

Bryan G Hall		Page 0
Suite E8 Joseph's Well		
Hanover Walk		
Leeds LS3 1AB		
Date 01/01/0001	Designed by nathanbridge	
File SWSV4.MDX	Checked by	
Elstree Computing Ltd	Network 2020.1.3	

Network 2020.1.3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SWSV1.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales			
Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.342	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for SWSV1.SWS

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.022	4-8	0.736	8-12	0.286	12-16	0.006

Total Area Contributing (ha) = 1.049

Total Pipe Volume (m³) = 78.795

Network Design Table for SWSV1.SWS

« - Indicates pipe capacity < flow

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	11.987	0.500	24.0	0.092	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	35.139	0.142	247.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	42.486	0.172	247.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	55.592	0.225	247.1	0.106	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	13.728	0.056	247.0	0.069	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	47.79	5.07	83.500	0.092	0.0	0.0	0.0	2.68	106.7	11.9
1.001	45.62	5.66	82.925	0.092	0.0	0.0	0.0	1.00	70.4	11.9
1.002	43.28	6.37	82.783	0.120	0.0	0.0	0.0	1.00	70.4	14.1
1.003	40.61	7.30	82.611	0.226	0.0	0.0	0.0	1.00	70.4	24.9
1.004	40.01	7.53	82.386	0.295	0.0	0.0	0.0	1.00	70.4	32.0

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Network Design Table for SWSV1.SWS

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
1.005	17.857	0.261	68.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.006	26.384	0.053	500.0	0.070	0.00	0.0	0.600	o	600	Pipe/Conduit	
2.000	48.826	0.400	122.1	0.125	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	29.234	2.525	11.6	0.092	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	34.566	0.900	38.4	0.046	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	34.947	1.500	23.3	0.065	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.004	16.590	1.659	10.0	0.123	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	40.009	0.080	500.0	0.064	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.008	48.933	0.098	500.0	0.133	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.009	21.246	0.042	500.0	0.036	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.010	17.091	0.034	500.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.011	11.027	1.103	10.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.012	13.371	0.005	2674.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.013	13.867	0.050	277.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.014	16.600	1.660	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.015	75.903	0.506	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

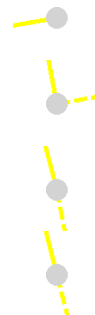
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	39.70	7.65	82.188	0.295	0.0	0.0	0.0	2.46	391.4	32.0
1.006	38.70	8.06	81.777	0.365	0.0	0.0	0.0	1.08	306.0	38.3
2.000	45.53	5.69	90.000	0.125	0.0	0.0	0.0	1.18	47.0	15.4
2.001	45.09	5.81	89.600	0.217	0.0	0.0	0.0	3.87	153.8	26.5
2.002	44.34	6.04	87.000	0.263	0.0	0.0	0.0	2.54	179.9	31.6
2.003	43.76	6.22	86.100	0.328	0.0	0.0	0.0	3.27	231.2	38.9
2.004	43.59	6.27	84.600	0.451	0.0	0.0	0.0	5.00	353.4	53.2
1.007	37.30	8.68	81.724	0.880	0.0	0.0	0.0	1.08	306.0	88.9
1.008	35.74	9.43	81.644	1.013	0.0	0.0	0.0	1.08	306.0	98.0
1.009	35.11	9.76	81.546	1.049	0.0	0.0	0.0	1.08	306.0	99.7
1.010	34.62	10.02	81.504	1.049	0.0	0.0	0.0	1.08	306.0	99.7
1.011	34.57	10.05	81.470	1.049	0.0	0.0	0.0	7.73	2185.8	99.7
1.012	33.72	10.53	79.880	1.049	0.0	0.0	0.0	0.46	130.5	99.7
1.013	33.45	10.69	78.675	1.049	0.0	0.0	0.0	1.46	412.0	99.7
1.014	33.30	10.77	78.625	1.049	0.0	0.0	0.0	3.20	56.6«	99.7
1.015	31.03	12.32	76.736	1.049	0.0	0.0	0.0	0.82	14.5«	99.7

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Manhole Schedules for SWSV1.SWS

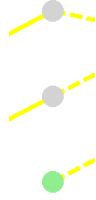
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	85.622	2.122	Open Manhole	1500	1.000	83.500	225				
2	84.600	1.675	Open Manhole	1200	1.001	82.925	300	1.000	83.000	225	
3	86.500	3.717	Open Manhole	1200	1.002	82.783	300	1.001	82.783	300	
4	86.179	3.568	Open Manhole	1500	1.003	82.611	300	1.002	82.611	300	
5	85.000	2.614	Open Manhole	1500	1.004	82.386	300	1.003	82.386	300	
6	83.500	1.312	Open Manhole	1500	1.005	82.188	450	1.004	82.330	300	
7	83.277	1.500	Open Manhole	1500	1.006	81.777	600	1.005	81.927	450	
8	93.223	3.223	Open Manhole	1500	2.000	90.000	225				
9	91.229	1.629	Open Manhole	1500	2.001	89.600	225	2.000	89.600	225	
10	88.878	1.878	Open Manhole	1500	2.002	87.000	300	2.001	87.075	225	
11	87.914	1.814	Open Manhole	1500	2.003	86.100	300	2.002	86.100	300	
12	86.160	1.560	Open Manhole	1500	2.004	84.600	300	2.003	84.600	300	
13	84.921	3.197	Open Manhole	1800	1.007	81.724	600	1.006	81.724	600	
								2.004	82.941	300	917
14	85.918	4.274	Open Manhole	1800	1.008	81.644	600	1.007	81.644	600	
15	86.938	5.392	Open Manhole	1800	1.009	81.546	600	1.008	81.546	600	
16	83.800	2.296	Open Manhole	1800	1.010	81.504	600	1.009	81.504	600	
17	83.700	2.230	Open Manhole	1800	1.011	81.470	600	1.010	81.470	600	
18	81.075	1.195	Open Manhole	1500	1.012	79.880	600	1.011	80.367	600	487
18A	81.075	2.400	Open Manhole	1800	1.013	78.675	600	1.012	79.875	600	1200
19	81.075	2.450	Open Manhole	2400	1.014	78.625	150	1.013	78.625	600	
20	78.500	1.764	Open Manhole	1200	1.015	76.736	150	1.014	76.965	150	229
HW1	77.900	1.670	Open Manhole	0		OUTFALL		1.015	76.230	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	418618.400	414707.057	418618.400	414707.057	Required	
2	418606.596	414704.972	418606.596	414704.972	Required	
3	418599.979	414739.482	418599.979	414739.482	Required	
4	418589.252	414780.591	418589.252	414780.591	Required	



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Manhole Schedules for SWSV1.SWS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
19	418476.489	414966.221	418476.489	414966.221	Required	
20	418461.809	414958.472	418461.809	414958.472	Required	
HW1	418394.643	414923.117			No Entry	

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PIPELINE SCHEDULES for SWSV1.SWS

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)
1.000	o	225	1	85.622	83.500	1.897	Open Manhole	1500
1.001	o	300	2	84.600	82.925	1.375	Open Manhole	1200
1.002	o	300	3	86.500	82.783	3.417	Open Manhole	1200
1.003	o	300	4	86.179	82.611	3.268	Open Manhole	1500
1.004	o	300	5	85.000	82.386	2.314	Open Manhole	1500
1.005	o	450	6	83.500	82.188	0.862	Open Manhole	1500
1.006	o	600	7	83.277	81.777	0.900	Open Manhole	1500
2.000	o	225	8	93.223	90.000	2.998	Open Manhole	1500
2.001	o	225	9	91.229	89.600	1.404	Open Manhole	1500
2.002	o	300	10	88.878	87.000	1.578	Open Manhole	1500
2.003	o	300	11	87.914	86.100	1.514	Open Manhole	1500
2.004	o	300	12	86.160	84.600	1.260	Open Manhole	1500
1.007	o	600	13	84.921	81.724	2.597	Open Manhole	1800
1.008	o	600	14	85.918	81.644	3.674	Open Manhole	1800
1.009	o	600	15	86.938	81.546	4.792	Open Manhole	1800
1.010	o	600	16	83.800	81.504	1.696	Open Manhole	1800
1.011	o	600	17	83.700	81.470	1.630	Open Manhole	1800
1.012	o	600	18	81.075	79.880	0.595	Open Manhole	1500
1.013	o	600	18A	81.075	78.675	1.800	Open Manhole	1800

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)
1.000	11.987	24.0	2	84.600	83.000	1.375	Open Manhole	1200
1.001	35.139	247.0	3	86.500	82.783	3.417	Open Manhole	1200
1.002	42.486	247.0	4	86.179	82.611	3.268	Open Manhole	1500
1.003	55.592	247.1	5	85.000	82.386	2.314	Open Manhole	1500
1.004	13.728	247.0	6	83.500	82.330	0.870	Open Manhole	1500
1.005	17.857	68.4	7	83.277	81.927	0.900	Open Manhole	1500
1.006	26.384	500.0	13	84.921	81.724	2.597	Open Manhole	1800
2.000	48.826	122.1	9	91.229	89.600	1.404	Open Manhole	1500
2.001	29.234	11.6	10	88.878	87.075	1.578	Open Manhole	1500
2.002	34.566	38.4	11	87.914	86.100	1.514	Open Manhole	1500
2.003	34.947	23.3	12	86.160	84.600	1.260	Open Manhole	1500
2.004	16.590	10.0	13	84.921	82.941	1.680	Open Manhole	1800
1.007	40.009	500.0	14	85.918	81.644	3.674	Open Manhole	1800
1.008	48.933	500.0	15	86.938	81.546	4.792	Open Manhole	1800
1.009	21.246	500.0	16	83.800	81.504	1.696	Open Manhole	1800
1.010	17.091	500.0	17	83.700	81.470	1.630	Open Manhole	1800
1.011	11.027	10.0	18	81.075	80.367	0.108	Open Manhole	1500
1.012	13.371	2674.2	18A	81.075	79.875	0.600	Open Manhole	1800
1.013	13.867	277.3	19	81.075	78.625	1.850	Open Manhole	2400

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PIPELINE SCHEDULES for SWSV1.SWS

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)
1.014	o	150	19	81.075	78.625	2.300	Open Manhole	2400
1.015	o	150	20	78.500	76.736	1.614	Open Manhole	1200

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)
1.014	16.600	10.0	20	78.500	76.965	1.385	Open Manhole	1200
1.015	75.903	150.0	HW1	77.900	76.230	1.520	Open Manhole	0

Free Flowing Outfall Details for SWSV1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.015	HW1	77.900	76.230	76.200	0	0
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Simulation Criteria for SWSV1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	0.000
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	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)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.342		

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Online Controls for SWSV1.SWS

Hydro-Brake® Optimum Manhole: 19, DS/PN: 1.014, Volume (m³): 14.4

Unit Reference	MD-SHE-0134-1000-1800-1000
Design Head (m)	1.800
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	134
Invert Level (m)	78.625
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	10.0
Flush-Flo™	0.525	10.0
Kick-Flo®	1.089	7.9
Mean Flow over Head Range	-	8.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	1.200	8.3	3.000	12.7	7.000	19.1
0.200	8.6	1.400	8.9	3.500	13.7	7.500	19.7
0.300	9.5	1.600	9.5	4.000	14.6	8.000	20.3
0.400	9.8	1.800	10.0	4.500	15.4	8.500	20.9
0.500	10.0	2.000	10.5	5.000	16.2	9.000	21.5
0.600	9.9	2.200	11.0	5.500	17.0	9.500	22.1
0.800	9.6	2.400	11.5	6.000	17.7		
1.000	8.7	2.600	11.9	6.500	18.4		

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Storage Structures for SWSV1.SWS

Tank or Pond Manhole: 18A, DS/PN: 1.013

Invert Level (m) 78.675

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	445.0	0.700	445.0	1.400	445.0	2.100	0.0
0.100	445.0	0.800	445.0	1.500	445.0	2.200	0.0
0.200	445.0	0.900	445.0	1.600	445.0	2.300	0.0
0.300	445.0	1.000	445.0	1.700	445.0	2.400	0.0
0.400	445.0	1.100	445.0	1.800	445.0	2.500	0.0
0.500	445.0	1.200	445.0	1.900	0.0		
0.600	445.0	1.300	445.0	2.000	0.0		

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SWSV1.SWS

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
1.000	1	-0.164	0.000	0.16			14.9	OK	
1.001	2	-0.202	0.000	0.23			14.7	OK	
1.002	3	-0.193	0.000	0.27			18.0	OK	
1.003	4	-0.154	0.000	0.45			30.3	OK	
1.004	5	-0.121	0.000	0.66			38.3	OK	
1.005	6	-0.341	0.000	0.13			38.4	OK	
1.006	7	-0.326	0.000	0.19			45.6	OK	
2.000	8	-0.119	0.000	0.44			19.8	OK	
2.001	9	-0.152	0.000	0.23			32.3	OK	
2.002	10	-0.202	0.000	0.23			38.6	OK	
2.003	11	-0.204	0.000	0.22			47.5	OK	
2.004	12	-0.206	0.000	0.21			64.1	OK	
1.007	13	-0.290	0.000	0.41			108.1	OK	
1.008	14	-0.280	0.000	0.43			115.7	OK	
1.009	15	-0.253	0.000	0.53			113.4	OK	
1.010	16	-0.260	0.000	0.61			112.7	OK	
1.011	17	-0.470	0.000	0.11			112.7	OK	

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SWSV1.SWS

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act. Level (m)
1.012	18	15 Winter	2	+0%	100/15 Summer			80.320
1.013	18A	240 Winter	2	+0%	30/180 Winter			78.959
1.014	19	240 Winter	2	+0%	2/15 Summer			78.961
1.015	20	240 Winter	2	+0%				76.827

US/MH		Surcharged	Flooded	Half Drain		Pipe	Level		
PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Exceeded
1.012	18	-0.160	0.000	0.93			112.1	OK	
1.013	18A	-0.316	0.000	0.04			11.3	OK	
1.014	19	0.186	0.000	0.18			9.6	SURCHARGED	
1.015	20	-0.059	0.000	0.68			9.6	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SWSV1.SWS

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
1.000	1	-0.139	0.000	0.31			28.2	OK	
1.001	2	-0.161	0.000	0.43			27.7	OK	
1.002	3	-0.139	0.000	0.52			34.2	OK	
1.003	4	-0.024	0.000	0.87			57.8	OK	
1.004	5	0.022	0.000	1.27			73.7	SURCHARGED	
1.005	6	-0.295	0.000	0.26			73.9	OK	
1.006	7	-0.087	0.000	0.35			84.2	OK	
2.000	8	-0.064	0.000	0.83			37.4	OK	
2.001	9	-0.116	0.000	0.46			65.8	OK	
2.002	10	-0.150	0.000	0.48			80.1	OK	
2.003	11	-0.152	0.000	0.47			100.6	OK	
2.004	12	-0.154	0.000	0.47			140.0	OK	
1.007	13	-0.051	0.000	0.84			218.5	OK	
1.008	14	-0.024	0.000	0.85			226.4	OK	
1.009	15	0.000	0.000	0.97			208.1	OK	
1.010	16	0.000	0.000	1.12			206.2	OK	
1.011	17	-0.420	0.000	0.19			203.2	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWSV1.SWS

PN	US/MH Name	Surcharged		Flooded		Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Volume (m³)	Flow (l/s)						
1.000	1	0.168	0.000		0.54				49.6	SURCHARGED	
1.001	2	0.564	0.000		0.68				44.1	SURCHARGED	
1.002	3	0.657	0.000		0.82				53.7	SURCHARGED	
1.003	4	0.735	0.000		1.39				92.8	SURCHARGED	
1.004	5	0.496	0.000		2.06				120.2	SURCHARGED	
1.005	6	0.296	0.000		0.42				120.5	SURCHARGED	
1.006	7	0.514	0.000		0.59				144.6	SURCHARGED	
2.000	8	0.500	0.000		1.46				65.8	SURCHARGED	
2.001	9	-0.068	0.000		0.79				113.7	OK	
2.002	10	-0.082	0.000		0.84				139.4	OK	
2.003	11	-0.086	0.000		0.83				176.3	OK	
2.004	12	-0.088	0.000		0.82				247.7	OK	
1.007	13	0.536	0.000		1.48				385.8	SURCHARGED	
1.008	14	0.433	0.000		1.60				428.9	SURCHARGED	
1.009	15	0.282	0.000		2.02				436.0	SURCHARGED	
1.010	16	0.128	0.000		2.37				435.9	SURCHARGED	
1.011	17	-0.332	0.000		0.41				434.3	OK	

