

AMENDED



STRUCTURAL CALCULATIONS

For

PROPOSED LCS FOODSTORE

VICTORIA ROAD

BARNETBY LE WOLD

SURFACE WATER DRAINAGE STRATEGY

LINCOLNSHIRE COOPERATIVE SOCIETY LTD

Revision B

YORK SILLS LTD

Civil and Structural Consulting Engineers

5 Checkpoint Court,

LINCOLN LN6 3PW

Tel: +44 (0)1522 690815

PROJECT No: 6224

DATE : 08 OCT 2021

Prepared : **HK**

Checked :

Approved : **RW**

Reference:

Job ref : **6224**Sheet : **1 –**Rev No: **A**Date : **19 Dec 2019**

INTRODUCTION

The project involves the proposed construction of new LCS convenience store with car park, service yard and public access to south site boundary on a site located to west of Victoria Road in Barnetby le Wold (site location: TA055099) near the train station.

From the historical maps, it appears that a small structure near the North boundary was built on a green field and cattle market site in the 1970s that was extended and additional structure was built to West of the original structure in 1995. The site is a former depot and offices for scaffolding firm.

The Environment Agency map record indicates the following information for the site:

- It is located in Flood Zone 1 area, therefore low probability of flooding from rivers and sea
- It is in an area of very low surface water flooding
- It lies over an Unproductive Strata (bedrock). These are geological strata with low permeability that have negligible significance for water supply or river base flow.
- It lies over a designed Secondary A Aquifer (superficial drift), where permeable strata is capable of supporting water supplies at a local rather than strategic scale in some cases forming an important source of base flow to rivers

The British Geological Survey (BGS) map indicates that the bedrock formation is of Kimmeridge Clay with Glaciolacustrine superficial deposits over. The Humberside Materials Laboratory Ltd's site investigation report indicates that the shallow geology is similar to the BGS and additional information as below:

- Approximately 500mm of made ground and granular fill under laid with sand and chalk gravel layer and silt/clay. Near the west boundary, generally the ground to under of the made ground and granular fill appears to be built up of sand.
- The CBR ranges from 1% to 17%
- The groundwater is approximately 1.6m below ground level towards the eastern area of the site
- The infiltration rate varies from between 5.37×10^{-7} m/s and 5.80×10^{-7} m/s

Based on the above infiltration rate, the ground is not suitable for a soakaway system. Therefore, it is proposed that the surface water is to be discharged into the downstream drainage, Skegger Beck that runs parallel to the south boundary of the site. The existing run-off area into the stream is approximately 2070 m² (refer sheet 2), which will be slightly reduced to 1985 m² with the redevelopment. It is proposed to limit the surface water discharge to a practical minimum of 5 litres/sec using flow control device and attenuation designed to retain water for up to and including 1:100 year event and **40%** Climate Change Allowance with no off-site flooding.

The following calculations are prepared in accordance with the appropriate British Standards as listed below. All dimensions used in the calculations are taken from the Architect's drawings and must be confirmed on site before ordering materials or the like. No changes or modifications must be made to the calculations without prior and written permission from York Sills Ltd. Any such action will invalidate the designs.

Prepared : **HK**

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Approved : **RW**

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Job ref : **6224**Sheet : **2 –**Rev No: **A**Date : **19 Dec 2019**

BRITISH STANDARDS AND OTHER REFERENCES

- a) Building Regulation 2010 – Approved Document H – Drainage and Waste Disposal
- b) Humberside Materials Laboratory Ltd: Report reference – 0088/4925/P1 & P2 (Oct 2019)
- c) Topographical Survey – Daniel Charles Surveys Ltd – Drawing No. 19-139-01
- d) Utility Survey – Xpose Surveys Utility Detection & Mapping – Drawing No. D2PL13.003
- e) CommercialDW Drainage and Water Enquiry – Ref – G2418749-1 (20 March 2019)
- f) Proprietary manufacturer's technical literature.

ATTENUATION DESIGN

Proposed areas are as follows:

- Roof water (Store) – 410 m²
- Car-parking – 1435 m²
- Service yard – 140 m²

DESIGN INPUT CRITERIA

Beck Bed level = 16.7m (taken from topo)

Min Outfall level = 16.7 + 0.5 = 17.2m

Exceedance event occurs at the lowest end of the site discharging onto Public Highway


Max design level = 17.485m

FFL = 18.250m

Car park level > 17.700m

Lowest drainage feature is the gully pair at the entrance to the car park

Attenuation crates provided in light duty car parking areas with minimum 600mm cover.

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1







Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	75	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	8.974	0.122	73.6	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	31.442	0.456	69.0	0.045	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	15.575	0.236	66.0	0.083	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	15.575	0.186	83.7	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	10.133	0.195	52.0	0.020	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	4.556	0.027	168.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	66.03	5.13	16.847	0.033	0.0	0.0	0.0	1.17	20.7	5.9
1.001	63.75	5.56	16.675	0.078	0.0	0.0	0.0	1.21	21.4	13.5
2.000	65.59	5.21	16.650	0.083	0.0	0.0	0.0	1.24	21.9	14.7
3.000	65.44	5.24	16.650	0.010	0.0	0.0	0.0	1.10	19.4	1.7
2.001	64.80	5.36	16.414	0.113	0.0	0.0	0.0	1.40	24.7	19.8
1.002	63.37	5.64	17.200	0.191	0.0	0.0	0.0	1.00	39.9	32.9

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Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.002	HW	17.700	17.173	17.200	900	675
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Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	3
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)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Surface Network 1

Pump Manhole: PS2, DS/PN: 1.002, Volume (m³): 2.5

Invert Level (m) 17.200

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	2.0000	1.800	4.0000	3.400	4.0000	5.000	4.0000
0.400	3.0000	2.000	4.0000	3.600	4.0000	5.200	4.0000
0.600	4.0000	2.200	4.0000	3.800	4.0000	5.400	4.0000
0.800	4.0000	2.400	4.0000	4.000	4.0000	5.600	4.0000
1.000	4.0000	2.600	4.0000	4.200	4.0000	5.800	4.0000
1.200	4.0000	2.800	4.0000	4.400	4.0000	6.000	4.0000
1.400	4.0000	3.000	4.0000	4.600	4.0000		
1.600	4.0000	3.200	4.0000	4.800	4.0000		

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Storage Structures for Surface Network 1

Tank or Pond Manhole: PS5, DS/PN: 1.001

Invert Level (m) 16.675

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	4.0	0.400	4.0

Tank or Pond Manhole: S3, DS/PN: 2.000

Invert Level (m) 16.990

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	107.0	2.800	0.0	5.600	0.0	8.400	0.0
0.400	107.0	3.200	0.0	6.000	0.0	8.800	0.0
0.800	0.0	3.600	0.0	6.400	0.0	9.200	0.0
1.200	0.0	4.000	0.0	6.800	0.0	9.600	0.0
1.600	0.0	4.400	0.0	7.200	0.0	10.000	0.0
2.000	0.0	4.800	0.0	7.600	0.0		
2.400	0.0	5.200	0.0	8.000	0.0		

Tank or Pond Manhole: PS1, DS/PN: 3.000

Invert Level (m) 16.900

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	85.0	0.400	85.0

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Summary Wizard of 60 minute 2 year Winter I+0% for Surface Network 1

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 Coefficient 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 3
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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 240, 360, 600, 720, 1440, 2880
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 40, 40

PN	US/MH Name	Storm Rank	Water			Surcharged		Flooded		Pipe Flow (l/s)	Status
			Level (m)	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)				
1.000	PS6	50	17.112	0.115	0.000	0.15	2.7	SURCHARGED			
1.001	PS5	50	17.104	0.279	0.000	0.29	5.9	SURCHARGED			
2.000	S3	49	17.045	0.245	0.000	0.23	4.6	SURCHARGED			
3.000	PS1	49	17.039	0.239	0.000	0.01	0.2	SURCHARGED			
2.001	S4	49	17.046	0.482	0.000	0.11	2.4	SURCHARGED			
1.002	PS2	50	17.070	-0.355	0.000	0.00	0.0	OK			

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Summary Wizard of 1440 minute 2 year Winter I+0% for Surface Network 1

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 Coefficient 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 3
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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 240, 360, 600, 720, 1440, 2880
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 40, 40

PN	US/MH Name	Storm Rank	Water			Surcharged		Flooded		Pipe	
			Level (m)	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status		
1.000	PS6	39	17.201	0.204	0.000	0.02			0.3	SURCHARGED	
1.001	PS5	39	17.201	0.376	0.000	0.03			0.6	SURCHARGED	
2.000	S3	34	17.201	0.401	0.000	0.02			0.5	SURCHARGED	
3.000	PS1	32	17.201	0.401	0.000	0.01			0.1	SURCHARGED	
2.001	S4	35	17.202	0.638	0.000	0.01			0.2	SURCHARGED	
1.002	PS2	39	17.203	-0.222	0.000	0.00			0.0	OK	

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Summary Wizard of 15 minute 30 year Winter I+40% for Surface Network 1

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 Coefficient 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 3
 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 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 240, 360, 600, 720, 1440, 2880
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 40, 40

PN	US/MH Name	Storm Rank	Water			Surcharged		Flooded		Pipe Flow (l/s)	Status
			Level (m)	Depth (m)	Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)				
1.000	PS6	7	17.837	0.840	0.000	0.64	11.7	SURCHARGED			
1.001	PS5	7	17.793	0.968	0.000	1.02	20.9	SURCHARGED			
2.000	S3	40	17.149	0.349	0.000	0.43	8.8	SURCHARGED			
3.000	PS1	44	17.113	0.313	0.000	0.05	0.9	SURCHARGED			
2.001	S4	39	17.170	0.606	0.000	0.30	6.6	SURCHARGED			
1.002	PS2	30	17.320	-0.105	0.000	0.04	1.2	OK			

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Summary Wizard of 60 minute 30 year Winter I+40% for Surface Network 1

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 Coefficient 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 3
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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 240, 360, 600, 720, 1440, 2880
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 40, 40

PN	US/MH Name	Storm Rank	Water Surcharged			Flooded		Pipe		Status
			Level (m)	Depth (m)	Volume (m ³)	Flow / Cap.	Flow / Overflow (l/s)	Flow (l/s)		
1.000	PS6	12	17.574	0.577	0.000	0.39	7.1	SURCHARGED		
1.001	PS5	12	17.551	0.726	0.000	0.75	15.4	SURCHARGED		
2.000	S3	28	17.246	0.446	0.000	0.21	4.4	SURCHARGED		
3.000	PS1	28	17.229	0.429	0.000	0.02	0.4	SURCHARGED		
2.001	S4	30	17.240	0.676	0.000	0.15	3.3	SURCHARGED		
1.002	PS2	32	17.313	-0.112	0.000	0.04	1.1	OK		

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Summary Wizard of 1440 minute 30 year Winter I+40% for Surface Network 1

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 Coefficient 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 3
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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 240, 360, 600, 720, 1440, 2880
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 40, 40

PN	US/MH Name	Storm Rank	Water Surcharged Flooded			Pipe		Status
			Level (m)	Depth (m)	Volume (m ³)	Flow / Overflow Cap. (l/s)	Flow (l/s)	
1.000	PS6	25	17.382	0.385	0.000	0.04	0.7	SURCHARGED
1.001	PS5	25	17.381	0.556	0.000	0.08	1.6	SURCHARGED
2.000	S3	13	17.383	0.583	0.000	0.04	0.9	SURCHARGED
3.000	PS1	13	17.380	0.580	0.000	0.02	0.4	SURCHARGED
2.001	S4	13	17.381	0.817	0.000	0.06	1.4	SURCHARGED
1.002	PS2	19	17.378	-0.047	0.000	0.06	1.8	OK

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Summary Wizard of 360 minute 100 year Winter I+40% for Surface Network 1

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 Coefficient 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 3
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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 240, 360, 600, 720, 1440, 2880
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 40, 40

PN	US/MH Name	Storm Rank	Water Surcharged Flooded			Pipe		Status
			Level (m)	Depth (m)	Volume (m ³)	Flow / Overflow Cap. (l/s)	Flow (l/s)	
1.000	PS6	16	17.475	0.478	0.000	0.14	2.6	SURCHARGED
1.001	PS5	16	17.473	0.648	0.000	0.29	6.0	SURCHARGED
2.000	S3	4	17.476	0.676	0.000	0.07	1.3	FLOOD RISK
3.000	PS1	4	17.471	0.671	0.000	0.06	1.2	SURCHARGED
2.001	S4	4	17.472	0.908	0.000	0.10	2.3	SURCHARGED
1.002	PS2	5	17.468	0.043	0.000	0.08	2.3	SURCHARGED