



ENVIRONMENTAL CONSULTING

Piling Risk Assessment

**Wessex Yard
8 New Lane
Havant
PO9 2JJ**

Prepared for

**Days Estates Ltd
3 Marmion Road
Southsea
Hampshire
PO5 2AT**

**Omnia ref: A10708/3.0
August 2017**

Quality Assurance

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Project number	A10708/3.0

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Table of Contents

1.0	INTRODUCTION	22
1.1	Background	22
1.2	Objectives.....	22
1.3	Sources of Information	22
1.4	Limitations.....	23
1.5	Confidentiality	23
2.0	SITE SETTING	24
2.1	Site Location and Description	24
2.1.1	Geology	24
2.1.2	Hydrogeology and Hydrology	24
2.2	Soil and Groundwater Conditions.....	25
2.2.1	Summary of Contaminant Distribution	25
2.3	Geotechnical Considerations	26
2.4	Selection of Piling Method	26
3.0	CONCEPTUAL SITE MODEL.....	27
3.1	Hazard Identification	27
3.1.1	Assessment of Contaminant Risk	27
3.1.2	Assessment of Piling Methodology Risk	27
4.0	DISCUSSION.....	29
5.0	CONCLUSIONS & RECOMMENDATIONS	31

APPENDICES

Appendix I	Limitations
Appendix II	Glossary
Appendix III	Drawings
	Figure 1.0 – Site Location Plan
	Figure 2.0 – Proposed Development
	Figure 3.0 – Piled Foundation Scheme – Block A (Sheet 1)
	Figure 3.1 – Piled Foundation Scheme – Block A (Sheet 2)
	Figure 3.2 – Piled Foundation Scheme – Block B
	Figure 3.3 – Piled Foundation Scheme – Block C

1.0 INTRODUCTION

1.1 Background

Omnia Environmental Consulting (OEC) have been commissioned by Days Estates Ltd to undertake a Piling Risk Assessment (PRA) for the site of Wessex Yard, 8 New Lane, Havant, PO9 2JJ.

OEC have previously undertaken ground investigation works at the site, as set out within the following reports:

- OEC Report A10708/1.1 – ‘Phase II-III Geo-Environmental Assessment, Wessex Yard, 8 New Lane, Havant, PO9 2JJ.’ Dated November 2016.
- OEC Report A10708/2.0 – ‘Phase II-III Groundwater Risk Assessment, Wessex Yard, 8 New Lane, Havant, PO9 2JJ.’ Dated August 2017.

This document is being prepared to satisfy comments made by Havant Borough Council of Planning Permission APP/15/01425, which sets out a requirement for a Piling Risk Assessment for piling or any other foundation design using penetrative methods.

The proposed development will comprise the construction of three (3no.) apartment blocks understood to range from three to four storeys in height, with associated parking areas and areas of communal soft landscaping.

The site location plan and proposed development plan area presented as Figure 1.0 and Figure 2.0 in Appendix II.

1.2 Objectives

The purpose of this piling risk assessment is to assess piling methods together with the soil and groundwater chemical analysis data with regards to the potential environmental impact that different piling methods may have at the site. Identification of potential hazards from source-pathway-receptor linkages will ensure that a suitable method of piling is selected for the site which will minimise any environmental impact.

1.3 Sources of Information

Background information was sought from the following sources:

- OEC Report A10708/1.1 – ‘Phase II-III Geo-Environmental Assessment, Wessex Yard, 8 New Lane, Havant, PO9 2JJ.’ Dated November 2016.
 - OEC Report A10708/2.0 – ‘Phase II-III Groundwater Risk Assessment, Wessex Yard, 8 New Lane, Havant, PO9 2JJ.’ Dated August 2017.
 - Piling and Penetrative Ground Improvement methods on Land Affected by Contamination: Guidance on Pollution Prevention. Environment Agency National Groundwater and Contaminated Land Centre report NC/99/73. May 2001.
-

1.4 Limitations

The limitations of this report are presented in Appendix I.

1.5 Confidentiality

OEC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from OEC; a charge may be levied against such for approval.

2.0 SITE SETTING

2.1 Site Location and Description

Site Address	Wessex Yard, 8 New Lane, Havant, Hampshire, PO9 2JJ
National Grid Reference	472139, 106616
Area	~0.33Ha

The site comprised a roughly rectangular plot of land which at the time of investigation was occupied by A1 Recovery, a vehicle recovery, storage and repair company, with offices and garage located in the south of the site and vehicle storage and parking occupying the remainder of the site.

2.1.1 Geology

The site was underlain by a cohesive unit of Made Ground, underlain by superficial River Terrace Deposits further underlain by bedrock of London Clay Formation and the Bognor Sand Member. River Terrace Deposits were recorded as a lithologically variable unit grading between gravelly and clayey CLAY and SAND, with the London Clay Formation logged as a laterally uniform stiff grey CLAY grading into a gravelly CLAY as the base of the unit was encountered. Directly underling the London Clay was the Bognor Sand Member which was encountered at depths ranging from 7.60 to 11.00m bgl and comprised a dense, greenish-grey slightly gravelly silty SAND.

2.1.2 Hydrogeology and Hydrology

The River Terrace deposits are classified as a Secondary (A) Aquifer, the London Clay Formation is classified as a unproductive strata and the Bognor Sand Member is classified as a Secondary (A) Aquifer. BGS hydrogeological mapping indicates that the top of the Chalk (Principal Aquifer) is located at a depth of approximately 65m bgl.

The site is located within a Source Protection Zone 1c (SPZ1c) for confined aquifers. The SPZ1c is considered to be associated with the Bedhampton & Havant Springs, which draw water from the Principal Chalk Aquifer located at depth beneath a confining layer of London Clay Formation. The SPZ1 for the Bedhampton & Havant Springs is located approximately 403m south of the site. SPZ1c is a relatively new classification which is applied to aquifers that were previously considered to be protected from contamination due to low permeability overlying geology, but which could be impacted by subsurface activities such as drilling and deep bored piling may present a risk to controlled waters.

No groundwater abstraction licenses or public water supplies were identified within a 1km radius of the site.

One (1no.) surface watercourse was identified within a 250m radius of the site, an unnamed tertiary river and culvert located 190m west of the site.

2.2 Soil and Groundwater Conditions

Information on soil and groundwater concentrations encountered beneath the site during the previous phases of investigation are presented within the reports listed in Section 1.3 and is summarised in the following sections.

2.2.1 Summary of Contaminant Distribution

2.2.1.1 Soils

Elevated concentrations of metals (arsenic, lead, and beryllium), cyanide, PAH and TPH were identified within the soils tested across the site. Elevated concentrations were identified to a maximum depth of 4.80m bgl, but were not considered to be characteristic of widespread gross impact, as detailed in OEC report ref. A10708/1.1. Asbestos fibres were identified in a single sample at a depth of 3.00m bgl in location WS106. Location WS106 was advanced within the footprint of a historic gasometer in the east of the site.

The elevated concentrations summarised above were considered to have the potential to present a significant risk to Human Health, through the ingestion of contaminated soils, and in the case of cyanide, naphthalene and TPH C₈-C₁₀ through vapour inhalation.

Due to the proposed development comprising three (3no.) apartment blocks with external areas of concrete hardstanding and areas of raised planting, it was considered that the dermal contact and ingestion exposure pathways would be severed and rendered inactive. However, in the case of cyanide, naphthalene and TPH C₈-T₁₀, it was considered that the elevated concentrations had the potential to pose a significant risk to future site users through vapour inhalation and it was recommended that a mitigation system in the form of a vapour resistant membrane was installed within the proposed buildings.

2.2.1.2 Groundwater

A Groundwater Risk Assessment was undertaken and is detailed within OEC Report A10708/2.0. The assessment identified very low pH conditions (pH 1.75 – pH 1.99) within perched water in the Made Ground at location WS108 and identified elevated but transient concentrations of PAHs, Cyanide and TPH C₈-C₁₀. The report concluded that with the exception of transient exceedances of the Tier I screening criteria, which were attributed to drilling disturbance, that groundwater concentrations in the most downgradient borehole (CP103) did not consistently exceed the adopted screening criteria and that the proposed development would not lead to an increased risk to Controlled Waters. However, in line with comments made by the Local Authority the report recommended that a Piling Risk Assessment was produced to assess the risks presented to the underlying aquifer by piling activities.

2.2.1.3 Ground Gas

Based upon information available to date and previous rounds of ground gas monitoring carried out by OEC, the site has been classified as Characteristic Situation 1 (CS-1) for the proposed development on-site.

2.3 Geotechnical Considerations

Given the variation in proposed loading, along with the presence of great thicknesses of Made Ground, a piled foundation solution was proposed across the site. Pile lengths are set out as follows:

Type of building	Diameter of Pile (mm)	Maximum Pile Length (m)
Multi-storey flats	350/ 400/ 450	c.18.0

2.4 Selection of Piling Method

The structural engineer has recommended that Continuous Flight Auger (CFA) piles should be used as the foundation solution for the site. This scheme involves a rotary boring technique which brings soil arisings to the surface rather than utilising percussion to drive piles downwards and offer a low noise and vibration method of foundation design that is suitable for sensitive sites where existing residential properties are in close proximity to the subject site. The CFA piles can also be formed in water bearing strata and are suitable for geology with a low strength.

Experience on previous projects indicates that the Environment Agency consider CFA piles to minimise the risks posed to underlying aquifers from contaminated material identified near surface, and as such the adoption of CFA piles is considered to be an appropriate choice for this site. Pile diameters vary across the site with pile depths to a maximum depth of 18.0m bgl.

Pile design was modelled on a water level of 2.5m bgl due to the presence of a discontinuous water body across the site.

3.0 CONCEPTUAL SITE MODEL

3.1 Hazard Identification

The Piling Risk Assessment has been undertaken in accordance with guidance set out by the Environment Agency, 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention NC/99/73 (A, 2001)'. A Conceptual Site Model has been developed to identify potential sources, migration pathways and receptors within the study area.

3.1.1 Assessment of Contaminant Risk

Table 3.0 – Risk Associated with Contaminant Distribution

Source	Potential Contaminant	Potential Migration Pathway	Potential Receptors
Elevated concentrations in soil	Heavy Metals (As, Be & Pb) PAH TPH	Leaching of contaminants and downward migration along length of pile	Controlled Waters within the Principal Aquifer (Tarrant Chalk Member)
		Contact with impacted arisings	Human Health
		Contact with impacted soils	Concrete Piles
Perched water (location WS108)	Low pH (pH 1.75-1.99) High Soluble SO ₄ High Total Dissolved Sulphur	Leaching of contaminants and downward migration along length of pile	Degradation of Concrete Piles

A risk assessment relating to the contaminants above is presented in Section 4.0.

3.1.2 Assessment of Piling Methodology Risk

Consideration has also been given to the advised piling method in relation to any risk this may present to the on-site SPZ1c associated with the Bedhampton springs. This is detailed within Table 3.1 below.

Table 3.1 – Risk Associated with CFA Piling Methodology

Activity	Consequence	Discussion
Advancement of SFA Piling Head	Agitation of soil particles leading to increased turbidity within groundwater in the Chalk aquifer of the Bedhampton & Havant springs.	Low likelihood due to the rotary method of pile advancement. The top of the Chalk is considered to be at a depth of c.63m bgl and with maximum pile depths of c.18.0m bgl it is not considered that piles will penetrate the Chalk.

Activity	Consequence	Discussion
Injection of high pressure concrete	Injecting concrete under high pressure in a confined space may cause dispersion into voids/pore spaces in the surrounding soils and therefore migrate into the groundwater.	Real-time monitoring of the volumes of concrete and pumping pressure should be undertaken with comparison with the expected volumes/pressures required for the pile. If these were to deviate piling should be halted. This risk is mitigated through the correct procedures being followed by piling contractors on-site.
General use of deep concrete piles	Bored concrete pile could create a new preferential pathway for the migration of contaminated groundwater	The selection of CFA pile design represents the best available technique to limit preferential migration of water around the annulus of the pile, as the pile and the surrounding material creates a seal to prevent vertical migration.
	Degradation of concrete in the pile from known contamination in the ground and perched groundwater.	An appropriate mix of corrosion resistant cement, as set out by the structural engineer, should be used based on the ground conditions encountered during site investigation.

The information provided in Table 3.1 demonstrates that the risks associated with the piling methodology have been suitably considered, with control measures in place to reduce the risk potential to a minimum.

4.0 DISCUSSION

Following a review of the data obtained for the site and the conceptual model presented above further consideration is given to the potential for an active pollution pathway, based on the source/pathway/receptor pollution linkage, both during the installation of the piled foundations and post installation.

➤ Leaching of Contaminants within the soils and Downward Migration Along Length of Pile

The pollution linkage between soils within the unsaturated zone and the underlying aquifer through downward migration along the length of the CFA pile is not considered to be active. During the CFA piling process the hole is rotary drilled to the specified depth, and the concrete mix is injected through the centre of the auger into the hole as the auger is retracted. During the injection process the pile hole is backfilled together with any cavities or fissures, resulting in a seal between the pile and the surrounding formations. Following removal of the auger and injection of the concrete mix the reinforcing framework of the pile is then introduced.

Should a pathway be created during the augering process this will be sealed in a rapid time period, thus the pathway will not be active for a substantial period of time. This is also highlighted in the National Groundwater and Contaminated Land Centre report NC/99/73 "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance of Pollution Prevention". As a result of this it is considered that the pathway is inactive. Furthermore, given that the chalk aquifer that supplies the Bedhampton & Havant springs is at a depth of c.63m bgl it is considered unlikely that contamination will migrate downwards from the Made Ground during this timeframe. It is therefore considered the potential downward migration pathway to the aquifer will be inactive.

➤ Contact with Contaminated Arisings – Human Health

During the installation of the piles, soil is extruded up the flights of the auger and out of the hole resulting in potential contact with arisings of both surface and deep soils. The soil arisings should be stockpiled on-site in a suitable location ensuring downward migration cannot occur and subsequently be removed from site to an appropriately licensed waste management facility in accordance with Part II A of EPA 1990 and supporting documents. During the piling phase, all operatives should work under appropriate site health and safety procedures. As the soil arisings are to be removed from site the risk pathway for human health is therefore considered to be transient and will therefore not remain active once soil arisings have been removed from site.

➤ Contact with Contaminated Soils – Concrete Piles

The concrete used in the CFA piling method should be specified in accordance with BRE Special Digest 1 (2005) and BS8110 to ensure that concrete degradation by any soil contamination, whilst unlikely based on the identified concentrations **across the majority of the site**, will not occur. Given that degradation of the pile should not occur, an increase in permeability of the pile and therefore the creation of a potential preferential pathway is considered unlikely and the pathway is considered to be inactive.

➤ Contact with acidic sulphate rich perched water in the vicinity of WS108 – Concrete Piles

The concrete used in the CFA piling method should be specified in accordance with BRE Special Digest 1 (2005) and BS8110 to ensure that concrete degradation by any soil contamination.

Perched water in the vicinity of WS108 is characterised by a very low pH (pH 1.75 – pH 1.99) and contains high concentrations of soluble SO_4 and Total Dissolved Sulphur. Acidic sulphate rich water is prone to attack the hardened concrete of the pile leading to degradation.

This is considered to be an active linkage, and it is recommended that advice is sought from a specialist piling contractor to ensure that a suitable design of pile, methodology of installation and concrete classification is adopted in order to mitigate the risk of pile degradation and/or creation of a potential preferential pathway in piles in this area.

An option exists to carry out additional works in order to remediate this area prior to pile installation to further mitigate, but as a minimum a watching brief by a suitably experienced and qualified environmental consultant should be considered in order to observe and assist the management potentially contaminated arisings.

5.0 CONCLUSIONS

The piling risk assessment has assessed the use of CFA piling at the site and it is concluded that this piling method will not result in the creation of preferential pollution pathways to the underlying Secondary A Aquifer within the Bognor Sand Member, the Principal Chalk Aquifer at depth or to human health.

However, particular consideration should be given to perched water conditions in the vicinity of WS108, where acidic (pH 1.75 – pH 1.99) sulphate rich perched water was encountered and is considered to have the potential to attack the hardened concrete of the pile leading to degradation.

From the results of the foundation works risk assessment, it is concluded that the use of CFA piling for the construction of the development on site will not result in an increased risk to controlled waters or to human health.

6.0 RECOMMENDATIONS

It is recommended that advice is sought from a specialist piling contractor with regards to the low pH sulphate-rich perched water conditions encountered in the vicinity of location WS108, to ensure that a suitable design of pile, methodology of installation and concrete classification is adopted in order to mitigate risk of pile degradation and/or creation of a potential preferential pathway in piles in this area.

The piling works will be undertaken carried out by a suitably qualified and experienced piling contractor, with all site works carried out under an appropriate quality assurance and quality control regime, as specified in the contract

An option exists to carry out additional works in order to remediate this area prior to pile installation to further mitigate, but as a minimum a watching brief by a suitably experienced and qualified environmental consultant should be considered in order to observe and assist the management potentially contaminated arisings.

APPENDIX I

LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between OE Ltd and the Client as indicated in Section 1.2.
 2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
 3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination, which are enforced, by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
 4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
 5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
 6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
 7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
 8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
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APPENDIX II

GLOSSARY

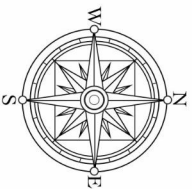
AST	ABOVE GROUND STORAGE TANK
BGS	BRITISH GEOLOGICAL SURVEY
BSI	BRITISH STANDARDS INSTITUTE
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, XYLENES
CIEH	CHARTERED INSTITUTE OF ENVIRONMENTAL HEALTH
CIRIA	CONSTRUCTION INDUSTRY RESEARCH ASSOCIATION
CLEA	CONTAMINATED LAND EXPOSURE ASSESSMENT
CSM	CONCEPTUAL SITE MODEL
DNAPL	DENSE NON-AQUEOUS PHASE LIQUID (CHLORINATED SOLVENTS, PCB)
DWS	DRINKING WATER STANDARD
EA	ENVIRONMENT AGENCY
EQS	ENVIRONMENTAL QUALITY STANDARD
GAC	GENERAL ASSESSMENT CRITERIA
GL	GROUND LEVEL
GSV	GAS SCREENING VALUE
HCV	HEALTH CRITERIA VALUE
ICSM	INITIAL CONCEPTUAL SITE MODEL
LNAPL	LIGHT NON-AQUEOUS PHASE LIQUID (PETROL, DIESEL, KEROSENE)
ND	NOT DETECTED
LMRL	LOWER METHOD REPORTING LIMIT
NR	NOT RECORDED
PAH	POLY AROMATIC HYDROCARBON
PCB	POLY-CHLORINATED BIPHENYL
PID	PHOTO IONISATION DETECTOR
QA	QUALITY ASSURANCE
SGV	SOIL GUIDELINE VALUE
SPH	SEPARATE PHASE HYDROCARBON
SP.TPH (CWG)	TOTAL PETROLEUM HYDROCARBON (CRITERIA WORKING GROUP)
SPT	STANDARD PENETRATION TEST
SVOC	SEMI VOLATILE ORGANIC COMPOUND
UST	UNDERGROUND STORAGE TANK
VCCS	VIBRO CONCRETE COLUMNS
VOC	VOLATILE ORGANIC COMPOUND
WTE	WATER TABLE ELEVATION
UNITS	
M	METRES
KM	KILOMETRES
%	PERCENT
%V/V	PERCENT VOLUME IN AIR
MB	MILLI BARS (ATMOSPHERIC PRESSURE)
L/HR	LITRES PER HOUR
µG/L	MICROGRAMS PER LITRE (PARTS PER BILLION)
PPB	PARTS PER BILLION
MG/KG	MILLIGRAMS PER KILOGRAM (PARTS PER MILLION)
PPM	PARTS PER MILLION
MG/M ³	MILLIGRAM PER METRE CUBED
M BGL	METRES BELOW GROUND LEVEL

M BCL	METRE BELOW COVER LEVEL
MAOD	METRES ABOVE ORDNANCE DATUM (SEA LEVEL)
KN/M ²	KILO NEWTONS PER METRE SQUARED
μM	MICRO METRE

APPENDIX III

DRAWINGS

Key

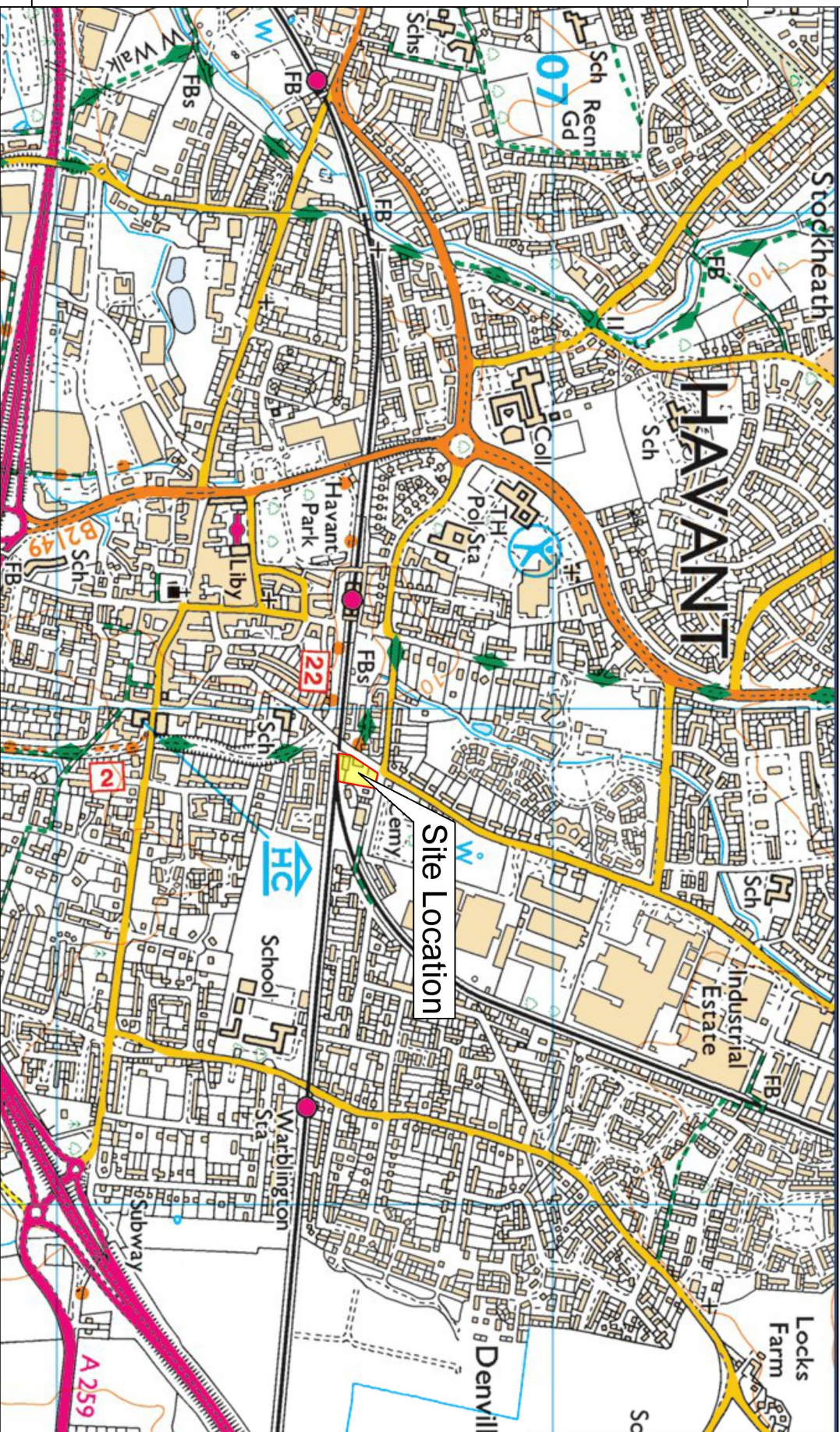


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Project No:

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Date:

16/08/2017

Drawn By:

G.Larcombe

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T.Mitchell

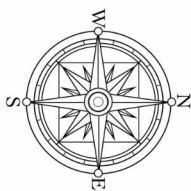
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Figure 1.0 - Site Location

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Figure 2.0 - Proposed
Development Layout

Drawn By:

G.Larcombe

Authorised By:

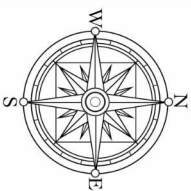
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Notes:



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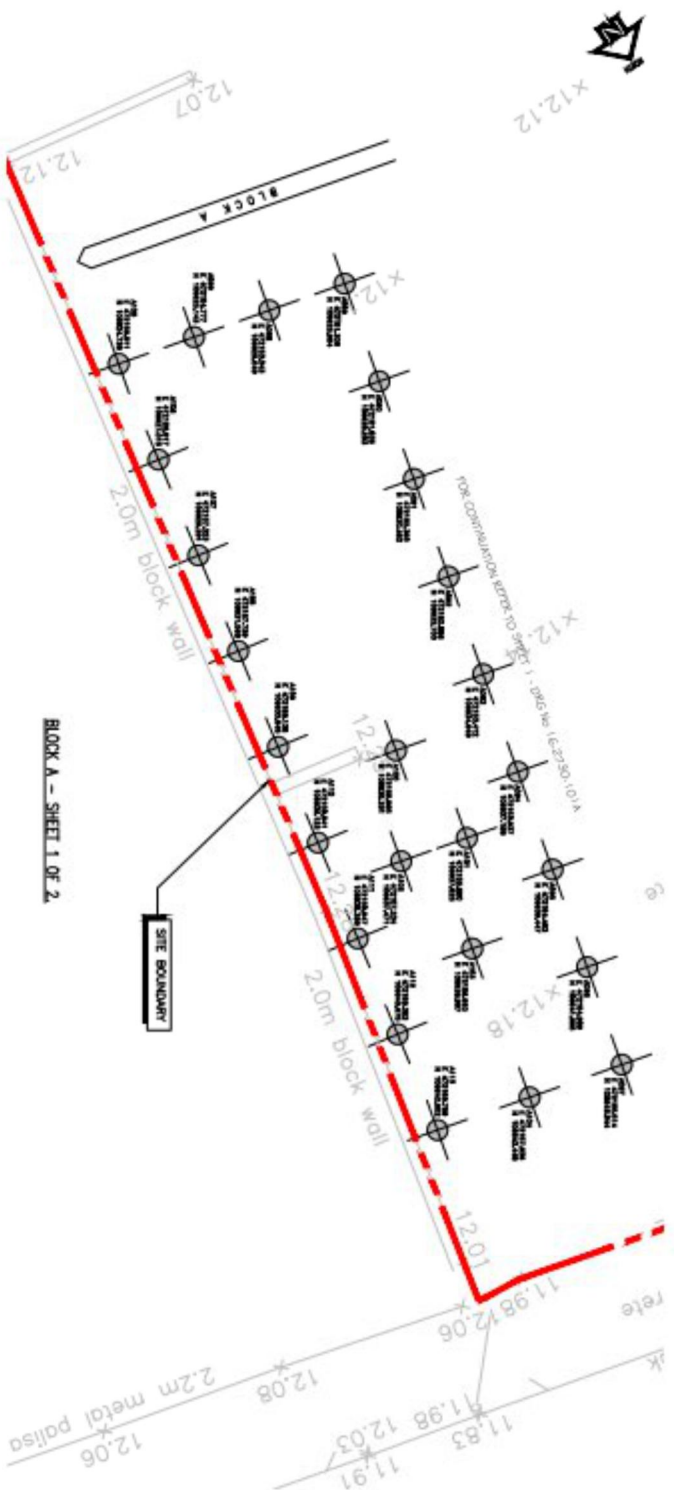


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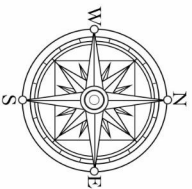
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Figure 3.0 - Piled Foundation
Scheme - Block A (Sheet 1)

Key



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ENVIRONMENTAL CONSULTING

Job Title:

Wessex Yard, New Lane,
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Client:

PMC

Project No:

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17/08/2017

Drawing Title:

Figure 3.1 - Piled Foundation
Scheme - Block A (Sheet 2)

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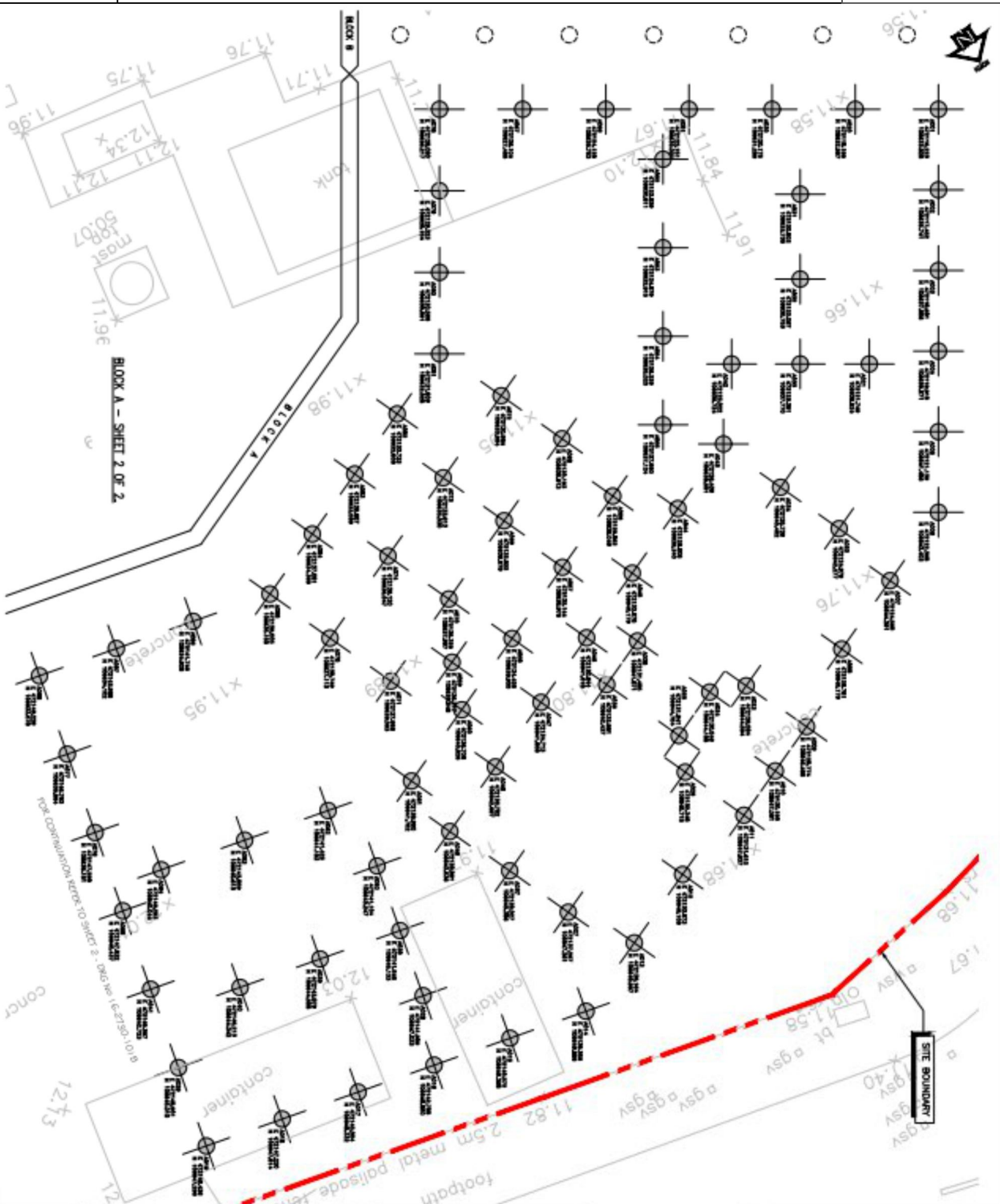
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FROM: PLANNING/ARCHITECTURE
STANDARD NOTES REFER TO
SHEETS 18-27/28-100

KEY PLAN

PILE PENETRATION DETAIL

PILE OFF-OFF LINE = (BLOCK A) (BLOCK B)

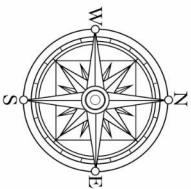
PILE LEGEND

PILE TYPE	NO. OFF
1. 150mm dia. 10m long	1
2. 150mm dia. 10m long	1
3. 150mm dia. 10m long	1
4. 150mm dia. 10m long	1
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90. 150mm dia. 10m long	1
91. 150mm dia. 10m long	1
92. 150mm dia. 10m long	1
93. 150mm dia. 10m long	1
94. 150mm dia. 10m long	1
95. 150mm dia. 10m long	1
96. 150mm dia. 10m long	1
97. 150mm dia. 10m long	1
98. 150mm dia. 10m long	1
99. 150mm dia. 10m long	1
100. 150mm dia. 10m long	1

PRELIMINARY

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Key



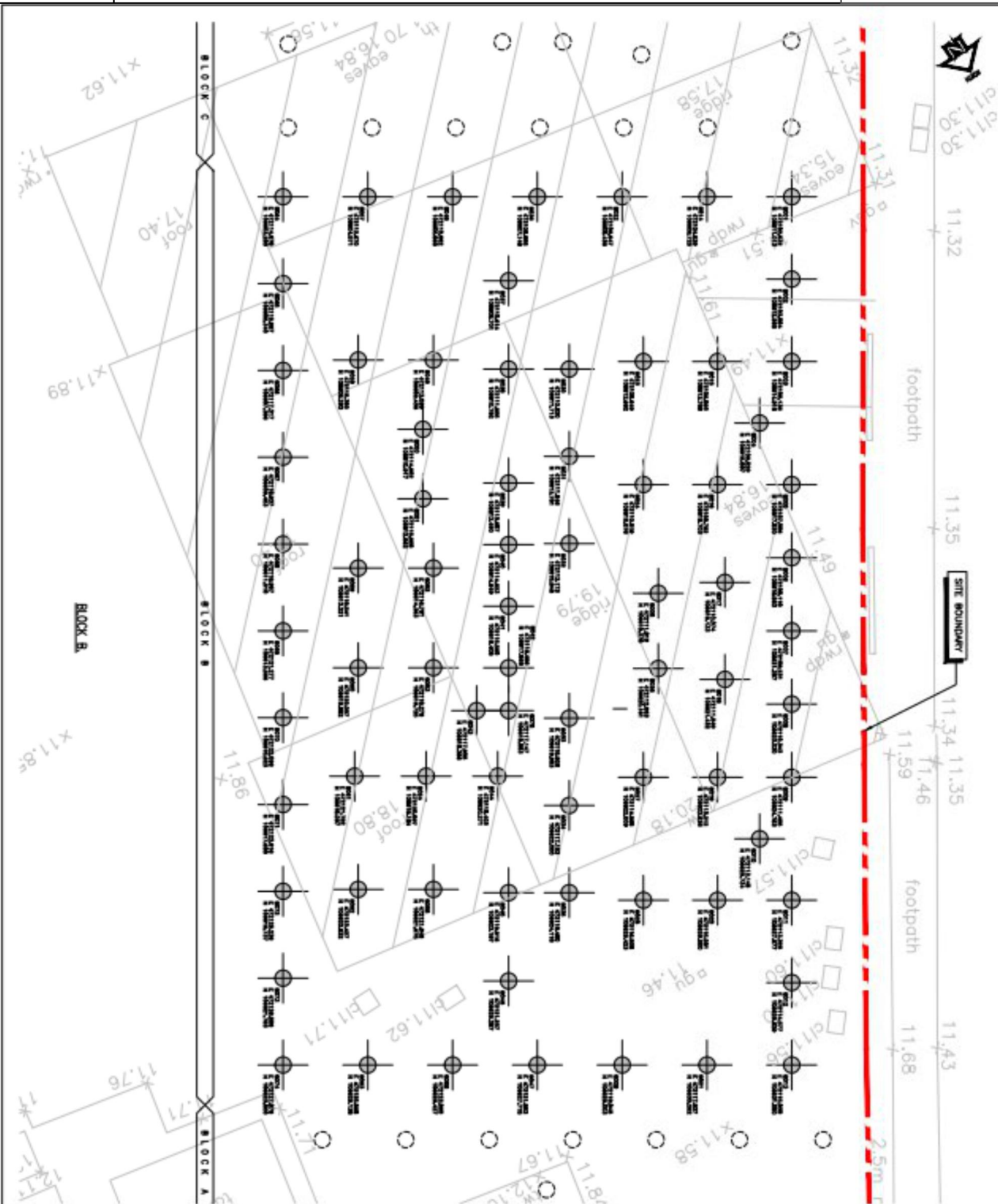
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Job Title:

Client:

Wessex Yard, New Lane,
Havant

PMC

Project No:

A10708

Date:

17/08/2017

Drawn By:

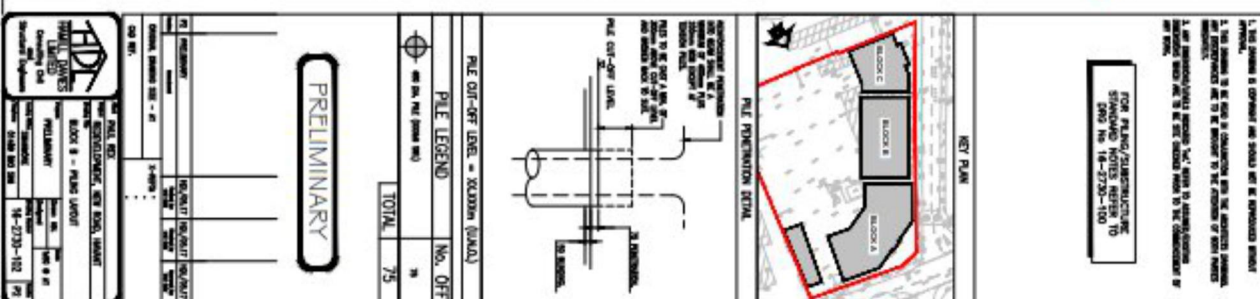
G.Larcombe

Authorised By:

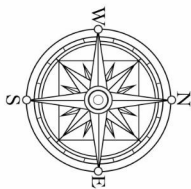
T.Mitchell

Drawing Title:

Figure 3.2 - Piled Foundation
Scheme - Block B



Key



Job Title:

Wessex Yard, New Lane,
Havant

Client:

PMC

Project No:

A10708

Date:

17/08/2017

Drawing Title:

Figure 3.3 - Piled Foundation
Scheme - Block C

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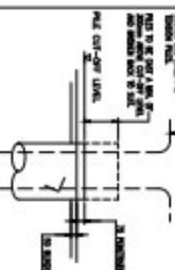
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KEY PLAN



PILE FOUNDATION DETAIL



PILE OFF-SET LEVEL = 1000mm (G.A.O.)	
PILE LEGEND	No. OFF
Ø 400mm PILE (SHEAR WALL)	49
TOTAL	49

PRELIMINARY

PILE FOUNDATION DETAIL	
PILE NO.	1000001
PILE TYPE	Ø 400mm PILE (SHEAR WALL)
PILE LENGTH	10.0m
PILE CAP	1000mm x 1000mm
PILE SPACING	1.0m
PILE ELEVATION	11.50
PILE CAP ELEVATION	11.50
PILE FOUNDATION DETAIL	1000001