civils ltd - consulting engineers



Land Northeast of Station Road Worthing, BN11 1JY

Flood Risk Assessment

CLIENT
Randall and Chisnall Construction Ltd.
27 Ferringham Lane
Ferring
Worthing
West Sussex BN12 5NB

Ref: 5541/2.3F
Date: February 2015

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Issue	Date	Compiled	Checked
First Issue	10 February 2015	JP	MR
Second issue	13th February 2015	JP	MR

Report by: **John Pakenham BSc (Hons)**
Checked by: **Martin Roberts I Eng, CIWEM, MCIHT**

1.0 INTRODUCTION

1.1 This Flood Risk Assessment (FRA) report has been prepared for Randall and Chisnall Construction. Ltd in relation to the above development and no responsibility is accepted to any third party for all or part of this study in connection with this or any other development.

1.2 GTA Civils Ltd was appointed by Randall and Chisnall Construction. Ltd to provide a FRA report as requested by Worthing Borough Council.

1.3 This report will take the form of a formal Flood Risk Assessment in accordance with the 2014 Planning Practice Guidance, which has recently superseded the 2012 National Planning Policy Framework (NPPF) and the associated Technical Guidance document (TG).

1.4 The NPPF and TG are now contained within the Planning Practice Guidance, 2014 (PPG). Essentially, at this time, national flood risk policy is largely unchanged from the NPPF.

2.0 EXISTING SITE & FLOOD CONDITIONS

2.1 The site is within the area administered by Worthing Borough Council (WBC), and is accessed from 53 Station Road. The site is a previously developed (but now vacant) plot whose area is approximately 1460m^2. A site location plan and aerial view of the site are shown in Appendix A.

2.2 Although there is some soft landscaping around the edges of the site, the majority of the surfacing is of concrete, ie impermeable.

2.3 The site is some 880m southwest of the nearest watercourse, this being a brook that discharges into the nearby Teville Stream in East Worthing.

2.4 Geology: the BGS online map shows that the site's solid geology is 'London Clay Formation' (clay, silt and sand) with drift (superficial) deposits of 'Raised Beach Deposits' (sand and gravel).

2.5 The topographic survey in Appendix B shows the site slopes towards the southwest corner; its levels range from 3.86m AOD at the northeast corner to 2.60m AOD at the southwest corner.

2.6 The existing greenfield run off rate has been estimated using Micro Drainage's ICP SUDS application. This shows that for an area of 0.146 ha, the urban QBar run off rate is 1.4*l/s*. The Q100 rate is 2.8*l/s*.

2.7 According to the Environment Agency's (EA) Fluvial Flood Map in Appendix C, the site falls within Flood Zone 1 (FZ1), which is land designated as having a low probability of flooding from watercourses (less than 1 in 1000 or 0.1% annual chance of flooding). The site does not benefit from defences.

2.8 The EA's 'Flooding from Surface Water' map shows the risk of flooding from overland flow or surface water within the site to be 'very low'. There is an overland flow route along the southwest edge of the site but this is limited to Station Road and a few metres within the site – see map in Appendix C. The maximum depth in the Low Chance (1 in 1000 years) storm is 0.3m – 0.9m. As the flood pattern extends some 25m into the site where the level is approximately 3.09m AOD, it is deduced that the maximum depth along this part of Station Road is 490mm (as the level drops to 2.60m AOD). Note that this is the worst case scenario – the most extreme storm.

2.9 The 2011 Strategic Flood Risk Assessment (SFRA) commissioned by WBC confirms that there is risk of flooding from surface water to the southwest quarter of the site. The map showing historical flooding incidents in the SFRA also indicates that there have been 2 sewer flood events that have affected this part of the site.

2.10 It can be concluded that the main sources of flooding to this site is surface water and sewer flooding. The southwest corner is the most affected part of the site. The maximum flood level of the recorded incidents and the EA's 'Low Chance' surface water flood map is approximately 3.1m AOD.

2.11 Groundwater: the site lies over a 'Minor Aquifer High' zone according to the Environment Agency's (EA) Groundwater vulnerability zone map – refer to Appendix C. The site is removed from the nearest Groundwater Source Protection Zone.

3.0 PROPOSED SITE AND DRAINAGE STRATEGY

3.1 The application is to construct 14 No flats over 3 levels with access road, parking spaces, paths and soft landscaping - see the proposed drawings in Appendix B.

3.2 As stated in section 2.14, the main sources of flooding is surface water and sewer flooding up to a level of approximately 3.1m AOD. The lowest floor level of the units will be 3.89m AOD, which provides a freeboard of over 0.75m. This is well in excess of the minimum freeboard of 0.3m that the NPPF requires in new developments.

3.3 Safe access to dry land: the units are removed from the threat of flooding. Occupants will be safe in their dwellings. If, during the peak of a flood event, they wish to travel away from the site, they would have to negotiate through flood waters up to 500mm deep. According to the Flood Hazard Table (figure 1 below) depths of up to 0.5m, where the velocity is no greater than 0.5m/s, are not hazardous (safe) to all users.

3.4 If the velocity of the flow is no greater than 1.5m/s then the more vulnerable occupants would be in danger if they attempted to wade through these flood waters. It must be noted that a) there should be no compunction for users to do so as they will be safe if they wait for the level to recede and b) this is the peak depths in the most extreme storm events.

d * (v+0.5) + DF

Velocity \ Depth	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
0.00	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25
0.50	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
1.00	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75
1.50	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
2.00	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
2.50	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
3.00	0.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75
3.50	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
4.00	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25
4.50	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
5.00	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75

Categories of flood hazard:

	From	To	
Class 1	0.75	1.50	Danger for some
Class 2	1.50	2.50	Danger for most
Class 3	2.50	20.00	Danger for all

Note: The table gives values of flood hazard (= d-(v+0.5) +DF)

Fig 1: Flood Hazard Table from *DEFRA/Environment Agency's Flood Risks to People, Phase 2, FD2321/TR2*

3.5 The total roof area of houses and garages is 437m^2. The area of paths, driveways, and access road is 448m^2; resulting in a total impermeable area of 885m^2. – see proposed drainage drawing in Appendix B.

3.6 Surface water drainage strategy: given the site's possible contamination due to previous industrial use(s), combined with it overlying an aquifer, it is proposed to discharge the surface water at a limited rate into Southern Water's sewer in Station Road. This is subject to SW's permission.

3.7 The offsite flow rate will be restricted to 4.00l/s in the '1 in 100 year plus 30% climate change' storm event, this being the practical minimum limit of devices like orifice plates and hydrobrakes. This is not much greater than the Q100 rate of 2.8l/s.

3.8 An offline cellular crate attenuation tank has been designed using Micro Drainage to hold the volume of the critical '1 in 100 year plus 30% climate change' flood. The tank's dimensions are 160m^2 x 0.4m deep x 0.95 void ratio = **60.8m^3** – refer to Appendix D for calculation sheets.

3.9 The site overlies an aquifer (section 2.9) which is considered a sensitive environment. To mitigate the risk of contamination, it is proposed to discharge the surface water from the access road and parking areas via deep-trapped gullies.

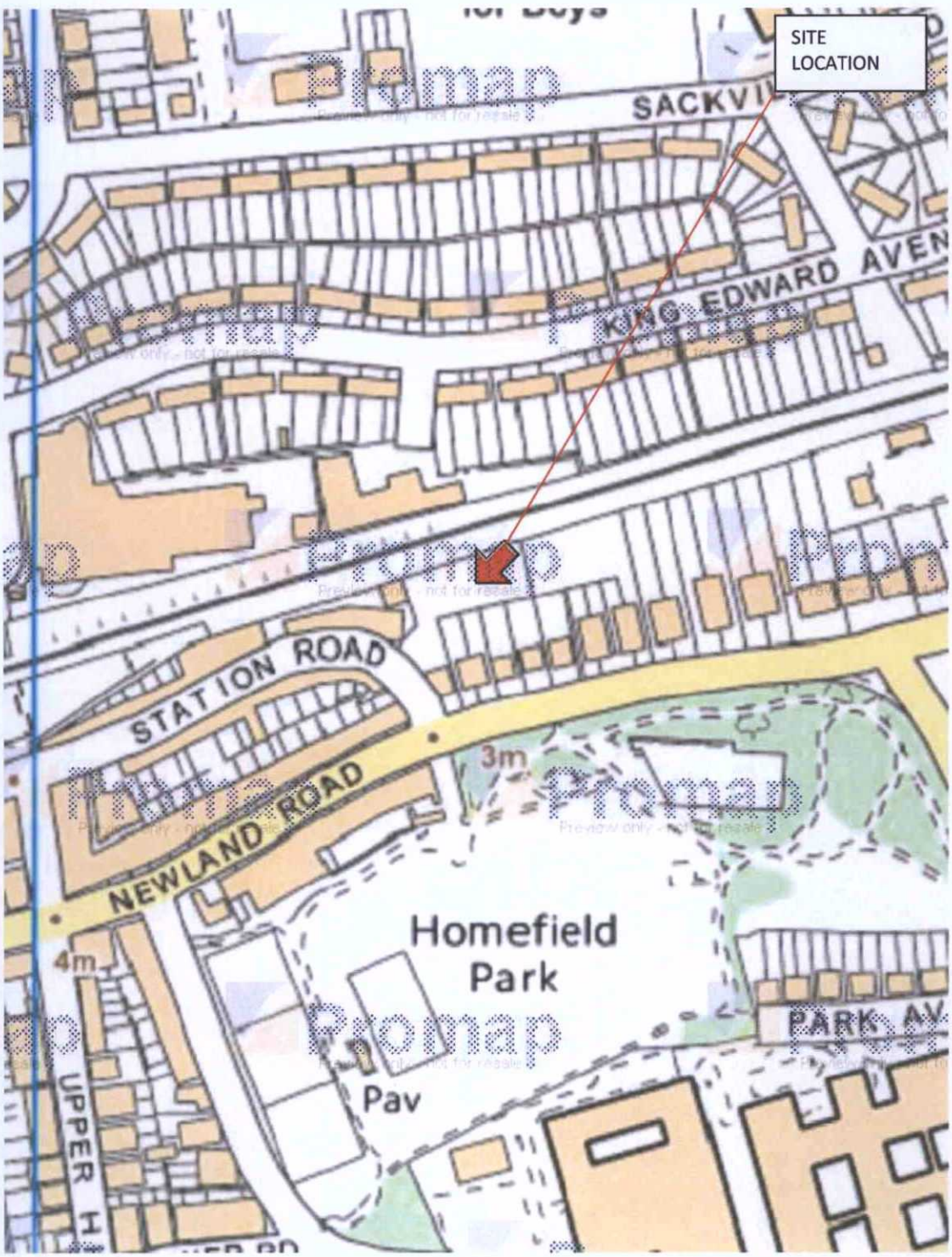
3.10 It is contended that, by attenuating the offsite flow rate to a run off rate of 4.0l/s, this is sustainable and in line with the EA and PPG.

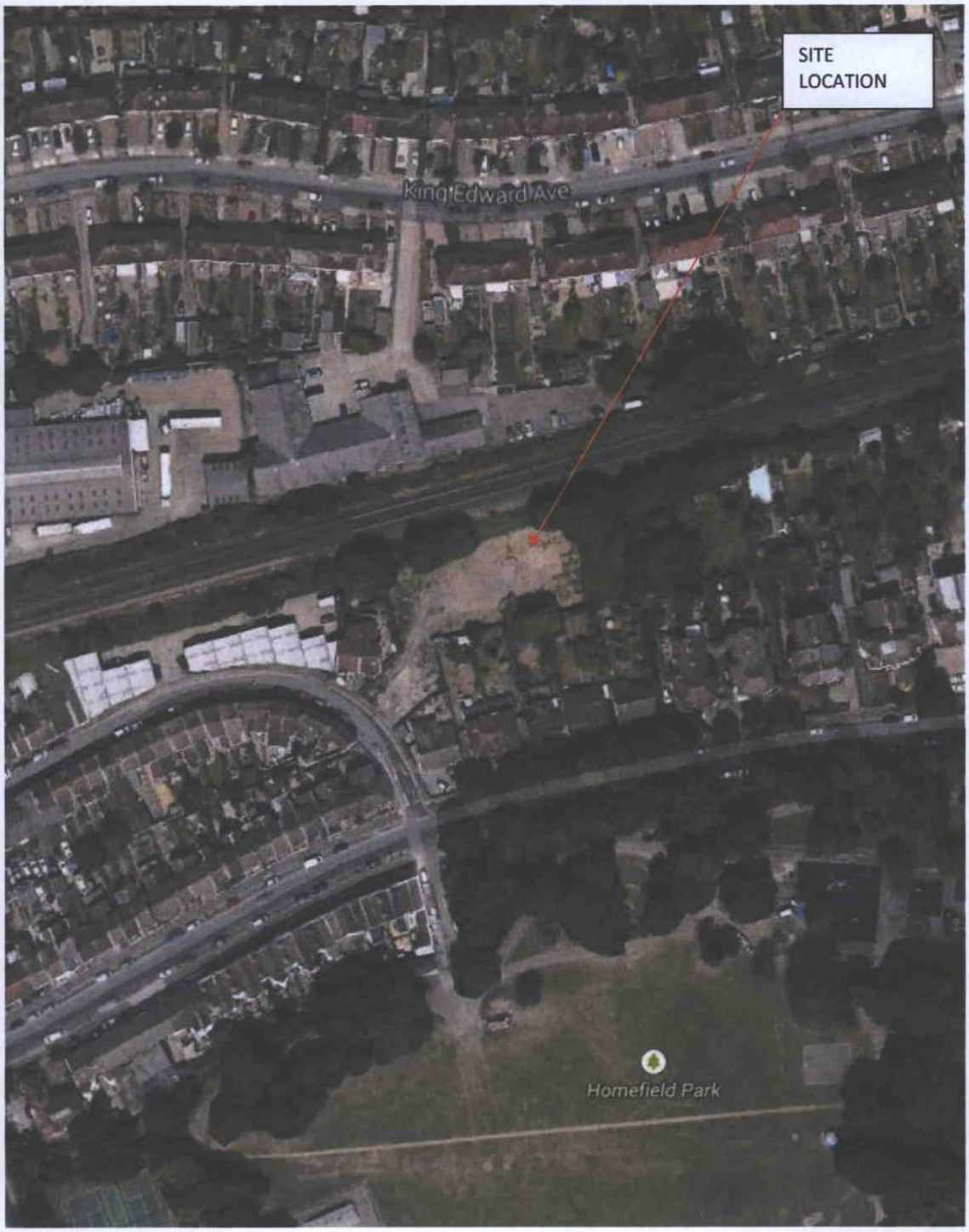
3.11 It is concluded that with these measures in place, the flood risk to this site and to the neighbouring properties is low and will not be increased by this development. It complies fully with the 2012 NPPF and 2014 PPG.

– End of Report –

APPENDIX A

Site Location Map and Aerial View




SITE
LOCATION
King Edward Ave
Homefield Park

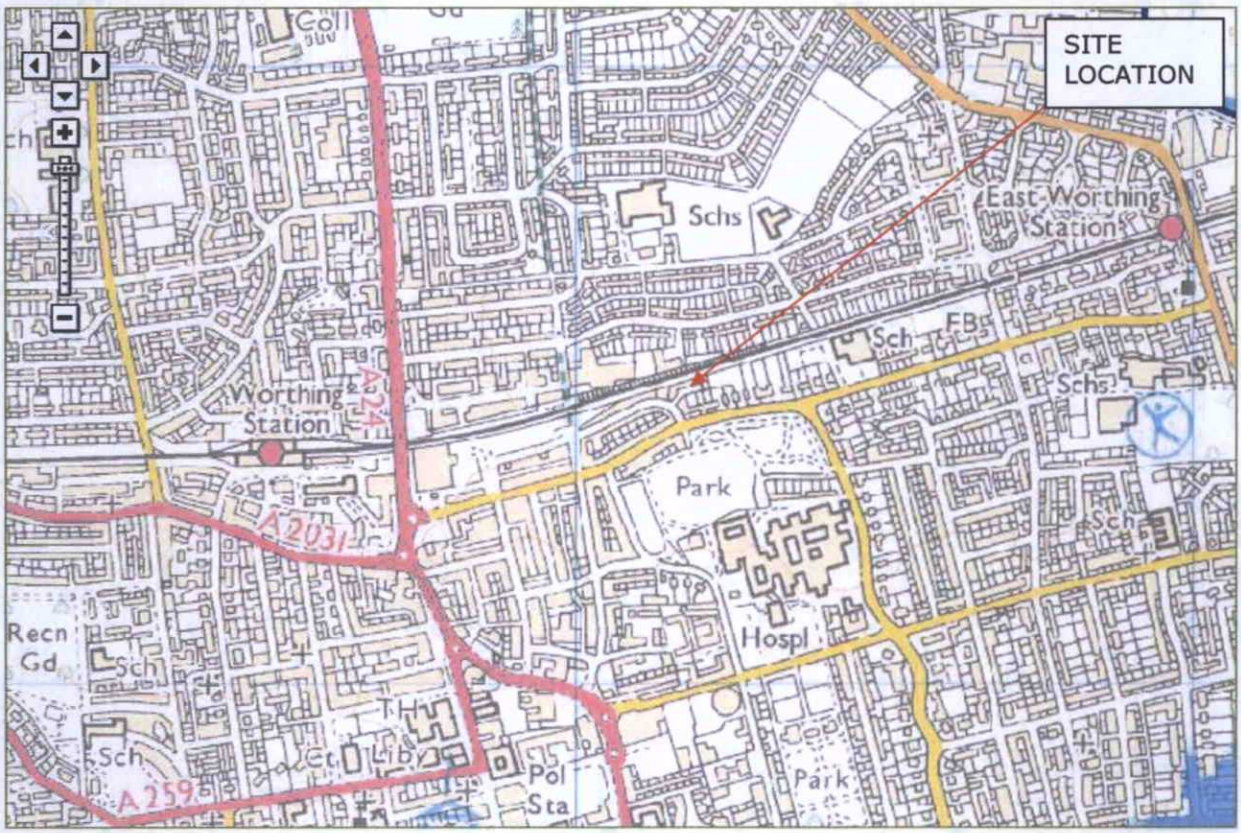
APPENDIX B

Topographic Survey, Scheme Drawings & Proposed Drainage Strategy Layout

APPENDIX C

Environment Agency & SFRA Maps

Map of BN11 1JY at scale 1:10,000 Other maps Data search Text only version



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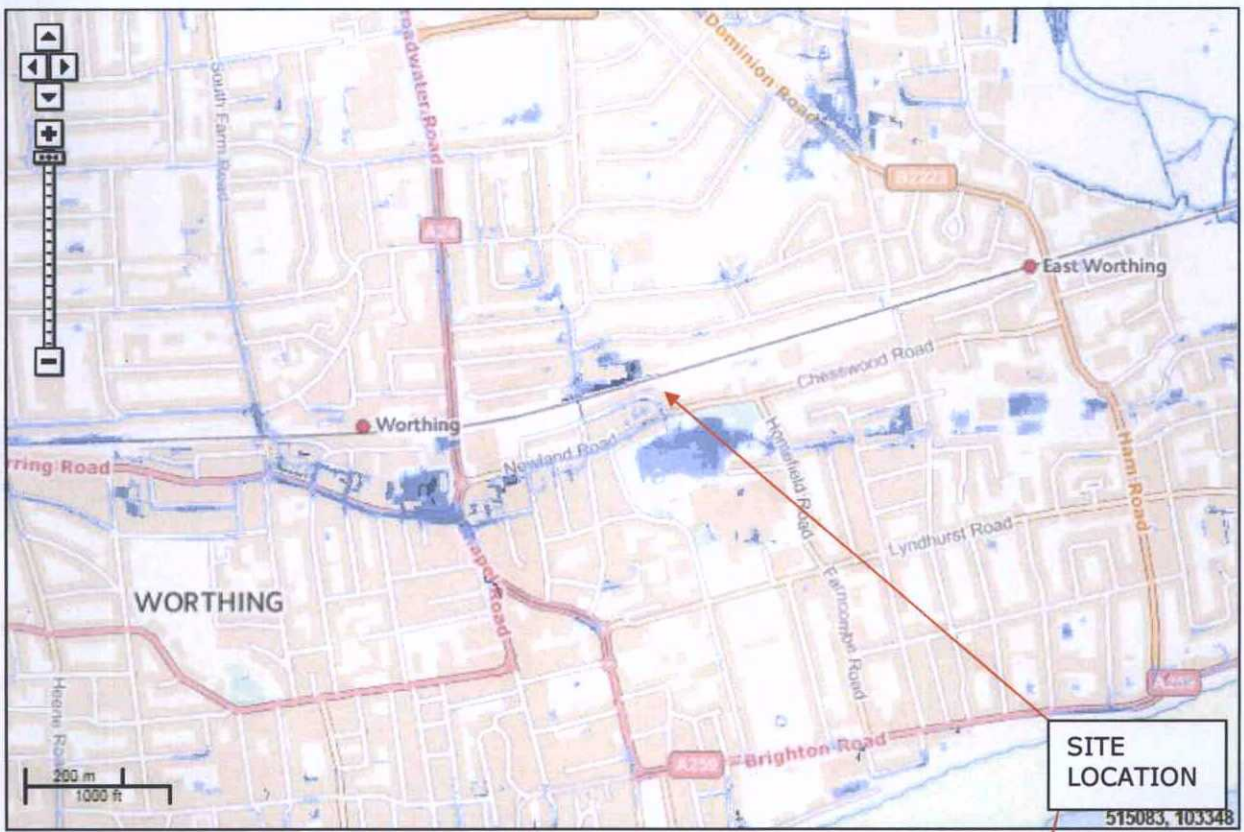
- Flooding from rivers or sea without defences
- Extent of extreme flood
- Flood defences (Not all may be shown*)
- Areas benefiting from flood defences (Not all may be shown*)
- Main rivers

EA's Rivers and Sea Flood Map – 'Risk of Flooding from Rivers and Seas'

The site is within Flood Zone 1 (FZ1)

Map of BN11 1JY at scale 1:10,000 Data search



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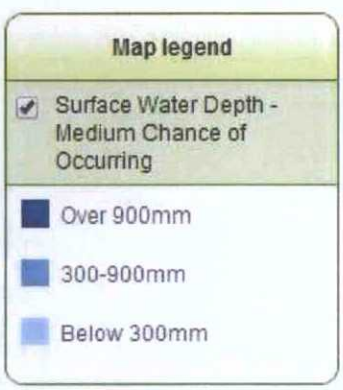
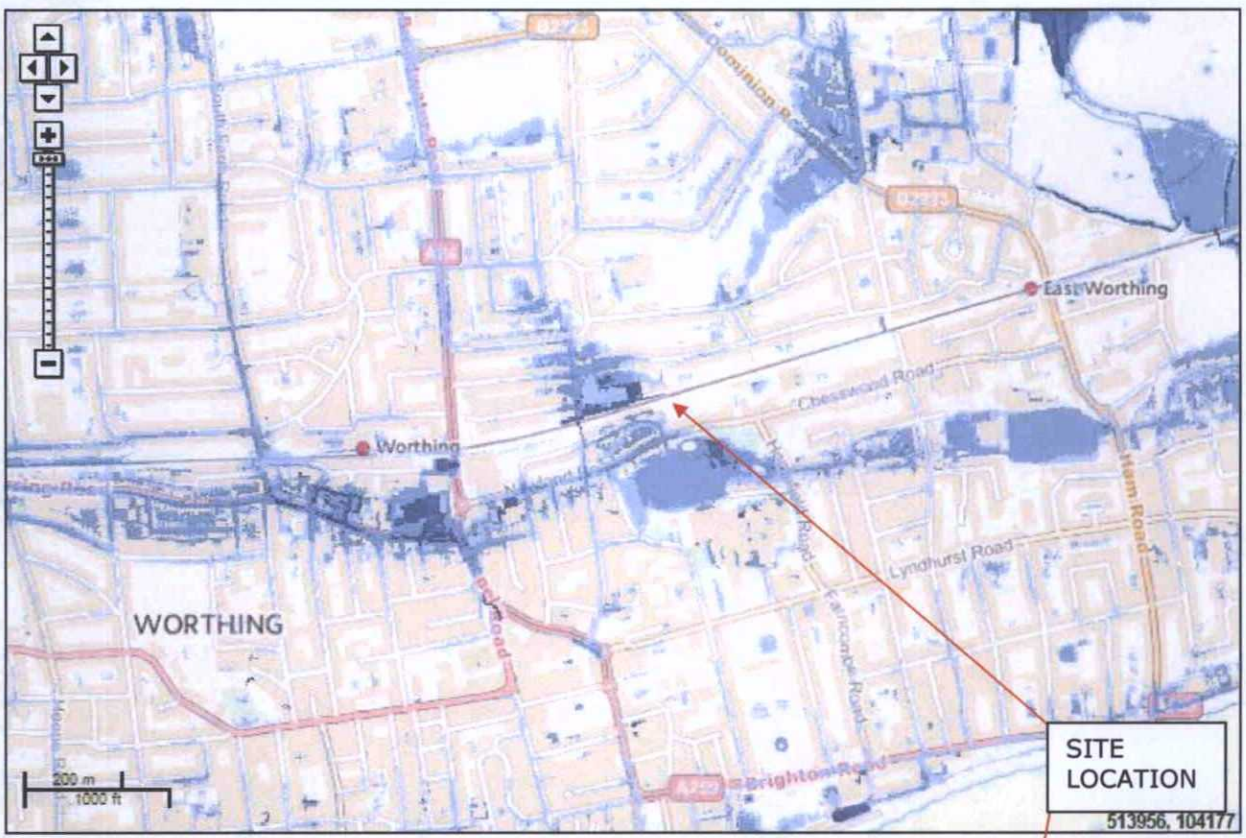




EA's Surface Water Depth Map for a 'Medium Chance' of Occurring
(Between a '1 in 30 year' and '1 in 100 year' storm event)

The site is clear of surface water flooding in this storm intensity.

Map of BN11 1JY at scale 1:10,000 Data search



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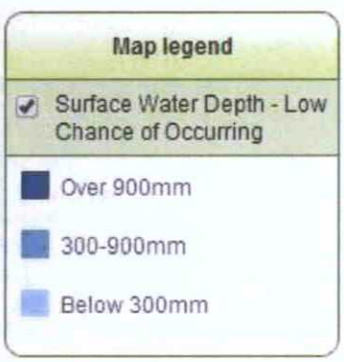
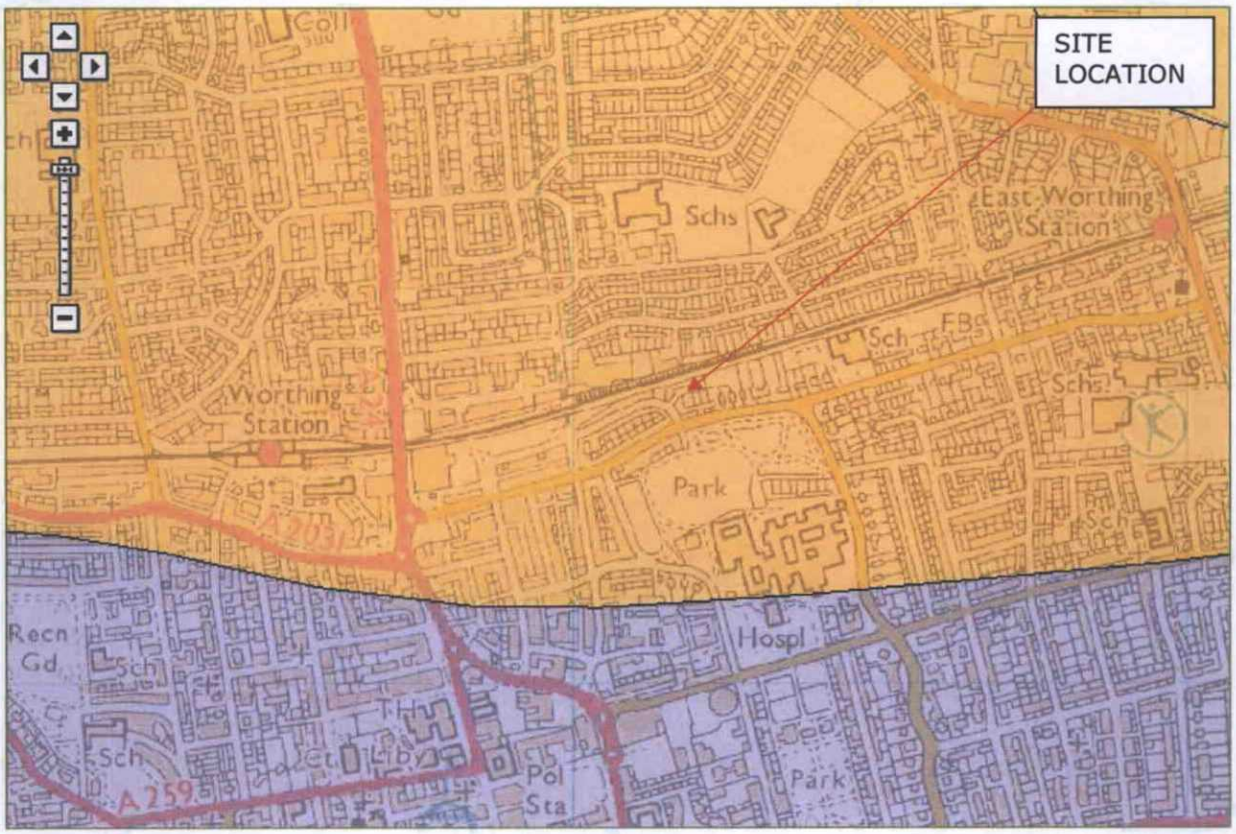




EA's Surface Water Depth Map for a 'Low Chance' of Occurring
(Between a '1 in 100 year' and '1 in 1000 year' storm event)

The majority of the site is clear but the overland flow extends to a part of the site whose elevation is approximately 3.0m AOD

Map of BN11 1JY at scale 1:10,000 Other maps Data search Text only version



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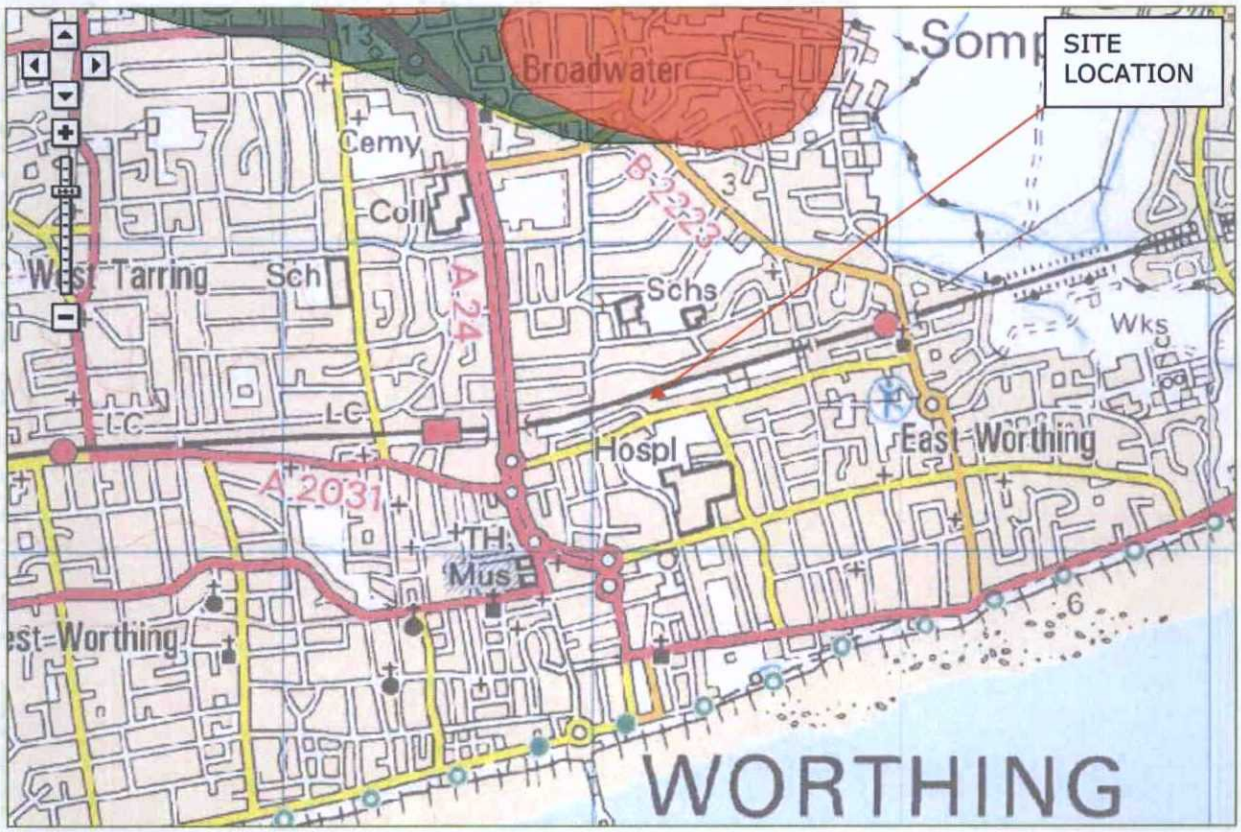
EA's 'Groundwater Vulnerability Zones' Map

The site overlies a 'Minor Aquifer High'

BN11 1JY at scale 1:20,000 Other maps Data search Text only version



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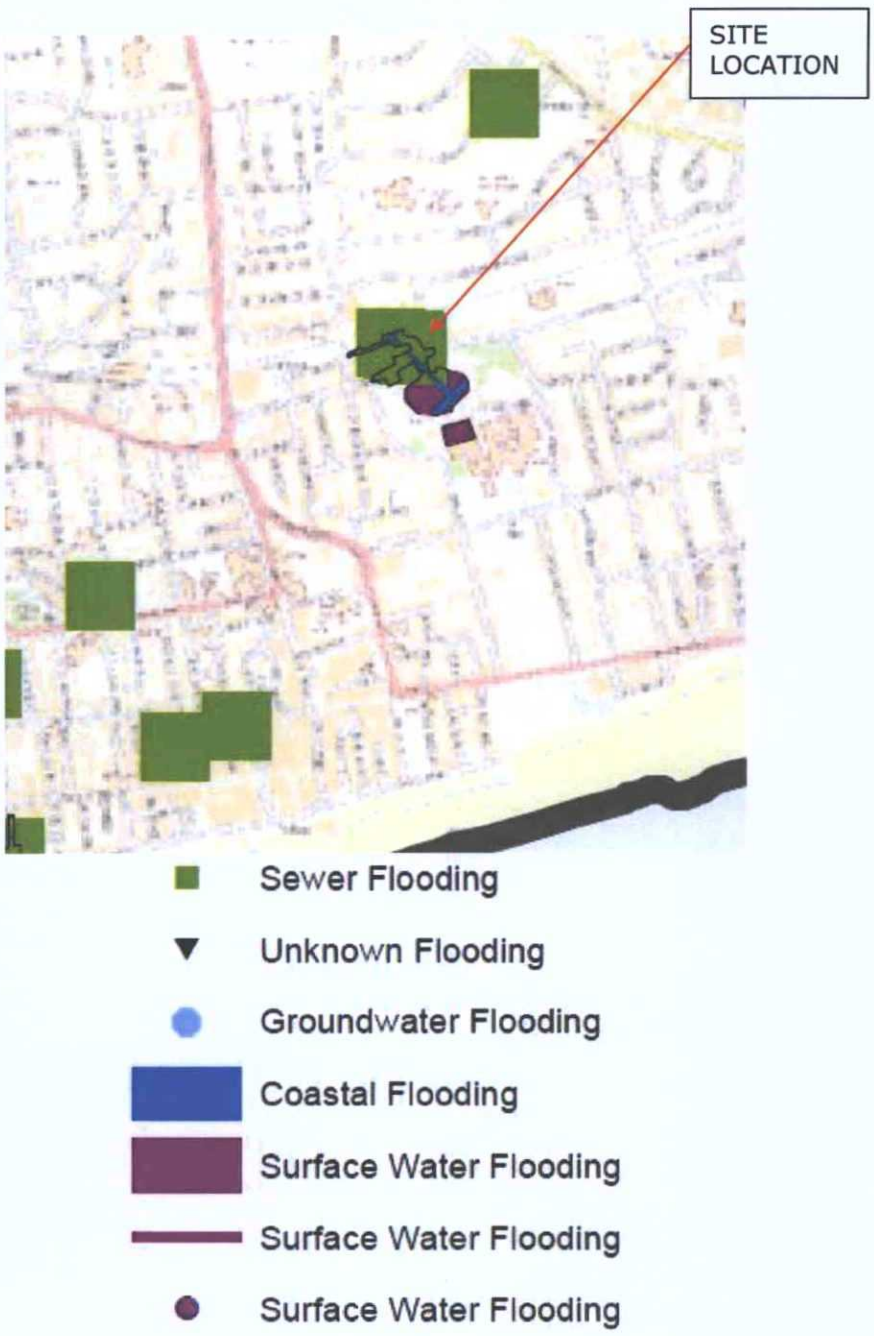
EA's 'Groundwater Source Protection Zones' map

The site is clear of the nearest such Zone



SFRA Historical Incidents Map (Map3)

The SW corner of the site has suffered from sewer flooding and surface water flooding incidents

APPENDIX D

Micro Drainage Calculations

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.067	4-8	0.029

Total Area Contributing (ha) = 0.096

Total Pipe Volume (m^3) = 3.249

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	13.360	0.220	60.7	0.040	5.00	0.0	0.600	o	150
S2.000	23.063	0.120	192.2	0.040	5.00	0.0	0.600	o	150
S1.001	14.502	0.281	51.6	0.010	0.00	0.0	0.600	o	225
S3.000	8.411	0.036	233.6	0.000	5.00	0.0	0.600	o	225
S1.002	14.502	0.100	145.0	0.006	0.00	0.0	0.600	o	375
S1.003	5.235	0.049	106.8	0.000	0.00	0.0	0.600	o	150

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S1.000	3.070	0.040	0.0	1.29	22.8
S2.000	2.970	0.040	0.0	0.72	12.7
S1.001	2.775	0.090	0.0	1.82	72.6
S3.000	2.530	0.000	0.0	0.85	33.8
S1.002	2.344	0.096	0.0	1.50	165.9
S1.003	2.244	0.096	0.0	0.97	17.2

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.040	0.040	0.040
2.000	-	-	100	0.040	0.040	0.040
1.001	-	-	100	0.010	0.010	0.010
3.000	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.006	0.006	0.006
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.096	0.096	0.096

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.003	S	2.600	2.195	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Storm Duration (mins)	15
Ratio R	0.340		

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Online Controls for Storm

Hydro-Brake® Manhole: S5, DS/PN: S1.003, Volume (m³): 2.2

Design Head (m) 0.800 Hydro-Brake® Type Md6 SW Only Invert Level (m) 2.244
Design Flow (l/s) 4.0 Diameter (mm) 88

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.5	1.200	4.8	3.000	7.7	7.000	11.7
0.200	3.5	1.400	5.2	3.500	8.3	7.500	12.1
0.300	3.3	1.600	5.6	4.000	8.8	8.000	12.5
0.400	3.2	1.800	5.9	4.500	9.4	8.500	12.9
0.500	3.3	2.000	6.2	5.000	9.9	9.000	13.3
0.600	3.5	2.200	6.6	5.500	10.4	9.500	13.6
0.800	4.0	2.400	6.8	6.000	10.8		
1.000	4.4	2.600	7.1	6.500	11.3		

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Storage Structures for Storm

Cellular Storage Manhole: S4, DS/PN: S3.000

Invert Level (m) 2.530 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.98
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	100.0	100.0	0.700	0.0	124.0
0.600	100.0	124.0			

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR Ratio R	0.339
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.900	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.000	15 Winter	100	+30%					
S2.000	15 Winter	100	+30%	100/15 Summer				
S1.001	15 Winter	100	+30%					
S3.000	60 Winter	100	+30%	100/30 Winter				
S1.002	15 Winter	100	+30%	30/15 Summer				
S1.003	15 Summer	100	+30%	1/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	3.211	-0.009	0.000	1.00	0.0	20.9	OK
S2.000	S6	3.334	0.214	0.000	1.65	0.0	19.9	FLOOD RISK
S1.001	S2	2.991	-0.009	0.000	0.71	0.0	45.2	OK
S3.000	S4	2.805	0.050	0.000	0.13	0.0	3.6	SURCHARGED
S1.002	S5	2.846	0.127	0.000	0.11	0.0	14.0	FLOOD RISK
S1.003	S5	2.861	0.467	0.000	0.25	0.0	3.5	FLOOD RISK

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Micro Drainage

File SW Network KEALSED TAN SOLS.mdx
Date 13.5.15

Network Solid.1

Checked by M. Stevenson
Designed by MR

Wear Swaaex Khis 3A3
Bryaeaa HILL
eea Cpmrcp Mark

60 min Winter
1 in 100yr+30%
Micro

Page 1

ATA Civil Ltd

US (mm)	Dia (mm)	Grade (1:X)	Area (ha)	US IL (m)	DS IL (m)	Water level (m)	Maximum volume (m^3)	Flow (l/s)	Status
1	150	40.000	0.000	5.000	4.850	5.814	5.104	8.401	FLOOD RISK
2	375	200.0	0.000	4.850	4.844	5.834	1.345	0.242	FLOOD RISK
3	225	200.0	0.000	4.420	4.230	5.808	52.252	3.333	SURCHARGED
4	225	40.000	0.000	4.000	3.950	5.811	0.114	3.971	OK
5	150	40.000	0.000	4.000	3.950	5.080	0.158	3.512	OK
6	150	40.000	0.000	4.000	3.950	4.127	0.380	7.103	OK

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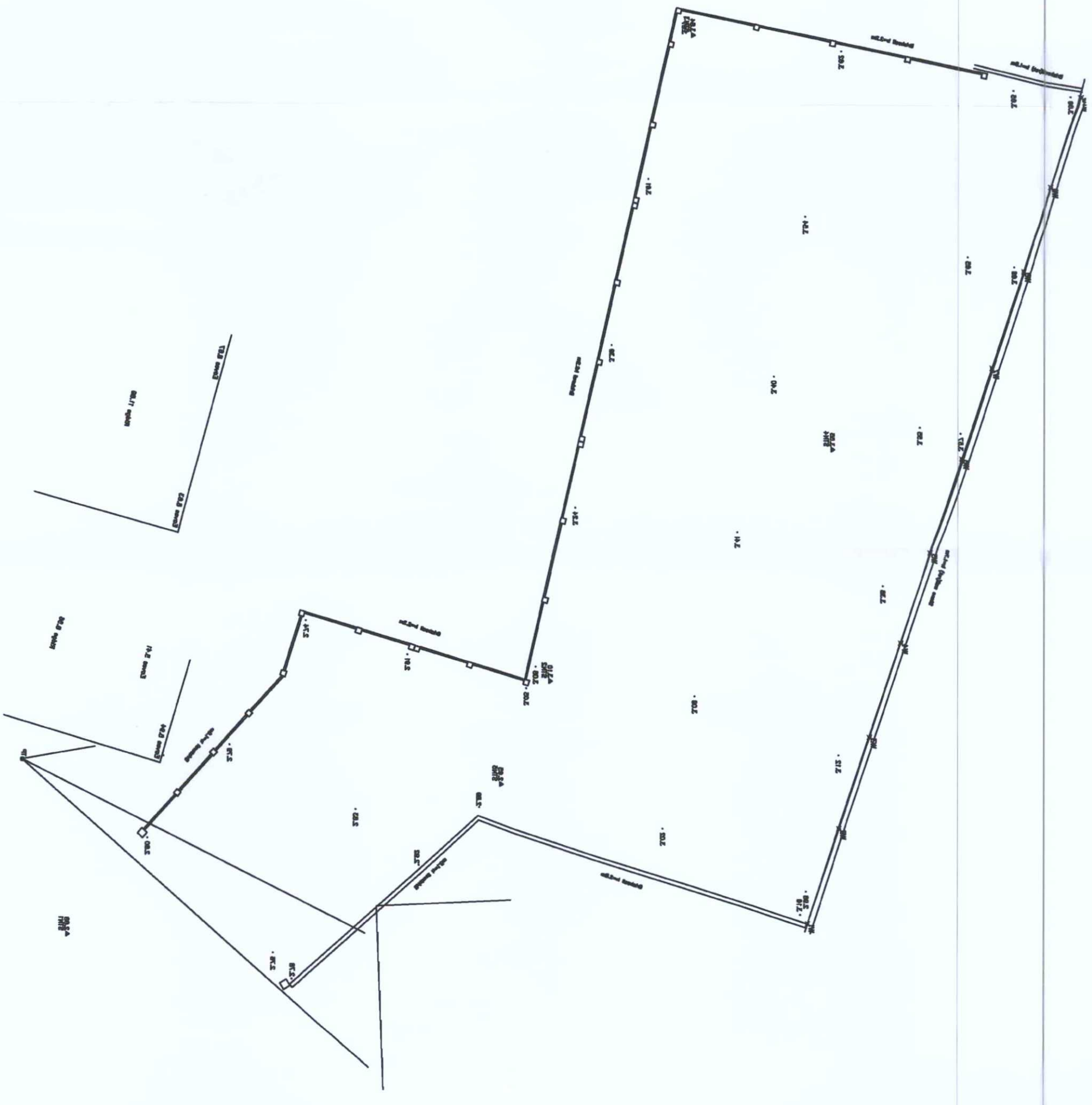

Item no.	Quantity	Title/Name, description, material, dimension etc	Architects Reference

Designed	Checked by	Approved	Drawing Number	Date	Scale
MCB			2020 Road Station	03\11	1:500

LAND NORTH EAST OF STATION ROAD WORTHING

LANDSCAPING AND PLANTING

Edition

Sheet

KEY TO PLANTING

1	Quercus ilex holly oak
2	Quercus robur English oak
3	Mixed hedge of Forsythia, Prunus laurel, Red robin, and Pyracantha
4	Salix Pendula Weeping willow
5	Mix of low growing varieties of Hebe, Hellenthemum, and Rosemarinus officinalis
6	Quercus cerris Turkey oak
7	Ilex aquifolium Holly
8	Acer palmatum Japanese maple
9	Silver birch

KEY TO HARD STANDING

1	Red multi block paving (note: paving above de-illustrated in alternative colourised block paving)
2	Indian stone paving (all paths)

Indian stone 2

Multi stone 1

Block paving 1

Timber sleepers 3

Trees 4

Shrubs 5

Grass 6

Kerbs 7

Gravel 8

Fencing 9

Lighting 10

Bollards 11

Signage 12

Benches 13

Bins 14

Cycle stands 15

Planters 16

Water features 17

Sculptures 18

Boundary walls 19

Retaining walls 20

Steps 21

Ramps 22

Handrails 23

Guardrails 24

Balustrades 25

Columns 26

Arches 27

Pergolas 28

Canopies 29

Awnings 30

Shelters 31

Gazebos 32

Summerhouses 33

Greenhouses 34

Polytunnels 35

Cold frames 36

Compost bins 37

Rainwater butts 38

Soil 39

Mulch 40

Fertilizer 41

Pesticides 42

Herbicides 43

Fungicides 44

Insecticides 45

Rodenticides 46

Molluscicides 47

Nematicides 48

Acaricides 49

Miticides 50

Ovicides 51

Larvicides 52

Pupicides 53

Adulticides 54

Repellents 55

Attractants 56

Traps 57

Lures 58

Baits 59

Pheromones 60

Hormones 61

Enzymes 62

Proteins 63

Peptides 64

Amino acids 65

Nucleic acids 66

DNA 67

RNA 68

Genes 69

Chromosomes 70

Cells 71

Tissues 72

Organs 73

Organisms 74

Species 75

Genera 76

Families 77

Orders 78

Classes 79

Phyla 80

Kingdoms 81

Domains 82

Life 83

Earth 84

Solar system 85

Galaxy 86

Universe 87

Time 88

Space 89

Matter 90

Energy 91

Mass 92

Weight 93

Volume 94

Density 95

Pressure 96

Temperature 97

Heat 98

Light 99

Sound 100

Electricity 101

Magnetism 102

Gravity 103

Motion 104

Force 105

Work 106

Power 107

Speed 108

Velocity 109

Acceleration 110

Momentum 111

Inertia 112

Friction 113

Elasticity 114

Viscosity 115

Surface tension 116

Capillarity 117

Osmosis 118

Diffusion 119

Convection 120

Conduction 121

Radiation 122

Thermodynamics 123

Entropy 124

Enthalpy 125

Free energy 126

Chemical potential 127

Phase transition 128

Critical point 129

Triple point 130

Boiling point 131

Melting point 132

Freezing point 133

Sublimation 134

Deposition 135

Evaporation 136

Condensation 137

Precipitation 138

Infiltration 139

Percolation 140

Groundwater 141

Aquifer 142

Spring 143

River 144

Lake 145

Ocean 146

Atmosphere 147

Weather 148

Climate 149

Ecosystem 150

Biome 151

Habitat 152

Niche 153

Population 154

Community 155

Food web 156

Food chain 157

Trophic level 158

Producer 159

Consumer 160

Decomposer 161

Detritus 162

Nutrient cycle 163

Carbon cycle 164

Nitrogen cycle 165

Phosphorus cycle 166

Water cycle 167

Rock cycle 168

Plate tectonics 169

Continental drift 170

Seafloor spreading 171

Subduction 172

Volcanism 173

Earthquake 174

Mountain building 175

Erosion 176

Weathering 177

Soil formation 178

Soil horizon 179

Soil profile 180

Soil texture 181

Soil structure 182

Soil porosity 183

Soil permeability 184

Soil water content 185

Soil temperature 186

Soil pH 187

Soil nutrients 188

Soil organic matter 189

Soil microorganisms 190

Soil fauna 191

Soil flora 192

Soil fungi 193

Soil bacteria 194

Soil viruses 195

Soil archaea 196

Soil protists 197

Soil algae 198

Soil lichens 199

Soil mosses 200

Soil ferns 201

Soil conifers 202

Soil deciduous trees 203

Soil shrubs 204

Soil grasses 205

Soil herbs 206

Soil vines 207

Soil epiphytes 208

Soil parasites 209

Soil saprophytes 210

Soil symbionts 211

Soil mutualists 212

Soil commensals 213

Soil amensals 214

Soil competitors 215

Soil predators 216

Soil prey 217

Soil hosts 218

Soil vectors 219

Soil pathogens 220

Soil diseases 221

Soil immunity 222

Soil resistance 223

Soil tolerance 224

Soil adaptation 225

Soil evolution 226

Soil speciation 227

Soil extinction 228

Soil biodiversity 229

Soil conservation 230

Soil restoration 231

Soil remediation 232

Soil pollution 233

Soil contamination 234

Soil degradation 235

Soil erosion 236

Soil compaction 237

Soil salinization 238

Soil desertification 239

Soil loss 240

Soil management 241

Soil tillage 242

Soil drainage 243

Soil irrigation 244

Soil fertilization 245

Soil liming 246

Soil mulching 247

Soil composting 248

Soil vermiculture 249

Soil aquaculture 250

Soil hydroponics 251

Soil aeroponics 252

Soil aquaponics 253

Soil permaculture 254

Soil agroforestry 255

Soil silvopasture 256

Soil alley cropping 257

Soil intercropping 258

Soil crop rotation 259

Soil fallow 260

Soil cover crop 261

Soil green manure 262

Soil no-till 263

Soil minimum tillage 264

Soil conservation tillage 265

Soil strip tillage 266

Soil ridge tillage 267

Soil contour farming 268

Soil terracing 269

Soil swales 270

Soil keyline design 271

Soil holistic management 272

Soil regenerative agriculture 273

Soil organic farming 274

Soil biodynamic farming 275

Soil natural farming 276

Soil permaculture design 277

Soil agroecology 278

Soil sustainable agriculture 279

Soil ecological agriculture 280

Soil low-input agriculture 281

Soil high-input agriculture 282

Soil conventional agriculture 283

Soil industrial agriculture 284

Soil monoculture 285

Soil polyculture 286

Soil genetic engineering 287

Soil genetically modified organisms 288

Soil transgenic crops 289

Soil hybrid crops 290

Soil heirloom varieties 291

Soil landrace varieties 292

Soil wild relatives 293

Soil germplasm 294

Soil seed bank 295

Soil gene bank 296

Soil tissue culture 297

Soil micropropagation 298

Soil somatic embryogenesis 299

Soil protoplast fusion 300

Soil haploid breeding 301

Soil marker-assisted selection 302

Soil genomic selection 303

Soil CRISPR-Cas9 304

Soil gene editing 305

Soil synthetic biology 306

Soil nanotechnology 307

Soil precision agriculture 308

Soil digital agriculture 309

Soil robotic agriculture 310

Soil autonomous agriculture 311

Soil vertical farming 312

Soil controlled environment agriculture 313

Soil urban agriculture 314

Soil peri-urban agriculture 315

Soil rural agriculture 316

Soil subsistence agriculture 317

Soil commercial agriculture 318

Soil export agriculture 319

Soil import substitution agriculture 320

Soil food security 321

Soil food sovereignty 322

Soil food justice 323

Soil food ethics 324

Soil food culture 325

Soil food tradition 326

Soil food heritage 327

Soil food identity 328

Soil food quality 329

Soil food safety 330

Soil food nutrition 331

Soil food health 332

Soil food medicine 333

Soil food pharmacology 334

Soil food toxicology 335

Soil food allergy 336

Soil food intolerance 337

Soil food sensitivity 338

Soil food preference 339

Soil food choice 340

Soil food habit 341

Soil food behavior 342

Soil food psychology 343

Soil food sociology 344

Soil food anthropology 345

Soil food history 346

Soil food geography 347

Soil food economics 348

Soil food politics 349

Soil food law 350

Soil food policy 351

Soil food regulation 352

Soil food standard 353

Soil food certification 354

Soil food labeling 355

Soil food marketing 356

Soil food advertising 357

Soil food consumption 358

Soil food waste 359

Soil food loss 360

Soil food recovery 361

Soil food recycling 362

Soil food composting 363

Soil food anaerobic digestion 364

Soil food biogas 365

Soil food biofuel 366

Soil food bioplastic 367

Soil food biomaterial 368

Soil food biochemical 369

Soil food pharmaceutical 370

Soil food cosmetic 371

Soil food textile 372

Soil food paper 373

Soil food wood 374

Soil food fiber 375

Soil food fuel 376

Soil food energy 377

Soil food water 378

Soil food air 379

Soil food soil 380

Soil food land 381

Soil food space 382

Soil food time 383

Soil food matter 384

Soil food energy 385

Soil food mass 386

Soil food weight 387

Soil food volume 388

Soil food density 389

Soil food pressure 390

Soil food temperature 391

Soil food heat 392

Soil food light 393

Soil food sound 394

Soil food electricity 395

Soil food magnetism 396

Soil food gravity 397

Soil food motion 398

Soil food force 399

Soil food work 400

Soil food power 401

Soil food speed 402

Soil food velocity 403

Soil food acceleration 404

Soil food momentum 405

Soil food inertia 406

Soil food friction 407

Soil food elasticity 408

Soil food viscosity 409

Soil food surface tension 410

Soil food capillarity 411

Soil food osmosis 412

Soil food diffusion 413

Soil food convection 414

Soil food conduction 415

Soil food radiation 416

Soil food thermodynamics 417

Soil food entropy 418

Soil food enthalpy 419

Soil food free energy 420

Soil food chemical potential 421

Soil food phase transition 422

Soil food critical point 423

Soil food triple point 424

Soil food boiling point 425

Soil food melting point 426

Soil food freezing point 427

Soil food sublimation 428

Soil food deposition 429

Soil food evaporation 430

Soil food condensation 431

Soil food precipitation 432

Soil food infiltration 433

Soil food percolation 434

Soil food groundwater 435

Soil food aquifer 436

Soil food spring 437

Soil food river 438

Soil food lake 439

Soil food ocean 440

Soil food atmosphere 441

Soil food weather 442

Soil food climate 443

Soil food ecosystem 444

Soil food biome 445

Soil food habitat 446

Soil food niche 447

Soil food population 448

Soil food community 449

Soil food food web 450

Soil food food chain 451

Soil food trophic level 452

Soil food producer 453

Soil food consumer 454

Soil food decomposer 455

Soil food detritus 456

Soil food nutrient cycle 457

Soil food carbon cycle 458

Soil food nitrogen cycle 459

Soil food phosphorus cycle 460

Soil food water cycle 461

Soil food rock cycle 462

Soil food plate tectonics 463

Soil food continental drift 464

Soil food seafloor spreading 465

Soil food subduction 466

Soil food volcanism 467

Soil food earthquake 468

Soil food mountain building 469

Soil food erosion 470

Soil food weathering 471

Soil food soil formation 472

Soil food soil horizon 473

Soil food soil profile 474

Soil food soil texture 475

Soil food soil structure 476

Soil food soil porosity 477

Soil food soil permeability 478

Soil food soil water content 479

Soil food soil temperature 480

Soil food soil pH 481

Soil food soil nutrients 482

Soil food soil organic matter 483

Soil food soil microorganisms 484

Soil food soil fauna 485

Soil food soil flora 486

Soil food soil fungi 487

Soil food soil bacteria 488

Soil food soil viruses 489

Soil food soil archaea 490

Soil food soil protists 491

Soil food soil algae 492

Soil food soil lichens 493

Soil food soil mosses 494

Soil food soil ferns 495

Soil food soil conifers 496

Soil food soil deciduous trees 497

Soil food soil shrubs 498

Soil food soil grasses 499

Soil food soil herbs 500

Soil food soil vines 501

Soil food soil epiphytes 502

Soil food soil parasites 503

Soil food soil saprophytes 504

Soil food soil symbionts 505

Soil food soil mutualists 506

Soil food soil commensals 507

Soil food soil amensals 508

Soil food soil competitors 509

Soil food soil predators 510

Soil food soil prey 511

Soil food soil hosts 512

Soil food soil vectors 513

Soil food soil pathogens 514

Soil food soil diseases 515

Soil food soil immunity 516

Soil food soil resistance 517

Soil food soil tolerance 518

Soil food soil adaptation 519

Soil food soil evolution 520

Soil food soil speciation 521

Soil food soil extinction 522

Soil food soil biodiversity 523

Soil food soil conservation 524

Soil food soil restoration 525

Soil food soil remediation 526

Soil food soil pollution 527

Soil food soil contamination 528

Soil food soil degradation 529

Soil food soil erosion 530

Soil food soil compaction 531

Soil food soil salinization 532

Soil food soil desertification 533

Soil food soil loss 534

Soil food soil management 535

Soil food soil tillage 536

Soil food soil drainage 537

Soil food soil irrigation 538

Soil food soil fertilization 539

Soil food soil liming 540

Soil food soil mulching 541

Soil food soil composting 542

Soil food soil vermiculture 543

Soil food soil aquaculture 544

Soil food soil hydroponics 545

Soil food soil aeroponics 546

Soil food soil aquaponics 547

Soil food soil permaculture 548

Soil food soil agroforestry 549

Soil food soil silvopasture 550

Soil food soil alley cropping 551

Soil food soil intercropping 552

Soil food soil crop rotation 553

Soil food soil fallow 554

Soil food soil cover crop 555

Soil food soil green manure 556

Soil food soil no-till 557

Soil food soil minimum tillage 558

Soil food soil conservation tillage 559

Soil food soil strip tillage 560

Soil food soil ridge tillage 561

Soil food soil contour farming 562

Soil food soil terracing 563

Soil food soil swales 564

Soil food soil keyline design 565

Soil food soil holistic management 566

Soil food soil regenerative agriculture 567

Soil food soil organic farming 568

Soil food soil biodynamic farming 569

Soil food soil natural farming 570

Soil food soil permaculture design 571

Soil food soil agroecology 572

Soil food soil sustainable agriculture 573

Soil food soil ecological agriculture 574

Soil food soil low-input agriculture 575

Soil food soil high-input agriculture 576

Soil food soil conventional agriculture 577

Soil food soil industrial agriculture 578

Soil food soil monoculture 579

Soil food soil polyculture 580

Soil food soil genetic engineering 581

Soil food soil genetically modified organisms 582

Soil food soil transgenic crops 583

Soil food soil hybrid crops 584

Soil food soil heirloom varieties 585

Soil food soil landrace varieties 586

Soil food soil wild relatives 587

Soil food soil germplasm 588

Soil food soil seed bank 589

Soil food soil gene bank 590

Soil food soil tissue culture 591

Soil food soil micropropagation 592

Soil food soil somatic embryogenesis 593

Soil food soil protoplast fusion 594

Soil food soil haploid breeding 595

Soil food soil marker-assisted selection 596

Soil food soil genomic selection 597

Soil food soil CRISPR-Cas9 598

Soil food soil gene editing 599

Soil food soil synthetic biology 600

Soil food soil nanotechnology 601

Soil food soil precision agriculture 602

Soil food soil digital agriculture 603

Soil food soil robotic agriculture 604

Soil food soil autonomous agriculture 605

Soil food soil vertical farming 606

Soil food soil controlled environment agriculture 607

Soil food soil urban agriculture 608

Soil food soil peri-urban agriculture 609

Soil food soil rural agriculture 610

Soil food soil subsistence agriculture 611

Soil food soil commercial agriculture 612

Soil food soil export agriculture 613

Soil food soil import substitution agriculture 614

Soil food soil food security 615

Soil food soil food sovereignty 616

Soil food soil food justice 617

Soil food soil food ethics 618

Soil food soil food culture 619

Soil food soil food tradition 620

Soil food soil food heritage 621

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Soil food soil food nutrition 625

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Soil food soil food medicine 627

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Soil food soil food allergy 630

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Soil food soil food waste 653

Soil food soil food loss 654

Soil food soil food recovery 655

Soil food soil food recycling 656

Soil food soil food composting 657

Soil food soil food anaerobic digestion 658

Soil food soil food biogas 659

Soil food soil food biofuel 660

Soil food soil food bioplastic 661

Soil food soil food biomaterial 662

Soil food soil food biochemical 663

Soil food soil food pharmaceutical 664

Soil food soil food cosmetic 665

Soil food soil food textile 666

Soil food soil food paper 667

Soil food soil food wood 668

Soil food soil food fiber 669

Soil food soil food fuel 670

Soil food soil food energy 671

Soil food soil food water 672

Soil food soil food air 673

Soil food soil food soil 674

Soil food soil food land 675

Soil food soil food space 676

Soil food soil food time 677

Soil food soil food matter 678

Soil food soil food energy 679

Soil food soil food mass 680

Soil food soil food weight 681

Soil food soil food volume 682

Soil food soil food density 683

Soil food soil food pressure 684

Soil food soil food temperature 685

Soil food soil food heat 686

Soil food soil food light 687

Soil food soil food sound 688

Soil food soil food electricity 689

Soil food soil food magnetism 690

Soil food soil food gravity 691

Soil food soil food motion 692

Soil food soil food force 693

Soil food soil food work 694

Soil food soil food power 695

Soil food soil food speed 696

Soil food soil food velocity 697

Soil food soil food acceleration 698

Soil food soil food momentum 699

Soil food soil food inertia 700

Soil food soil food friction 701

Soil food soil food elasticity 702

Soil food soil food viscosity 703

Soil food soil food surface tension 704

Soil food soil food capillarity 705

Soil food soil food osmosis 706

Soil food soil food diffusion 707

Soil food soil food convection 708

Soil food soil food conduction 709

Soil food soil food radiation 710

Soil food soil food thermodynamics 711

Soil food soil food entropy 712

Soil food soil food enthalpy 713

Soil food soil food free energy 714

Soil food soil food chemical potential 715

Soil food soil food phase transition 716

Soil food soil food critical point 717

Soil food soil food triple point 718

Soil food soil food boiling point 719

Soil food soil food melting point 720

Soil food soil food freezing point 721

Soil food soil food sublimation 722

Soil food soil food deposition 723

Soil food soil food evaporation 724

Soil food soil food condensation 725

Soil food soil food precipitation 726

Soil food soil food infiltration 727

Soil food soil food percolation 728

Soil food soil food groundwater 729

Soil food soil food aquifer 730

Soil food soil food spring 731

Soil food soil food river 732

Soil food soil food lake 733

Soil food soil food ocean 734

Soil food soil food atmosphere 735

Soil food soil food weather 736

Soil food soil food climate 737

Soil food soil food ecosystem 738

Soil food soil food biome 739

Soil food soil food habitat 740

Soil food soil food niche 741

Soil food soil food population 742

Soil food soil food community 743

Soil food soil food food web 744

Soil food soil food food chain 745

Soil food soil food trophic level 746

Soil food soil food producer 747

Soil food soil food consumer 748

Soil food soil food decomposer 749

Soil food soil food detritus 750

Soil food soil food nutrient cycle 751

Soil food soil food carbon cycle 752

Soil food soil food nitrogen cycle 753

Soil food soil food phosphorus cycle 754

Soil food soil food water cycle 755

Soil food soil food rock cycle 756

Soil food soil food plate tectonics 757

Soil food soil food continental drift 758

Soil food soil food seafloor spreading 759

Soil food soil food subduction 760

Soil food soil food volcanism 761

Soil food soil food earthquake 762

Soil food soil food mountain building 763

Soil food soil food erosion 764

Soil food soil food weathering 765

Soil food soil food soil formation 766

Soil food soil food soil horizon 767

Soil food soil food soil profile 768

Soil food soil food soil texture 769

Soil food soil food soil structure 770

Soil food soil food soil porosity 771

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Soil food soil food soil pH 775

Soil food soil food soil nutrients 776

Soil food soil food soil organic matter 777

Soil food soil food soil microorganisms 778

Soil food soil food soil fauna 779

Soil food soil food soil flora 780

Soil food soil food soil fungi 781

Soil food soil food soil bacteria 782

Soil food soil food soil viruses 783

Soil food soil food soil archaea 784

Soil food soil food soil protists 785

Soil food soil food soil algae 786

Soil food soil food soil lichens 787

Soil food soil food soil mosses 788

Soil food soil food soil ferns 789

Soil food soil food soil conifers 790

Soil food soil food soil deciduous trees 791

Soil food soil food soil shrubs 792

Soil food soil food soil grasses 793

Soil food soil food soil herbs 794

Soil food soil food soil vines 795

Soil food soil food soil epiphytes 796

Soil food soil food soil parasites 797

Soil food soil food soil saprophytes 798

Soil food soil food soil symbionts 799

Soil food soil food soil mutualists 800

Soil food soil food soil commensals 801

Soil food soil food soil amensals 802

Soil food soil food soil competitors 803

Soil food soil food soil predators 804

Soil food soil food soil prey 805

Soil food soil food soil hosts 806

Soil food soil food soil vectors 807

Soil food soil food soil pathogens 808

Soil food soil food soil diseases 809

Soil food soil food soil immunity 810

Soil food soil food soil resistance 811

Soil food soil food soil tolerance 812

Soil food soil food soil adaptation 813

Soil food soil food soil evolution 814

Soil food soil food soil speciation 815

Soil food soil food soil extinction 816

Soil food soil food soil biodiversity 817

Soil food soil food soil conservation 818

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Soil food soil food soil pollution 821

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Soil food soil food soil compaction 825

Soil food soil food soil salinization 826

Soil food soil food soil desertification 827

Soil food soil food soil loss 828

Soil food soil food soil management 829

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Soil food soil food soil irrigation 832

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Soil food soil food soil mulching 835

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Soil food soil food soil vermiculture 837

Soil food soil food soil aquaculture 838

Soil food soil food soil hydroponics 839

Soil food soil food soil aeroponics 840

Soil food soil food soil aquaponics 841

Soil food soil food soil permaculture 842

Soil food soil food soil agroforestry 843

Soil food soil food soil silvopasture 844

Soil food soil food soil alley cropping 845

Soil food soil food soil intercropping 846

Soil food soil food soil crop rotation 847

Soil food soil food soil fallow 848

Soil food soil food soil cover crop 849

Soil food soil food soil green manure 850

Soil food soil food soil no-till 851

Soil food soil food soil minimum tillage 852

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Soil food soil food soil ridge tillage 855

Soil food soil food soil contour farming 856

Soil food soil food soil terracing 857

Soil food soil food soil swales 858

Soil food soil food soil keyline design 859

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Soil food soil food soil natural farming 864

Soil food soil food soil permaculture design 865

Soil food soil food soil agroecology 866

Soil food soil food soil sustainable agriculture 867

Soil food soil food soil ecological agriculture 868

Soil food soil food soil low-input agriculture 869

Soil food soil food soil high-input agriculture 870

Soil food soil food soil conventional agriculture 871

Soil food soil food soil industrial agriculture 872

Soil food soil food soil monoculture 873

Soil food soil food soil polyculture 874

Soil food soil food soil genetic engineering 875

Soil food soil food soil genetically modified organisms 876

Soil food soil food soil transgenic crops 877

Soil food soil food soil hybrid crops 878

Soil food soil food soil heirloom varieties 879

Soil food soil food soil landrace varieties 880

Soil food soil food soil wild relatives 881

Soil food soil food soil germplasm 882

Soil food soil food soil seed bank 883

Soil food soil food soil gene bank 884

Soil food soil food soil tissue culture 885

Soil food soil food soil micropropagation 886

Soil food soil food soil somatic embryogenesis 887

Soil food soil food soil protoplast fusion 888

Soil food soil food soil haploid breeding 889

Soil food soil food soil marker-assisted selection 890

Soil food soil food soil genomic selection 891

Soil food soil food soil CRISPR-Cas9 892

Soil food soil food soil gene editing 893

Soil food soil food soil synthetic biology 894

Soil food soil food soil nanotechnology 895

Soil food soil food soil precision agriculture 896

Soil food soil food soil digital agriculture 897

Soil food soil food soil robotic agriculture 898

Soil food soil food soil autonomous agriculture 899

Soil food soil food soil vertical farming 900

Soil food soil food soil controlled environment agriculture 901

Soil food soil food soil urban agriculture 902

Soil food soil food soil peri-urban agriculture 903

Soil food soil food soil rural agriculture 904

Soil food soil food soil subsistence agriculture 905

Soil food soil food soil commercial agriculture 906

Soil food soil food soil export agriculture 907

Soil food soil food soil import substitution agriculture 908

Soil food soil food soil food security 909

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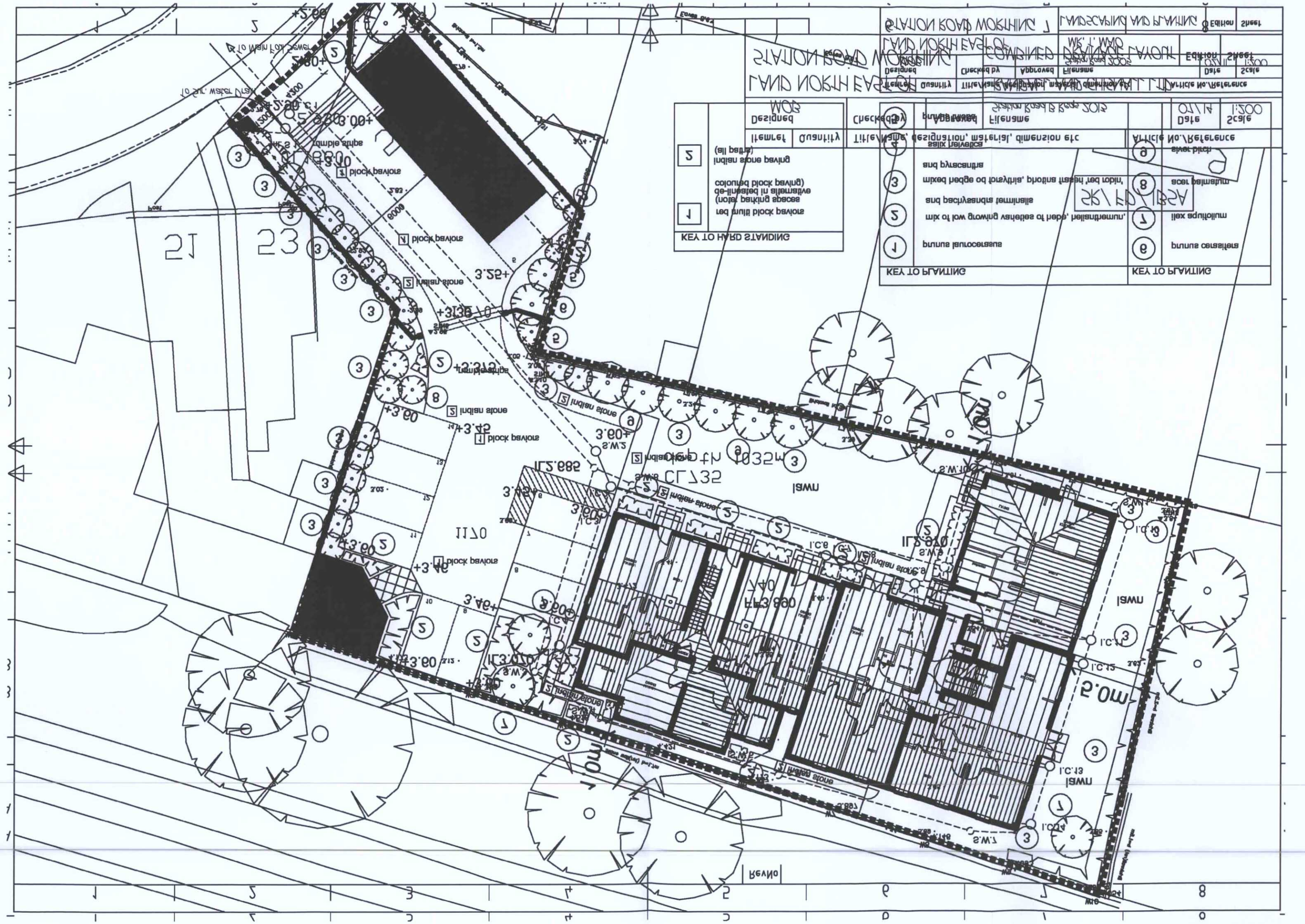

STATION ROAD WORTHING
LAND NORTH EAST OF
COMBINED DRAINAGE LAYOUT
LANDSCAPING AND PLANTING
Edition
Sheet
Item
Quantity
Title/Name, designation, material, dimension etc
Article No./Reference
Designed
Checked by
Approved
Filename
Date
Scale
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KEY TO PLANTING