


Waterman Group		Page 1
Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm






Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 459550 219500 SP 59550 19500
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500


Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	66.218	0.123	538.4	0.099	5.00	0.0	0.600		o	600	Pipe/Conduit	
S2.000	31.238	0.089	351.0	0.048	5.00	0.0	0.600		o	600	Pipe/Conduit	
S1.001	37.823	0.071	532.7	0.036	0.00	0.0	0.600		o	600	Pipe/Conduit	
S3.000	20.139	0.066	305.1	0.043	5.00	0.0	0.600		o	600	Pipe/Conduit	
S4.000	21.501	0.050	430.0	0.031	5.00	0.0	0.600		o	600	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)
S1.000	50.00	6.06	68.799	0.099	0.0	0.0	0.0	1.04	294.8	13.4
S2.000	50.00	5.40	68.765	0.048	0.0	0.0	0.0	1.29	365.9	6.5
S1.001	50.00	6.66	68.676	0.183	0.0	0.0	0.0	1.05	296.3	24.8
S3.000	50.00	5.24	68.800	0.043	0.0	0.0	0.0	1.39	392.7	5.8
S4.000	50.00	5.31	68.850	0.031	0.0	0.0	0.0	1.17	330.2	4.2

Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
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Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S4.001	31.078	0.066	470.9	0.062	0.00	0.0	0.600		o	600	Pipe/Conduit	
S3.001	68.465	0.129	530.7	0.017	0.00	0.0	0.600		o	600	Pipe/Conduit	
S5.000	45.620	0.105	434.5	0.061	5.00	0.0	0.600		o	600	Pipe/Conduit	
S1.002	5.808	0.012	484.0	0.036	0.00	0.0	0.600		o	600	Pipe/Conduit	
S6.000	41.898	0.089	470.8	0.047	5.00	0.0	0.600		o	600	Pipe/Conduit	
S7.000	55.030	0.285	193.1	0.055	5.00	0.0		0.045 3 \=/		225	1:3 Swale	
S8.000	35.075	0.185	189.6	0.034	5.00	0.0		0.045 3 \=/		225	1:3 Swale	
S7.001	21.376	0.847	25.2	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S1.003	14.786	0.148	99.9	0.000	0.00	0.0	0.600		o	300	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)
S4.001	50.00	5.77	68.800	0.093	0.0	0.0	0.0	1.12	315.4	12.6
S3.001	50.00	6.86	68.734	0.153	0.0	0.0	0.0	1.05	296.9	20.7
S5.000	50.00	5.65	68.710	0.061	0.0	0.0	0.0	1.16	328.5	8.3
S1.002	50.00	6.95	68.605	0.433	0.0	0.0	0.0	1.10	311.1	58.6
S6.000	50.00	5.63	68.682	0.047	0.0	0.0	0.0	1.12	315.5	6.4
S7.000	50.00	7.94	70.100	0.055	0.0	0.0	0.0	0.31	31.6	7.4
S8.000	50.00	6.86	70.000	0.034	0.0	0.0	0.0	0.32	31.9	4.6
S7.001	50.00	8.05	69.740	0.089	0.0	0.0	0.0	3.14	222.1	12.1
S1.003	50.00	8.21	68.593	0.569	0.0	0.0	0.0	1.57	111.2	77.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	70.778	1.979	Open Manhole	1500	S1.000	68.799	600				
S5	71.125	2.360	Open Manhole	1500	S2.000	68.765	600				
S2	70.854	2.178	Open Manhole	1500	S1.001	68.676	600	S1.000	68.676	600	
								S2.000	68.676	600	
S6	71.031	2.231	Open Manhole	1500	S3.000	68.800	600				
S8	70.205	1.355	Open Manhole	1500	S4.000	68.850	600				
S9	70.447	1.647	Open Manhole	1500	S4.001	68.800	600	S4.000	68.800	600	
S7	70.712	1.978	Open Manhole	1500	S3.001	68.734	600	S3.000	68.734	600	
								S4.001	68.734	600	
S10	70.874	2.164	Open Manhole	1500	S5.000	68.710	600				
S3	70.805	2.200	Open Manhole	1500	S1.002	68.605	600	S1.001	68.605	600	
								S3.001	68.605	600	
								S5.000	68.605	600	
S11	70.896	2.214	Open Manhole	1500	S6.000	68.682	600				
SIC13	70.794	0.694	Open Manhole	600	S7.000	70.100	225				
SIC14	70.595	0.595	Open Manhole	600	S8.000	70.000	225				
SS12	70.669	0.929	Open Manhole	1200	S7.001	69.740	300	S7.000	69.815	225	
								S8.000	69.815	225	
S4	70.997	2.404	Open Manhole	1500	S1.003	68.593	300	S1.002	68.593	600	
								S6.000	68.593	600	
								S7.001	68.893	300	
SHW1	69.500	1.055	Open Manhole	0		OUTFALL		S1.003	68.445	300	300

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
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S1	459604.722	220800.306	459604.722	220800.306	Required	
S5	459636.121	220709.657	459636.121	220709.657	Required	
S2	459633.786	220740.807	459633.786	220740.807	Required	
S6	459667.372	220695.832	459667.372	220695.832	Required	

Pickfords Wharf  
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A41 Roundabout SW Drainage  
Graven Hill, Bicester



Date 03/09/2021 09:21  
File WIE11386-A41-92-CAL - A...


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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S8	459734.827	220684.550	459734.827	220684.550	Required	
S9	459717.226	220696.899	459717.226	220696.899	Required	
S7	459686.561	220701.946	459686.561	220701.946	Required	
S10	459632.586	220800.681	459632.586	220800.681	Required	
S3	459662.095	220765.890	459662.095	220765.890	Required	
S11	459698.909	220744.685	459698.909	220744.685	Required	
SIC13	459674.027	220719.300	459674.027	220719.300	Required	
SIC14	459680.643	220723.026	459680.643	220723.026	Required	
SS12	459671.959	220749.892	459671.959	220749.892	Required	
S4	459665.801	220770.362	459665.801	220770.362	Required	
SHW1	459660.889	220784.308			No Entry	

Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
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Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	600	S1	70.778	68.799	1.379	Open Manhole	1500
S2.000	o	600	S5	71.125	68.765	1.760	Open Manhole	1500
S1.001	o	600	S2	70.854	68.676	1.578	Open Manhole	1500
S3.000	o	600	S6	71.031	68.800	1.631	Open Manhole	1500
S4.000	o	600	S8	70.205	68.850	0.755	Open Manhole	1500
S4.001	o	600	S9	70.447	68.800	1.047	Open Manhole	1500
S3.001	o	600	S7	70.712	68.734	1.378	Open Manhole	1500
S5.000	o	600	S10	70.874	68.710	1.564	Open Manhole	1500
S1.002	o	600	S3	70.805	68.605	1.600	Open Manhole	1500
S6.000	o	600	S11	70.896	68.682	1.614	Open Manhole	1500
S7.000	3 \=/	225	SIC13	70.794	70.100	0.544	Open Manhole	600

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	66.218	538.4	S2	70.854	68.676	1.578	Open Manhole	1500
S2.000	31.238	351.0	S2	70.854	68.676	1.578	Open Manhole	1500
S1.001	37.823	532.7	S3	70.805	68.605	1.600	Open Manhole	1500
S3.000	20.139	305.1	S7	70.712	68.734	1.378	Open Manhole	1500
S4.000	21.501	430.0	S9	70.447	68.800	1.047	Open Manhole	1500
S4.001	31.078	470.9	S7	70.712	68.734	1.378	Open Manhole	1500
S3.001	68.465	530.7	S3	70.805	68.605	1.600	Open Manhole	1500
S5.000	45.620	434.5	S3	70.805	68.605	1.600	Open Manhole	1500
S1.002	5.808	484.0	S4	70.997	68.593	1.804	Open Manhole	1500
S6.000	41.898	470.8	S4	70.997	68.593	1.804	Open Manhole	1500
S7.000	55.030	193.1	SS12	70.669	69.815	0.704	Open Manhole	1200

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S8.000	3 \=/	225	SIC14	70.595	70.000	0.445	Open Manhole	600
S7.001	o	300	SS12	70.669	69.740	0.629	Open Manhole	1200
S1.003	o	300	S4	70.997	68.593	2.104	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S8.000	35.075	189.6	SS12	70.669	69.815	0.704	Open Manhole	1200
S7.001	21.376	25.2	S4	70.997	68.893	1.804	Open Manhole	1500
S1.003	14.786	99.9	SHW1	69.500	68.445	0.755	Open Manhole	0

Waterman Group		Page 7
Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.099	0.099	0.099
2.000	-	-	100	0.048	0.048	0.048
1.001	-	-	100	0.036	0.036	0.036
3.000	-	-	100	0.043	0.043	0.043
4.000	-	-	100	0.031	0.031	0.031
4.001	-	-	100	0.062	0.062	0.062
3.001	-	-	100	0.017	0.017	0.017
5.000	-	-	100	0.061	0.061	0.061
1.002	-	-	100	0.036	0.036	0.036
6.000	-	-	100	0.047	0.047	0.047
7.000	-	-	100	0.055	0.055	0.055
8.000	-	-	100	0.034	0.034	0.034
7.001	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.569	0.569	0.569

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)
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S1.003	SHW1	69.500	68.445	67.850	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m <sup>3</sup> /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	2
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	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 459550 219500 SP 59550 19500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750

Waterman Group		Page 8
Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

Synthetic Rainfall Details

Cv (Winter) 0.840  
Storm Duration (mins) 30



Waterman Group		Page 9
Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

Online Controls for Storm


Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 18.3

Unit Reference	MD-SHE-0254-3530-1000-3530
Design Head (m)	1.000
Design Flow (l/s)	35.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	254
Invert Level (m)	68.593
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	35.3
Flush-Flo™	0.401	35.3
Kick-Flo®	0.759	30.9
Mean Flow over Head Range	-	28.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.2	1.200	38.5	3.000	59.9	7.000	90.5
0.200	26.0	1.400	41.5	3.500	64.6	7.500	93.5
0.300	34.7	1.600	44.2	4.000	68.9	8.000	96.5
0.400	35.3	1.800	46.8	4.500	72.9	8.500	99.4
0.500	34.9	2.000	49.2	5.000	76.8	9.000	102.3
0.600	34.1	2.200	51.6	5.500	80.4	9.500	105.0
0.800	31.7	2.400	53.8	6.000	83.9		
1.000	35.3	2.600	55.9	6.500	87.2		

Waterman Group		Page 10
Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

Storage Structures for Storm

Swale Manhole: SIC13, DS/PN: S7.000


Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	55.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.500
Invert Level (m)	70.100	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.6	Include Swale Volume	Yes

Swale Manhole: SIC14, DS/PN: S8.000

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	35.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.500
Invert Level (m)	70.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.6	Include Swale Volume	Yes

Waterman Group		Page 11
Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

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 \* 10m<sup>3</sup>/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 2  
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)                      20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0                      DVD Status OFF  
Analysis Timestep                      Fine Inertia Status OFF  
DTS Status                      ON

Profile(s)                      Summer and Winter  
Duration(s) (mins)                      15, 30, 60, 120, 180, 240, 360, 480, 600,  
720, 960, 1440, 2160, 2880, 4320, 5760,  
7200, 8640, 10080  
Return Period(s) (years)                      1, 30, 100  
Climate Change (%)                      0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m <sup>3</sup> )	Flow / Cap.
S1.000	S1	60 minute 100 year Winter I+40%	70.778	70.194	0.795	0.000	0.11
S2.000	S5	60 minute 100 year Winter I+40%	71.125	70.191	0.826	0.000	0.05
S1.001	S2	60 minute 100 year Winter I+40%	70.854	70.190	0.914	0.000	0.12
S3.000	S6	60 minute 100 year Winter I+40%	71.031	70.191	0.791	0.000	0.04
S4.000	S8	60 minute 100 year Winter I+40%	70.205	70.193	0.743	0.000	0.03
S4.001	S9	60 minute 100 year Winter I+40%	70.447	70.192	0.792	0.000	0.08
S3.001	S7	60 minute 100 year Winter I+40%	70.712	70.190	0.856	0.000	0.09
S5.000	S10	60 minute 100 year Winter I+40%	70.874	70.186	0.876	0.000	0.06
S1.002	S3	60 minute 100 year Winter I+40%	70.805	70.184	0.979	0.000	0.31
S6.000	S11	60 minute 100 year Winter I+40%	70.896	70.180	0.898	0.000	0.05
S7.000	SIC13	15 minute 100 year Winter I+40%	70.794	70.240	-0.554	0.000	0.02
S8.000	SIC14	60 minute 100 year Winter I+40%	70.595	70.160	-0.435	0.000	0.01
S7.001	SS12	60 minute 100 year Winter I+40%	70.669	70.160	0.120	0.000	0.17
S1.003	S4	60 minute 100 year Winter I+40%	70.997	70.179	1.286	0.000	0.47

Waterman Group		Page 12
Pickfords Wharf Clink Street London, SE1 9DG	A41 Roundabout SW Drainage Graven Hill, Bicester	
Date 03/09/2021 09:21 File WIE11386-A41-92-CAL - A...	Designed by Karthi Palanniya... Checked by Darryl Pearson	
Innovyze	Network 2020.1.3	

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

PN	US/MH Name	Overflow (l/s)	Maximum Vol (m <sup>3</sup> )	Pipe	Status
				Flow (l/s)	
S1.000	S1		2.456	29.2	SURCHARGED
S2.000	S5		2.512	13.8	SURCHARGED
S1.001	S2		29.373	30.1	SURCHARGED
S3.000	S6		2.449	12.3	SURCHARGED
S4.000	S8		2.364	8.4	FLOOD RISK
S4.001	S9		8.107	20.4	FLOOD RISK
S3.001	S7		16.197	22.8	SURCHARGED
S5.000	S10		2.600	17.7	SURCHARGED
S1.002	S3		44.461	65.9	SURCHARGED
S6.000	S11		2.639	13.4	SURCHARGED
S7.000	SIC13		4.207	27.1	OK
S8.000	SIC14		4.355	10.5	OK
S7.001	SS12		19.116	33.7	SURCHARGED
S1.003	S4		16.849	44.0	SURCHARGED