724	1.024	28.9	15.7	O K
1440 min Summer	20.643	0.943	25.6	13.3	O K
2160 min Summer	20.562	0.862	22.4	11.1	O K
2880 min Summer	20.493	0.793	19.9	9.4	O K
4320 min Summer	20.426	0.726	17.5	7.9	O K
5760 min Summer	20.367	0.667	15.5	6.7	O K
7200 min Summer	20.333	0.633	14.4	6.0	O K
8640 min Summer	20.305	0.605	13.6	5.5	O K
15 min Winter	20.442	0.742	18.0	8.3	O K
30 min Winter	20.523	0.823	21.0	10.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	122
30 min Summer	89.506	0.0	133
60 min Summer	55.419	0.0	150
120 min Summer	34.313	0.0	182
180 min Summer	25.923	0.0	214
240 min Summer	21.246	0.0	248
360 min Summer	16.050	0.0	314
480 min Summer	13.155	0.0	380
600 min Summer	11.273	0.0	446
720 min Summer	9.938	0.0	512
960 min Summer	7.882	0.0	642
1440 min Summer	5.686	0.0	898
2160 min Summer	4.101	0.0	1280
2880 min Summer	3.253	0.0	1652
4320 min Summer	2.422	0.0	2408
5760 min Summer	1.964	0.0	3160
7200 min Summer	1.670	0.0	3912
8640 min Summer	1.463	0.0	4608
15 min Winter	144.558	0.0	122
30 min Winter	89.506	0.0	132

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	20.564	0.864	22.5	11.2	O K
120 min Winter	20.683	0.983	27.2	14.5	O K
180 min Winter	20.736	1.036	29.4	16.1	O K
240 min Winter	20.769	1.069	30.9	17.1	O K
360 min Winter	20.807	1.107	32.6	18.4	O K
480 min Winter	20.793	1.093	31.9	17.9	O K
600 min Winter	20.773	1.073	31.1	17.3	O K
720 min Winter	20.753	1.053	30.2	16.6	O K
960 min Winter	20.685	0.985	27.3	14.5	O K
1440 min Winter	20.580	0.880	23.1	11.6	O K
2160 min Winter	20.470	0.770	19.0	8.9	O K
2880 min Winter	20.392	0.692	16.4	7.2	O K
4320 min Winter	20.313	0.613	13.8	5.6	O K
5760 min Winter	20.254	0.554	12.0	4.6	O K
7200 min Winter	20.219	0.519	11.0	4.0	O K
8640 min Winter	20.191	0.491	10.2	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	55.419	0.0	150
120 min Winter	34.313	0.0	184
180 min Winter	25.923	0.0	218
240 min Winter	21.246	0.0	254
360 min Winter	16.050	0.0	324
480 min Winter	13.155	0.0	390
600 min Winter	11.273	0.0	460
720 min Winter	9.938	0.0	528
960 min Winter	7.882	0.0	662
1440 min Winter	5.686	0.0	928
2160 min Winter	4.101	0.0	1324
2880 min Winter	3.253	0.0	1728
4320 min Winter	2.422	0.0	2532
5760 min Winter	1.964	0.0	3336
7200 min Winter	1.670	0.0	4160
8640 min Winter	1.463	0.0	4944

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Model Details

Storage is Online Cover Level (m) 21.700

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	1.00000	Trench Width (m)	1.0
Infiltration Coefficient Side (m/hr)	1.00000	Trench Length (m)	215.0
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	19.700	Cap Infiltration Depth (m)	0.000

Cascade Summary of Results for Restored - Pond 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Restored - IT2.SRCX	Restored - IT2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	17.288	0.288	77.0	1390.9	O K
30 min Summer	17.341	0.341	98.8	1655.0	O K
60 min Summer	17.389	0.389	116.5	1905.7	O K
120 min Summer	17.502	0.502	123.7	2496.5	O K
180 min Summer	17.599	0.599	124.9	3022.6	O K
240 min Summer	17.683	0.683	125.0	3487.6	O K
360 min Summer	17.821	0.821	125.0	4280.7	O K
480 min Summer	17.926	0.926	125.0	4900.2	O K
600 min Summer	18.012	1.012	125.0	5420.5	O K
720 min Summer	18.079	1.079	125.0	5834.3	O K
960 min Summer	18.104	1.104	125.0	5989.4	O K
1440 min Summer	18.101	1.101	125.0	5973.5	O K
2160 min Summer	18.092	1.092	125.0	5912.7	O K
2880 min Summer	18.058	1.058	125.0	5705.8	O K
4320 min Summer	18.078	1.078	125.0	5825.5	O K
5760 min Summer	18.028	1.028	125.0	5515.3	O K
7200 min Summer	18.004	1.004	125.0	5369.6	O K
8640 min Summer	17.961	0.961	125.0	5107.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	2699.4	264
30 min Summer	89.506	0.0	3355.0	266
60 min Summer	55.419	0.0	4890.7	282
120 min Summer	34.313	0.0	6197.6	344
180 min Summer	25.923	0.0	7205.4	396
240 min Summer	21.246	0.0	8070.8	444
360 min Summer	16.050	0.0	9552.0	538
480 min Summer	13.155	0.0	10759.6	634
600 min Summer	11.273	0.0	11811.9	738
720 min Summer	9.938	0.0	12746.1	842
960 min Summer	7.882	0.0	13575.3	1062
1440 min Summer	5.686	0.0	14573.7	1476
2160 min Summer	4.101	0.0	19403.4	1880
2880 min Summer	3.253	0.0	20908.7	2284
4320 min Summer	2.422	0.0	24065.9	3148
5760 min Summer	1.964	0.0	29197.6	4024
7200 min Summer	1.670	0.0	32183.8	4888
8640 min Summer	1.463	0.0	34715.4	5712

Cascade Summary of Results for Restored - Pond 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	17.275	0.275	71.4	1321.3	O K
30 min Winter	17.321	0.321	90.5	1554.2	O K
60 min Winter	17.374	0.374	111.1	1824.2	O K
120 min Winter	17.522	0.522	124.1	2604.5	O K
180 min Winter	17.643	0.643	125.0	3266.3	O K
240 min Winter	17.753	0.753	125.0	3883.5	O K
360 min Winter	17.947	0.947	125.0	5021.9	O K
480 min Winter	18.047	1.047	125.0	5632.1	O K
600 min Winter	18.120	1.120	125.0	6087.6	O K
720 min Winter	18.177	1.177	125.0	6453.1	O K
960 min Winter	18.199	1.199	125.0	6593.5	O K
1440 min Winter	18.196	1.196	125.0	6573.4	O K
2160 min Winter	18.132	1.132	125.0	6166.7	O K
2880 min Winter	18.047	1.047	125.0	5635.9	O K
4320 min Winter	17.927	0.927	125.0	4901.7	O K
5760 min Winter	17.736	0.736	125.0	3788.9	O K
7200 min Winter	17.614	0.614	125.0	3104.6	O K
8640 min Winter	17.515	0.515	124.0	2569.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	144.558	0.0	2652.4	270
30 min Winter	89.506	0.0	3232.2	270
60 min Winter	55.419	0.0	4893.7	282
120 min Winter	34.313	0.0	6637.8	346
180 min Winter	25.923	0.0	7869.3	400
240 min Winter	21.246	0.0	8976.6	450
360 min Winter	16.050	0.0	10974.8	552
480 min Winter	13.155	0.0	12173.9	644
600 min Winter	11.273	0.0	13209.0	738
720 min Winter	9.938	0.0	14124.3	838
960 min Winter	7.882	0.0	15015.6	1046
1440 min Winter	5.686	0.0	16105.4	1460
2160 min Winter	4.101	0.0	21027.2	1900
2880 min Winter	3.253	0.0	22337.2	2356
4320 min Winter	2.422	0.0	24993.1	3264
5760 min Winter	1.964	0.0	29480.1	4032
7200 min Winter	1.670	0.0	31927.6	4800
8640 min Winter	1.463	0.0	33970.1	5528

Cascade Rainfall Details for Restored - Pond 1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Cascade Model Details for Restored - Pond 1.SRCX

Storage is Online Cover Level (m) 18.500

Tank or Pond Structure

Invert Level (m) 17.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4619.0	1.500	6930.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0431-1250-1200-1250
Design Head (m)	1.200
Design Flow (l/s)	125.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	431
Invert Level (m)	17.000
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	124.9
Flush-Flo™	0.615	125.0
Kick-Flo®	0.989	113.8
Mean Flow over Head Range	-	97.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	11.5	1.200	124.9	3.000	195.3	7.000	296.0
0.200	41.6	1.400	134.7	3.500	210.6	7.500	306.2
0.300	81.9	1.600	143.7	4.000	224.9	8.000	316.0
0.400	119.8	1.800	152.2	4.500	238.3	8.500	325.6
0.500	123.7	2.000	160.2	5.000	250.9	9.000	334.9
0.600	125.0	2.200	167.9	5.500	262.9	9.500	343.9
0.800	122.4	2.400	175.1	6.000	274.4		
1.000	114.3	2.600	182.1	6.500	285.4		

Cascade Summary of Results for Restored - IT2.SRCX

Upstream Structures	Outflow To	Overflow To
Restored - Pond 1.SRCX	(None)	(None)

Half Drain Time : 9 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	16.548	1.248	76.7	0.0	76.7	57.7	O K
30 min Summer	17.016	1.716	98.2	0.0	98.2	80.9	O K
60 min Summer	17.401	2.101	116.0	0.0	116.0	99.9	O K
120 min Summer	17.567	2.267	123.7	0.0	123.7	108.1	O K
180 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
240 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
360 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
480 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
600 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
720 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
960 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
1440 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
2160 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
2880 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
4320 min Summer	17.595	2.295	124.9	0.0	124.9	109.5	O K
5760 min Summer	17.596	2.296	125.0	0.0	125.0	109.5	O K
7200 min Summer	17.596	2.296	125.0	0.0	125.0	109.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	0.0	284
30 min Summer	89.506	0.0	0.0	285
60 min Summer	55.419	0.0	0.0	302
120 min Summer	34.313	0.0	0.0	362
180 min Summer	25.923	0.0	0.0	406
240 min Summer	21.246	0.0	0.0	584
360 min Summer	16.050	0.0	0.0	850
480 min Summer	13.155	0.0	0.0	1100
600 min Summer	11.273	0.0	0.0	1346
720 min Summer	9.938	0.0	0.0	1562
960 min Summer	7.882	0.0	0.0	1822
1440 min Summer	5.686	0.0	0.0	2266
2160 min Summer	4.101	0.0	0.0	2896
2880 min Summer	3.253	0.0	0.0	3440
4320 min Summer	2.422	0.0	0.0	4588
5760 min Summer	1.964	0.0	0.0	5344
7200 min Summer	1.670	0.0	0.0	6136

Cascade Summary of Results for Restored - IT2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	17.596	2.296	125.0	0.0	125.0	109.5	O K
15 min Winter	16.424	1.124	71.0	0.0	71.0	51.6	O K
30 min Winter	16.839	1.539	90.1	0.0	90.1	72.1	O K
60 min Winter	17.284	1.984	110.6	0.0	110.6	94.1	O K
120 min Winter	17.577	2.277	124.1	0.0	124.1	108.6	O K
180 min Winter	17.596	2.296	125.0	0.0	125.0	109.5	O K
240 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
360 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
480 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
600 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
720 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
960 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
1440 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
2160 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
2880 min Winter	17.595	2.295	124.9	0.0	124.9	109.5	O K
4320 min Winter	17.596	2.296	125.0	0.0	125.0	109.5	O K
5760 min Winter	17.596	2.296	125.0	0.0	125.0	109.5	O K
7200 min Winter	17.596	2.296	125.0	0.0	125.0	109.6	O K
8640 min Winter	17.575	2.275	124.0	0.0	124.0	108.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	1.463	0.0	0.0	6840
15 min Winter	144.558	0.0	0.0	287
30 min Winter	89.506	0.0	0.0	291
60 min Winter	55.419	0.0	0.0	302
120 min Winter	34.313	0.0	0.0	366
180 min Winter	25.923	0.0	0.0	478
240 min Winter	21.246	0.0	0.0	674
360 min Winter	16.050	0.0	0.0	1046
480 min Winter	13.155	0.0	0.0	1308
600 min Winter	11.273	0.0	0.0	1526
720 min Winter	9.938	0.0	0.0	1722
960 min Winter	7.882	0.0	0.0	1970
1440 min Winter	5.686	0.0	0.0	2402
2160 min Winter	4.101	0.0	0.0	2944
2880 min Winter	3.253	0.0	0.0	3416
4320 min Winter	2.422	0.0	0.0	2512
5760 min Winter	1.964	0.0	0.0	4584
7200 min Winter	1.670	0.0	0.0	4880
8640 min Winter	1.463	0.0	0.0	5552

Cascade Rainfall Details for Restored - IT2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Cascade Model Details for Restored - IT2.SRCX

Storage is Online Cover Level (m) 18.300

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	1.00000	Trench Width (m)	1.0
Infiltration Coefficient Side (m/hr)	1.00000	Trench Length (m)	165.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	15.300	Cap Infiltration Depth (m)	0.000

Weir Overflow Control

Discharge Coef 0.544 Width (m) 75.000 Invert Level (m) 17.950

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 6 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	17.776	0.776	19.2	9.0	O K
30 min Summer	17.872	0.872	22.8	11.4	O K
60 min Summer	17.901	0.901	23.9	12.2	O K
120 min Summer	17.981	0.981	27.1	14.4	O K
180 min Summer	18.018	1.018	28.7	15.6	O K
240 min Summer	18.037	1.037	29.5	16.1	O K
360 min Summer	18.055	1.055	30.3	16.7	O K
480 min Summer	18.061	1.061	30.5	16.9	O K
600 min Summer	18.061	1.061	30.5	16.9	O K
720 min Summer	18.059	1.059	30.4	16.8	O K
960 min Summer	18.011	1.011	28.4	15.3	O K
1440 min Summer	17.932	0.932	25.1	13.0	O K
2160 min Summer	17.853	0.853	22.1	10.9	O K
2880 min Summer	17.786	0.786	19.6	9.3	O K
4320 min Summer	17.721	0.721	17.3	7.8	O K
5760 min Summer	17.664	0.664	15.4	6.6	O K
7200 min Summer	17.631	0.631	14.4	6.0	O K
8640 min Summer	17.605	0.605	13.6	5.5	O K
15 min Winter	17.722	0.722	17.4	7.8	O K
30 min Winter	17.801	0.801	20.1	9.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	122
30 min Summer	89.506	0.0	133
60 min Summer	55.419	0.0	150
120 min Summer	34.313	0.0	182
180 min Summer	25.923	0.0	214
240 min Summer	21.246	0.0	248
360 min Summer	16.050	0.0	316
480 min Summer	13.155	0.0	380
600 min Summer	11.273	0.0	446
720 min Summer	9.938	0.0	512
960 min Summer	7.882	0.0	644
1440 min Summer	5.686	0.0	900
2160 min Summer	4.101	0.0	1284
2880 min Summer	3.253	0.0	1652
4320 min Summer	2.422	0.0	2408
5760 min Summer	1.964	0.0	3168
7200 min Summer	1.670	0.0	3912
8640 min Summer	1.463	0.0	4680
15 min Winter	144.558	0.0	122
30 min Winter	89.506	0.0	132

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	17.840	0.840	21.6	10.6	O K
120 min Winter	17.957	0.957	26.1	13.7	O K
180 min Winter	18.008	1.008	28.3	15.3	O K
240 min Winter	18.041	1.041	29.7	16.3	O K
360 min Winter	18.080	1.080	31.3	17.5	O K
480 min Winter	18.066	1.066	30.7	17.1	O K
600 min Winter	18.048	1.048	30.0	16.5	O K
720 min Winter	18.029	1.029	29.2	15.9	O K
960 min Winter	17.964	0.964	26.4	13.9	O K
1440 min Winter	17.862	0.862	22.4	11.2	O K
2160 min Winter	17.756	0.756	18.6	8.6	O K
2880 min Winter	17.682	0.682	16.0	7.0	O K
4320 min Winter	17.607	0.607	13.6	5.5	O K
5760 min Winter	17.550	0.550	11.9	4.5	O K
7200 min Winter	17.517	0.517	11.0	4.0	O K
8640 min Winter	17.491	0.491	10.2	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	55.419	0.0	150
120 min Winter	34.313	0.0	184
180 min Winter	25.923	0.0	218
240 min Winter	21.246	0.0	254
360 min Winter	16.050	0.0	324
480 min Winter	13.155	0.0	392
600 min Winter	11.273	0.0	460
720 min Winter	9.938	0.0	530
960 min Winter	7.882	0.0	662
1440 min Winter	5.686	0.0	930
2160 min Winter	4.101	0.0	1332
2880 min Winter	3.253	0.0	1728
4320 min Winter	2.422	0.0	2540
5760 min Winter	1.964	0.0	3344
7200 min Winter	1.670	0.0	4200
8640 min Winter	1.463	0.0	5016

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Model Details

Storage is Online Cover Level (m) 19.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	1.00000	Trench Width (m)	1.0
Infiltration Coefficient Side (m/hr)	1.00000	Trench Length (m)	168.0
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	17.000	Cap Infiltration Depth (m)	0.000

Cascade Summary of Results for Restored - Pond 2.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Restored - IT4.SRCX	Restored - IT4.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	15.376	0.376	132.4	212.6	O K
30 min Summer	15.431	0.431	158.6	248.9	O K
60 min Summer	15.461	0.461	168.4	269.7	O K
120 min Summer	15.572	0.572	173.4	349.2	O K
180 min Summer	15.683	0.683	174.8	434.4	O K
240 min Summer	15.780	0.780	174.8	513.9	O K
360 min Summer	15.932	0.932	174.8	649.6	O K
480 min Summer	16.032	1.032	174.8	745.3	O K
600 min Summer	16.081	1.081	174.8	794.1	O K
720 min Summer	16.110	1.110	174.8	823.4	O K
960 min Summer	15.979	0.979	174.8	694.1	O K
1440 min Summer	15.708	0.708	174.8	454.7	O K
2160 min Summer	15.491	0.491	170.2	290.6	O K
2880 min Summer	15.422	0.422	154.9	243.2	O K
4320 min Summer	15.382	0.382	135.8	217.0	O K
5760 min Summer	15.352	0.352	120.0	197.4	O K
7200 min Summer	15.334	0.334	111.0	186.1	O K
8640 min Summer	15.321	0.321	104.3	177.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	1751.2	125
30 min Summer	89.506	0.0	2139.7	136
60 min Summer	55.419	0.0	2924.2	156
120 min Summer	34.313	0.0	3677.2	212
180 min Summer	25.923	0.0	4257.2	266
240 min Summer	21.246	0.0	4755.2	316
360 min Summer	16.050	0.0	5607.7	414
480 min Summer	13.155	0.0	6304.0	504
600 min Summer	11.273	0.0	6912.5	572
720 min Summer	9.938	0.0	7455.6	636
960 min Summer	7.882	0.0	7952.6	762
1440 min Summer	5.686	0.0	8631.3	984
2160 min Summer	4.101	0.0	11086.8	1324
2880 min Summer	3.253	0.0	11962.4	1664
4320 min Summer	2.422	0.0	13831.7	2412
5760 min Summer	1.964	0.0	16496.6	3168
7200 min Summer	1.670	0.0	18200.5	3912
8640 min Summer	1.463	0.0	19662.5	4624

Cascade Summary of Results for Restored - Pond 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	15.355	0.355	121.8	199.6	O K
30 min Winter	15.402	0.402	145.4	229.7	O K
60 min Winter	15.437	0.437	161.2	253.0	O K
120 min Winter	15.589	0.589	173.8	361.4	O K
180 min Winter	15.742	0.742	174.8	482.7	O K
240 min Winter	15.897	0.897	174.8	616.8	O K
360 min Winter	16.150	1.150	174.8	865.9	O K
480 min Winter	16.180	1.180	174.8	897.0	O K
600 min Winter	16.175	1.175	174.8	891.7	O K
720 min Winter	16.155	1.155	174.8	870.7	O K
960 min Winter	15.924	0.924	174.8	642.2	O K
1440 min Winter	15.544	0.544	172.5	328.1	O K
2160 min Winter	15.407	0.407	148.0	233.4	O K
2880 min Winter	15.365	0.365	126.7	205.4	O K
4320 min Winter	15.324	0.324	105.8	179.8	O K
5760 min Winter	15.296	0.296	91.4	162.4	O K
7200 min Winter	15.279	0.279	82.8	152.3	O K
8640 min Winter	15.267	0.267	76.6	144.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	144.558	0.0	1743.6	125
30 min Winter	89.506	0.0	2087.2	136
60 min Winter	55.419	0.0	2942.7	154
120 min Winter	34.313	0.0	3946.8	214
180 min Winter	25.923	0.0	4655.0	270
240 min Winter	21.246	0.0	5291.5	328
360 min Winter	16.050	0.0	6440.0	426
480 min Winter	13.155	0.0	7131.9	504
600 min Winter	11.273	0.0	7731.8	576
720 min Winter	9.938	0.0	8266.3	646
960 min Winter	7.882	0.0	8805.6	776
1440 min Winter	5.686	0.0	9596.6	988
2160 min Winter	4.101	0.0	12026.8	1332
2880 min Winter	3.253	0.0	12791.8	1724
4320 min Winter	2.422	0.0	14368.3	2520
5760 min Winter	1.964	0.0	16684.8	3312
7200 min Winter	1.670	0.0	18085.7	4152
8640 min Winter	1.463	0.0	19270.4	4912

Cascade Rainfall Details for Restored - Pond 2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Cascade Model Details for Restored - Pond 2.SRCX

Storage is Online Cover Level (m) 16.500

Tank or Pond Structure

Invert Level (m) 15.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	487.0	1.500	1270.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0496-1750-1200-1750
Design Head (m)	1.200
Design Flow (l/s)	175.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	496
Invert Level (m)	15.000
Minimum Outlet Pipe Diameter (mm)	Site Specific Design (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	175.0
Flush-Flo™	0.677	174.8
Kick-Flo®	1.025	162.1
Mean Flow over Head Range	-	131.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	12.5	1.200	175.0	3.000	273.9	7.000	415.3
0.200	46.1	1.400	188.6	3.500	295.4	7.500	429.6
0.300	93.3	1.600	201.3	4.000	315.4	8.000	443.5
0.400	144.6	1.800	213.3	4.500	334.2	8.500	457.0
0.500	170.6	2.000	224.5	5.000	351.9	9.000	470.0
0.600	174.1	2.200	235.3	5.500	368.8	9.500	482.7
0.800	173.2	2.400	245.5	6.000	384.9		
1.000	164.0	2.600	255.3	6.500	400.4		

Cascade Summary of Results for Restored - IT4.SRCX

Upstream Structures	Outflow To	Overflow To
Restored - Pond 2.SRCX	(None)	(None)

Half Drain Time : 10 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	15.197	1.897	114.0	0.0	114.0	96.1	O K
30 min Summer	15.721	2.421	139.9	0.0	139.9	123.8	O K
60 min Summer	15.953	2.653	151.4	23.7	175.1	136.2	O K
120 min Summer	15.954	2.654	151.4	29.3	180.8	136.4	O K
180 min Summer	15.954	2.654	151.4	35.4	186.9	136.3	O K
240 min Summer	15.954	2.654	151.4	35.4	186.9	136.4	O K
360 min Summer	15.954	2.654	151.4	35.4	186.9	136.4	O K
480 min Summer	15.954	2.654	151.4	35.4	186.9	136.4	O K
600 min Summer	15.954	2.654	151.4	35.4	186.9	136.4	O K
720 min Summer	15.954	2.654	151.4	35.4	186.9	136.4	O K
960 min Summer	15.954	2.654	151.4	35.4	186.9	136.4	O K
1440 min Summer	15.954	2.654	151.4	35.4	186.9	136.4	O K
2160 min Summer	15.954	2.654	151.4	29.3	180.8	136.5	O K
2880 min Summer	15.951	2.651	151.3	5.6	156.9	136.2	O K
4320 min Summer	15.635	2.335	135.6	0.0	135.6	119.3	O K
5760 min Summer	15.317	2.017	119.9	0.0	119.9	102.4	O K
7200 min Summer	15.136	1.836	111.0	0.0	111.0	92.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	0.0	144
30 min Summer	89.506	0.0	0.0	156
60 min Summer	55.419	0.0	13.4	176
120 min Summer	34.313	0.0	107.1	238
180 min Summer	25.923	0.0	185.4	260
240 min Summer	21.246	0.0	244.2	318
360 min Summer	16.050	0.0	306.9	310
480 min Summer	13.155	0.0	317.4	620
600 min Summer	11.273	0.0	355.0	420
720 min Summer	9.938	0.0	394.1	470
960 min Summer	7.882	0.0	399.3	616
1440 min Summer	5.686	0.0	364.3	926
2160 min Summer	4.101	0.0	198.5	1292
2880 min Summer	3.253	0.0	14.1	1664
4320 min Summer	2.422	0.0	0.0	2428
5760 min Summer	1.964	0.0	0.0	3176
7200 min Summer	1.670	0.0	0.0	3928

Cascade Summary of Results for Restored - IT4.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	14.995	1.695	104.0	0.0	104.0	85.3	O K
15 min Winter	15.025	1.725	105.5	0.0	105.5	86.9	O K
30 min Winter	15.489	2.189	128.5	0.0	128.5	111.6	O K
60 min Winter	15.918	2.618	149.6	0.0	149.6	134.3	O K
120 min Winter	15.954	2.654	151.4	35.4	186.9	136.3	O K
180 min Winter	15.954	2.654	151.4	35.4	186.9	136.4	O K
240 min Winter	15.954	2.654	151.4	29.3	180.8	136.4	O K
360 min Winter	15.954	2.654	151.4	29.3	180.8	136.4	O K
480 min Winter	15.954	2.654	151.4	35.4	186.9	136.4	O K
600 min Winter	15.954	2.654	151.4	29.3	180.8	136.4	O K
720 min Winter	15.954	2.654	151.4	35.4	186.9	136.4	O K
960 min Winter	15.954	2.654	151.4	35.4	186.9	136.4	O K
1440 min Winter	15.954	2.654	151.4	29.3	180.8	136.4	O K
2160 min Winter	15.881	2.581	147.8	0.0	147.8	132.3	O K
2880 min Winter	15.449	2.149	126.5	0.0	126.5	109.4	O K
4320 min Winter	15.031	1.731	105.8	0.0	105.8	87.2	O K
5760 min Winter	14.738	1.438	91.3	0.0	91.3	71.6	O K
7200 min Winter	14.567	1.267	82.8	0.0	82.8	62.6	O K
8640 min Winter	14.441	1.141	76.6	0.0	76.6	55.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	1.463	0.0	0.0	4640
15 min Winter	144.558	0.0	0.0	144
30 min Winter	89.506	0.0	0.0	154
60 min Winter	55.419	0.0	0.0	176
120 min Winter	34.313	0.0	120.3	260
180 min Winter	25.923	0.0	217.2	288
240 min Winter	21.246	0.0	278.0	268
360 min Winter	16.050	0.0	347.1	282
480 min Winter	13.155	0.0	403.9	638
600 min Winter	11.273	0.0	436.9	410
720 min Winter	9.938	0.0	455.4	608
960 min Winter	7.882	0.0	455.9	682
1440 min Winter	5.686	0.0	291.4	944
2160 min Winter	4.101	0.0	0.0	1348
2880 min Winter	3.253	0.0	0.0	1732
4320 min Winter	2.422	0.0	0.0	2544
5760 min Winter	1.964	0.0	0.0	3336
7200 min Winter	1.670	0.0	0.0	4192
8640 min Winter	1.463	0.0	0.0	4960

Cascade Rainfall Details for Restored - IT4.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Cascade Model Details for Restored - IT4.SRCX

Storage is Online Cover Level (m) 16.300

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	1.00000	Trench Width (m)	1.0
Infiltration Coefficient Side (m/hr)	1.00000	Trench Length (m)	177.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	13.300	Cap Infiltration Depth (m)	0.000

Weir Overflow Control

Discharge Coef 0.544 Width (m) 75.000 Invert Level (m) 15.950

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 8 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	16.329	0.629	103.7	51.6	O K
30 min Summer	16.493	0.793	122.1	71.3	O K
60 min Summer	16.574	0.874	131.1	81.1	O K
120 min Summer	16.751	1.051	151.0	102.5	O K
180 min Summer	16.846	1.146	161.6	113.9	O K
240 min Summer	16.898	1.198	167.5	120.3	O K
360 min Summer	16.953	1.253	173.6	126.9	O K
480 min Summer	16.973	1.273	175.9	129.3	O K
600 min Summer	16.978	1.278	176.4	129.9	O K
720 min Summer	16.975	1.275	176.1	129.5	O K
960 min Summer	16.873	1.173	164.6	117.2	O K
1440 min Summer	16.705	1.005	145.9	97.0	O K
2160 min Summer	16.547	0.847	128.1	77.9	O K
2880 min Summer	16.419	0.719	113.8	62.4	O K
4320 min Summer	16.300	0.600	100.5	48.1	O K
5760 min Summer	16.201	0.501	89.4	36.2	O K
7200 min Summer	16.145	0.445	83.1	29.4	O K
8640 min Summer	16.102	0.402	78.3	24.2	O K
15 min Winter	16.262	0.562	96.2	43.5	O K
30 min Winter	16.387	0.687	110.3	58.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	123
30 min Summer	89.506	0.0	135
60 min Summer	55.419	0.0	152
120 min Summer	34.313	0.0	186
180 min Summer	25.923	0.0	220
240 min Summer	21.246	0.0	254
360 min Summer	16.050	0.0	322
480 min Summer	13.155	0.0	388
600 min Summer	11.273	0.0	454
720 min Summer	9.938	0.0	520
960 min Summer	7.882	0.0	650
1440 min Summer	5.686	0.0	908
2160 min Summer	4.101	0.0	1288
2880 min Summer	3.253	0.0	1664
4320 min Summer	2.422	0.0	2412
5760 min Summer	1.964	0.0	3168
7200 min Summer	1.670	0.0	3920
8640 min Summer	1.463	0.0	4672
15 min Winter	144.558	0.0	123
30 min Winter	89.506	0.0	134

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	16.481	0.781	120.8	70.0	O K
120 min Winter	16.737	1.037	149.4	100.8	O K
180 min Winter	16.861	1.161	163.3	115.8	O K
240 min Winter	16.943	1.243	172.5	125.7	O K
360 min Winter	17.039	1.339	183.3	137.3	O K
480 min Winter	17.012	1.312	180.2	134.0	O K
600 min Winter	16.972	1.272	175.8	129.2	O K
720 min Winter	16.931	1.231	171.2	124.2	O K
960 min Winter	16.787	1.087	155.0	106.9	O K
1440 min Winter	16.577	0.877	131.5	81.6	O K
2160 min Winter	16.373	0.673	108.7	57.0	O K
2880 min Winter	16.239	0.539	93.7	40.8	O K
4320 min Winter	16.111	0.411	79.4	25.4	O K
5760 min Winter	16.065	0.365	69.3	20.0	O K
7200 min Winter	16.041	0.341	63.5	17.4	O K
8640 min Winter	16.022	0.322	59.1	15.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	55.419	0.0	152
120 min Winter	34.313	0.0	188
180 min Winter	25.923	0.0	224
240 min Winter	21.246	0.0	260
360 min Winter	16.050	0.0	330
480 min Winter	13.155	0.0	398
600 min Winter	11.273	0.0	466
720 min Winter	9.938	0.0	534
960 min Winter	7.882	0.0	670
1440 min Winter	5.686	0.0	934
2160 min Winter	4.101	0.0	1332
2880 min Winter	3.253	0.0	1728
4320 min Winter	2.422	0.0	2540
5760 min Winter	1.964	0.0	3344
7200 min Winter	1.670	0.0	4200
8640 min Winter	1.463	0.0	5024

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Model Details

Storage is Online Cover Level (m) 17.700

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	1.00000	Trench Width (m)	1.0
Infiltration Coefficient Side (m/hr)	1.00000	Trench Length (m)	402.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	15.700	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 7 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	19.655	0.655	133.7	62.6	O K
30 min Summer	19.792	0.792	154.4	84.9	O K
60 min Summer	19.856	0.856	164.2	95.4	O K
120 min Summer	20.013	1.013	188.0	121.0	O K
180 min Summer	20.098	1.098	200.9	135.0	O K
240 min Summer	20.146	1.146	208.1	142.8	O K
360 min Summer	20.195	1.195	215.6	150.9	O K
480 min Summer	20.213	1.213	218.4	153.8	O K
600 min Summer	20.217	1.217	219.0	154.4	O K
720 min Summer	20.214	1.214	218.5	154.0	O K
960 min Summer	20.120	1.120	204.3	138.6	O K
1440 min Summer	19.966	0.966	180.9	113.4	O K
2160 min Summer	19.821	0.821	158.8	89.7	O K
2880 min Summer	19.703	0.703	141.0	70.4	O K
4320 min Summer	19.594	0.594	124.5	52.6	O K
5760 min Summer	19.523	0.523	110.8	41.0	O K
7200 min Summer	19.495	0.495	102.9	36.8	O K
8640 min Summer	19.473	0.473	96.8	33.6	O K
15 min Winter	19.600	0.600	125.3	53.5	O K
30 min Winter	19.702	0.702	140.8	70.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	123
30 min Summer	89.506	0.0	134
60 min Summer	55.419	0.0	152
120 min Summer	34.313	0.0	184
180 min Summer	25.923	0.0	220
240 min Summer	21.246	0.0	254
360 min Summer	16.050	0.0	322
480 min Summer	13.155	0.0	388
600 min Summer	11.273	0.0	454
720 min Summer	9.938	0.0	520
960 min Summer	7.882	0.0	650
1440 min Summer	5.686	0.0	908
2160 min Summer	4.101	0.0	1288
2880 min Summer	3.253	0.0	1664
4320 min Summer	2.422	0.0	2412
5760 min Summer	1.964	0.0	3152
7200 min Summer	1.670	0.0	3904
8640 min Summer	1.463	0.0	4608
15 min Winter	144.558	0.0	122
30 min Winter	89.506	0.0	134

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	19.776	0.776	152.0	82.2	O K
120 min Winter	20.003	1.003	186.4	119.4	O K
180 min Winter	20.115	1.115	203.5	137.8	O K
240 min Winter	20.190	1.190	214.9	150.1	O K
360 min Winter	20.278	1.278	228.2	164.4	O K
480 min Winter	20.252	1.252	224.3	160.2	O K
600 min Winter	20.216	1.216	218.8	154.2	O K
720 min Winter	20.178	1.178	213.0	148.0	O K
960 min Winter	20.045	1.045	192.8	126.3	O K
1440 min Winter	19.852	0.852	163.5	94.7	O K
2160 min Winter	19.664	0.664	135.0	63.9	O K
2880 min Winter	19.543	0.543	116.4	44.1	O K
4320 min Winter	19.479	0.479	98.4	34.4	O K
5760 min Winter	19.431	0.431	85.8	27.9	O K
7200 min Winter	19.403	0.403	78.5	24.3	O K
8640 min Winter	19.381	0.381	73.1	21.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	55.419	0.0	152
120 min Winter	34.313	0.0	188
180 min Winter	25.923	0.0	224
240 min Winter	21.246	0.0	260
360 min Winter	16.050	0.0	330
480 min Winter	13.155	0.0	398
600 min Winter	11.273	0.0	466
720 min Winter	9.938	0.0	534
960 min Winter	7.882	0.0	670
1440 min Winter	5.686	0.0	934
2160 min Winter	4.101	0.0	1332
2880 min Winter	3.253	0.0	1724
4320 min Winter	2.422	0.0	2536
5760 min Winter	1.964	0.0	3336
7200 min Winter	1.670	0.0	4152
8640 min Winter	1.463	0.0	5032

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Model Details

Storage is Online Cover Level (m) 21.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	1.00000	Trench Width (m)	1.0
Infiltration Coefficient Side (m/hr)	1.00000	Trench Length (m)	545.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	19.000	Cap Infiltration Depth (m)	0.000

Cascade Summary of Results for Restored - Basin1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Restored - IT7.SRCX	Restored - IT7.SRCX

Half Drain Time : 35 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	17.494	0.494	58.0	0.0	58.0	171.9	O K
30 min Summer	17.649	0.649	68.3	0.0	68.3	241.3	O K
60 min Summer	17.778	0.778	77.0	0.0	77.0	304.9	O K
120 min Summer	17.989	0.989	91.8	0.0	91.8	422.3	O K
180 min Summer	18.106	1.106	100.2	14.9	115.0	493.9	O K
240 min Summer	18.111	1.111	100.6	40.7	141.2	497.4	O K
360 min Summer	18.115	1.115	100.8	61.0	161.9	499.5	O K
480 min Summer	18.116	1.116	100.9	67.4	168.2	500.2	O K
600 min Summer	18.116	1.116	100.9	67.4	168.2	500.4	O K
720 min Summer	18.116	1.116	100.9	70.6	171.5	500.5	O K
960 min Summer	18.114	1.114	100.8	58.0	158.7	499.3	O K
1440 min Summer	18.111	1.111	100.5	38.0	138.5	497.1	O K
2160 min Summer	18.107	1.107	100.2	18.9	119.1	494.4	O K
2880 min Summer	18.061	1.061	96.9	0.0	96.9	465.6	O K
4320 min Summer	17.938	0.938	88.2	0.0	88.2	392.6	O K
5760 min Summer	17.816	0.816	79.7	0.0	79.7	325.2	O K
7200 min Summer	17.743	0.743	74.6	0.0	74.6	287.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	1243.8	164
30 min Summer	89.506	0.0	1516.1	180
60 min Summer	55.419	0.0	2071.3	204
120 min Summer	34.313	0.0	2600.1	244
180 min Summer	25.923	0.0	3007.0	274
240 min Summer	21.246	0.0	3356.0	284
360 min Summer	16.050	0.0	3952.9	332
480 min Summer	13.155	0.0	4439.7	390
600 min Summer	11.273	0.0	4864.9	452
720 min Summer	9.938	0.0	5243.9	512
960 min Summer	7.882	0.0	5589.6	638
1440 min Summer	5.686	0.0	6059.4	910
2160 min Summer	4.101	0.0	7807.3	1316
2880 min Summer	3.253	0.0	8417.8	1768
4320 min Summer	2.422	0.0	9715.4	2524
5760 min Summer	1.964	0.0	11615.2	3272
7200 min Summer	1.670	0.0	12809.6	4016

Cascade Summary of Results for Restored - Basin1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	17.683	0.683	70.5	0.0	70.5	257.6	O K
15 min Winter	17.446	0.446	54.9	0.0	54.9	152.2	O K
30 min Winter	17.586	0.586	64.1	0.0	64.1	212.3	O K
60 min Winter	17.731	0.731	73.8	0.0	73.8	281.0	O K
120 min Winter	18.017	1.017	93.8	0.0	93.8	439.1	O K
180 min Winter	18.110	1.110	100.5	35.4	135.8	496.5	O K
240 min Winter	18.115	1.115	100.8	61.0	161.9	499.9	O K
360 min Winter	18.118	1.118	101.0	80.6	181.6	501.5	O K
480 min Winter	18.117	1.117	101.0	77.2	178.2	501.2	O K
600 min Winter	18.116	1.116	100.9	70.6	171.5	500.6	O K
720 min Winter	18.116	1.116	100.9	67.4	168.2	500.2	O K
960 min Winter	18.113	1.113	100.7	49.1	149.7	498.4	O K
1440 min Winter	18.108	1.108	100.3	25.5	125.9	495.5	O K
2160 min Winter	18.049	1.049	96.0	0.0	96.0	458.2	O K
2880 min Winter	17.884	0.884	84.4	0.0	84.4	361.7	O K
4320 min Winter	17.707	0.707	72.2	0.0	72.2	269.5	O K
5760 min Winter	17.569	0.569	62.9	0.0	62.9	204.5	O K
7200 min Winter	17.485	0.485	57.4	0.0	57.4	168.2	O K
8640 min Winter	17.420	0.420	53.2	0.0	53.2	141.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.463	0.0	13831.8	4768
15 min Winter	144.558	0.0	1248.0	162
30 min Winter	89.506	0.0	1489.0	178
60 min Winter	55.419	0.0	2096.5	202
120 min Winter	34.313	0.0	2802.4	244
180 min Winter	25.923	0.0	3299.8	252
240 min Winter	21.246	0.0	3746.5	266
360 min Winter	16.050	0.0	4551.8	320
480 min Winter	13.155	0.0	5036.5	376
600 min Winter	11.273	0.0	5456.2	442
720 min Winter	9.938	0.0	5829.7	522
960 min Winter	7.882	0.0	6205.5	642
1440 min Winter	5.686	0.0	6754.5	912
2160 min Winter	4.101	0.0	8492.4	1428
2880 min Winter	3.253	0.0	9026.4	1824
4320 min Winter	2.422	0.0	10121.7	2624
5760 min Winter	1.964	0.0	11779.7	3424
7200 min Winter	1.670	0.0	12763.6	4224
8640 min Winter	1.463	0.0	13593.3	5040

Cascade Rainfall Details for Restored - Basin1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Cascade Model Details for Restored - Basin1.SRCX

Storage is Online Cover Level (m) 18.500

Infiltration Basin Structure

Invert Level (m) 17.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.70000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.70000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	280.0	1.500	800.0

Weir Outflow Control

Discharge Coef 0.544 Width (m) 20.000 Invert Level (m) 18.100

Cascade Summary of Results for Restored - IT7.SRCX

Upstream Structures	Outflow To	Overflow To
Restored - Basin1.SRCX	(None)	(None)

Half Drain Time : 13 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	15.500	0.000	0.0	0.0	O K
30 min Summer	15.500	0.000	0.0	0.0	O K
60 min Summer	15.500	0.000	0.0	0.0	O K
120 min Summer	15.500	0.000	0.0	0.0	O K
180 min Summer	15.566	0.066	14.3	1.0	O K
240 min Summer	16.131	0.631	27.2	19.3	O K
360 min Summer	16.839	1.339	41.6	42.2	O K
480 min Summer	17.163	1.663	48.2	52.7	O K
600 min Summer	17.359	1.859	52.2	59.1	O K
720 min Summer	17.480	1.980	54.7	63.0	O K
960 min Summer	17.077	1.577	46.5	49.9	O K
1440 min Summer	16.339	0.839	31.4	26.0	O K
2160 min Summer	15.621	0.121	16.7	2.7	O K
2880 min Summer	15.500	0.000	0.0	0.0	O K
4320 min Summer	15.500	0.000	0.0	0.0	O K
5760 min Summer	15.500	0.000	0.0	0.0	O K
7200 min Summer	15.500	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	144.558	0.0	0
30 min Summer	89.506	0.0	0
60 min Summer	55.419	0.0	0
120 min Summer	34.313	0.0	0
180 min Summer	25.923	0.0	276
240 min Summer	21.246	0.0	306
360 min Summer	16.050	0.0	368
480 min Summer	13.155	0.0	426
600 min Summer	11.273	0.0	486
720 min Summer	9.938	0.0	554
960 min Summer	7.882	0.0	680
1440 min Summer	5.686	0.0	944
2160 min Summer	4.101	0.0	1332
2880 min Summer	3.253	0.0	0
4320 min Summer	2.422	0.0	0
5760 min Summer	1.964	0.0	0
7200 min Summer	1.670	0.0	0

Cascade Summary of Results for Restored - IT7.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	15.500	0.000	0.0	0.0	O K
15 min Winter	15.500	0.000	0.0	0.0	O K
30 min Winter	15.500	0.000	0.0	0.0	O K
60 min Winter	15.500	0.000	0.0	0.0	O K
120 min Winter	15.500	0.000	0.0	0.0	O K
180 min Winter	15.930	0.430	23.0	12.8	O K
240 min Winter	16.809	1.309	41.0	41.2	O K
360 min Winter	17.827	2.327	61.8	74.2	O K
480 min Winter	17.882	2.382	62.9	76.0	O K
600 min Winter	17.806	2.306	61.4	73.6	O K
720 min Winter	17.672	2.172	58.6	69.2	O K
960 min Winter	16.979	1.479	44.5	46.7	O K
1440 min Winter	15.923	0.423	22.9	12.5	O K
2160 min Winter	15.500	0.000	0.0	0.0	O K
2880 min Winter	15.500	0.000	0.0	0.0	O K
4320 min Winter	15.500	0.000	0.0	0.0	O K
5760 min Winter	15.500	0.000	0.0	0.0	O K
7200 min Winter	15.500	0.000	0.0	0.0	O K
8640 min Winter	15.500	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
8640 min Summer	1.463	0.0	0
15 min Winter	144.558	0.0	0
30 min Winter	89.506	0.0	0
60 min Winter	55.419	0.0	0
120 min Winter	34.313	0.0	0
180 min Winter	25.923	0.0	270
240 min Winter	21.246	0.0	296
360 min Winter	16.050	0.0	358
480 min Winter	13.155	0.0	422
600 min Winter	11.273	0.0	488
720 min Winter	9.938	0.0	554
960 min Winter	7.882	0.0	690
1440 min Winter	5.686	0.0	964
2160 min Winter	4.101	0.0	0
2880 min Winter	3.253	0.0	0
4320 min Winter	2.422	0.0	0
5760 min Winter	1.964	0.0	0
7200 min Winter	1.670	0.0	0
8640 min Winter	1.463	0.0	0

Cascade Rainfall Details for Restored - IT7.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+40

Cascade Model Details for Restored - IT7.SRCX

Storage is Online Cover Level (m) 18.500

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	1.00000	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	1.00000	Trench Length (m)	72.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	15.500	Cap Infiltration Depth (m)	0.000