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Chiltern House Thame Road Haddenham Bucks HP17 8BY	Project 629- Johnson drive Finchampstead	
Date 06/02/2025 16:56 File 629-JOHNSON DRIVE_FEH D...	Designed by Felice Checked by	
XP Solutions	Network 2015.1	

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
Site Location GB 480850 165550	
C (1km)	-0.029
D1 (1km)	0.269
D2 (1km)	0.274
D3 (1km)	0.311
E (1km)	0.304
F (1km)	2.678
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.241	4-8	0.119

Total Area Contributing (ha) = 0.360

Total Pipe Volume (m³) = 3.093

Network Design Table for Storm

« - 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)	Auto Design
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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)
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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)	HYD SECT	DIA (mm)	Auto Design
1.000	13.900	0.093	149.5	0.083	5.00	0.0	0.600	o	300	
2.000	1.000	0.010	100.0	0.014	5.00	0.0	0.600	o	100	
2.001	1.000	0.010	100.0	0.014	0.00	0.0	0.600	o	100	
2.002	1.000	0.010	100.0	0.013	0.00	0.0	0.600	o	100	
2.003	1.000	0.010	100.0	0.013	0.00	0.0	0.600	o	100	
2.004	5.900	0.350	16.9	0.030	0.00	0.0	0.600	o	150	
3.000	4.500	0.905	5.0	0.118	5.00	0.0	0.600	o	225	
4.000	2.000	0.230	8.7	0.021	5.00	0.0	0.600	o	100	
5.000	2.500	0.880	2.8	0.038	5.00	0.0	0.600	o	150	
6.000	3.700	0.046	80.4	0.016	5.00	0.0	0.600	o	100	
6.001	4.300	0.920	4.7	0.000	0.00	0.0	0.600	o	100	
1.001	1.000	0.000	0.0	0.000	0.00	0.0	0.600	o	300	
1.002	40.300	0.269	149.8	0.000	0.00	0.0	0.600	o	225	

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	50.00	5.18	63.725	0.083	0.0	0.0	0.0	1.28	90.7	11.2
2.000	50.00	5.02	66.210	0.014	0.0	0.0	0.0	0.77	6.0	1.9
2.001	50.00	5.04	65.730	0.028	0.0	0.0	0.0	0.77	6.0	3.8
2.002	50.00	5.07	65.400	0.041	0.0	0.0	0.0	0.77	6.0	5.6
2.003	50.00	5.09	64.950	0.054	0.0	0.0	0.0	0.77	6.0«	7.3
2.004	50.00	5.13	64.270	0.084	0.0	0.0	0.0	2.47	43.6	11.4
3.000	50.00	5.01	64.750	0.118	0.0	0.0	0.0	5.91	234.9	16.0
4.000	50.00	5.01	64.200	0.021	0.0	0.0	0.0	2.64	20.7	2.8
5.000	50.00	5.01	64.800	0.038	0.0	0.0	0.0	6.02	106.5	5.1
6.000	50.00	5.07	64.940	0.016	0.0	0.0	0.0	0.86	6.7	2.2
6.001	50.00	5.09	64.890	0.016	0.0	0.0	0.0	3.60	28.3	2.2
1.001	50.00	5.29	63.270	0.360	0.0	0.0	0.0	0.15	10.5«	48.7
1.002	50.00	5.92	63.270	0.360	0.0	0.0	0.0	1.07	42.4«	48.7

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Online Controls for Storm

Orifice Manhole: 11, DS/PN: 6.001, Volume (m³): 0.8

Diameter (m) 0.035 Discharge Coefficient 0.600 Invert Level (m) 64.890

Complex Manhole: 12, DS/PN: 1.001, Volume (m³): 2.7

Orifice

Diameter (m) 0.120 Discharge Coefficient 0.600 Invert Level (m) 63.270

Weir

Discharge Coef 0.544 Width (m) 0.700 Invert Level (m) 63.720

Hydro-Brake Optimum® Manhole: 13, DS/PN: 1.002, Volume (m³): 1.5

Unit Reference	MD-SHE-0194-1850-0800-1850
Design Head (m)	0.800
Design Flow (l/s)	18.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	194
Invert Level (m)	63.270
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	18.4
Flush-Flo™	0.308	18.4
Kick-Flo®	0.601	16.1
Mean Flow over Head Range	-	15.2

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	6.7	1.200	22.3	3.000	34.7	7.000	52.3
0.200	17.8	1.400	24.1	3.500	37.4	7.500	54.0
0.300	18.4	1.600	25.6	4.000	39.8	8.000	55.8
0.400	18.2	1.800	27.1	4.500	42.2	8.500	57.2
0.500	17.6	2.000	28.5	5.000	44.4	9.000	58.8
0.600	16.1	2.200	29.9	5.500	46.5	9.500	60.5
0.800	18.4	2.400	31.1	6.000	48.5		
1.000	20.5	2.600	32.4	6.500	50.4		

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Storage Structures for Storm

Porous Car Park Manhole: 2, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	23.7
Max Percolation (l/s)	31.6	Slope (1:X)	25.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	66.210	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: 3, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	19.5
Max Percolation (l/s)	26.0	Slope (1:X)	45.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	65.730	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: 4, DS/PN: 2.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	20.2
Max Percolation (l/s)	26.9	Slope (1:X)	55.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	65.400	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: 5, DS/PN: 2.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	19.2
Max Percolation (l/s)	25.6	Slope (1:X)	35.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	64.950	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: 6, DS/PN: 2.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	17.7
Max Percolation (l/s)	23.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	64.270	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: 8, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	43.5
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

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<u>Porous Car Park Manhole: 8, DS/PN: 4.000</u> <table><tr><td>Porosity</td><td>0.30</td><td>Slope (1:X)</td><td>0.0</td></tr><tr><td>Invert Level (m)</td><td>64.200</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Width (m)</td><td>4.1</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Length (m)</td><td>38.2</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table> <u>Porous Car Park Manhole: 10, DS/PN: 6.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>4.1</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>20.0</td></tr><tr><td>Max Percolation (l/s)</td><td>22.8</td><td>Slope (1:X)</td><td>0.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>64.940</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table> <u>Cellular Storage Manhole: 12, DS/PN: 1.001</u> <table><tr><td>Invert Level (m)</td><td>63.270</td><td>Safety Factor</td><td>2.0</td></tr><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Porosity</td><td>0.95</td></tr><tr><td>Infiltration Coefficient Side (m/hr)</td><td>0.00000</td><td></td><td></td></tr></table> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>285.0</td><td>285.0</td><td>0.801</td><td>0.0</td><td>285.0</td></tr><tr><td>0.800</td><td>285.0</td><td>285.0</td><td></td><td></td><td></td></tr></table> <u>Volume Summary (Static)</u> Length Calculations based on True Length <table><tr><th colspan="4">Storage</th></tr><tr><th>Pipe Number</th><th>USMH Name</th><th>Structure Volume (m³)</th><th>Total Volume (m³)</th></tr><tr><td>1.000</td><td>1</td><td>0.000</td><td>0.000</td></tr><tr><td>2.000</td><td>2</td><td>4.725</td><td>4.725</td></tr><tr><td>2.001</td><td>3</td><td>8.617</td><td>8.617</td></tr><tr><td>2.002</td><td>4</td><td>9.073</td><td>9.073</td></tr><tr><td>2.003</td><td>5</td><td>6.615</td><td>6.615</td></tr><tr><td>2.004</td><td>6</td><td>8.921</td><td>8.921</td></tr><tr><td>3.000</td><td>7</td><td>0.000</td><td>0.000</td></tr><tr><td>4.000</td><td>8</td><td>16.445</td><td>16.445</td></tr><tr><td>5.000</td><td>9</td><td>0.000</td><td>0.000</td></tr><tr><td>6.000</td><td>10</td><td>8.610</td><td>8.610</td></tr><tr><td>6.001</td><td>11</td><td>0.000</td><td>0.000</td></tr><tr><td>1.001</td><td>12</td><td>216.690</td><td>216.690</td></tr><tr><td>1.002</td><td>13</td><td>0.000</td><td>0.000</td></tr><tr><td>Total</td><td></td><td>279.696</td><td>279.696</td></tr></table>				Porosity	0.30	Slope (1:X)	0.0	Invert Level (m)	64.200	Depression Storage (mm)	5	Width (m)	4.1	Evaporation (mm/day)	3	Length (m)	38.2	Cap Volume Depth (m)	0.350	Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.1	Membrane Percolation (mm/hr)	1000	Length (m)	20.0	Max Percolation (l/s)	22.8	Slope (1:X)	0.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	64.940	Cap Volume Depth (m)	0.350	Invert Level (m)	63.270	Safety Factor	2.0	Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95	Infiltration Coefficient Side (m/hr)	0.00000			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	285.0	285.0	0.801	0.0	285.0	0.800	285.0	285.0				Storage				Pipe Number	USMH Name	Structure Volume (m³)	Total Volume (m³)	1.000	1	0.000	0.000	2.000	2	4.725	4.725	2.001	3	8.617	8.617	2.002	4	9.073	9.073	2.003	5	6.615	6.615	2.004	6	8.921	8.921	3.000	7	0.000	0.000	4.000	8	16.445	16.445	5.000	9	0.000	0.000	6.000	10	8.610	8.610	6.001	11	0.000	0.000	1.001	12	216.690	216.690	1.002	13	0.000	0.000	Total		279.696	279.696
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XP Solutions						Network 2015.1			
<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>									
<u>Simulation Criteria</u>									
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 8									
Number of Online Controls 3 Number of Time/Area Diagrams 0									
Number of Offline Controls 0 Number of Real Time Controls 0									
<u>Synthetic Rainfall Details</u>									
Rainfall Model FEH D3 (1km) 0.311									
Site Location GB 480850 165550 E (1km) 0.304									
C (1km) -0.029 F (1km) 2.678									
D1 (1km) 0.269 Cv (Summer) 0.950									
D2 (1km) 0.274 Cv (Winter) 0.950									
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, 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									
<u>Water Level</u>									
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
1.000	1	15 Summer	1	+0%	100/15 Summer				63.825
2.000	2	15 Summer	1	+0%	30/15 Summer				66.271
2.001	3	15 Summer	1	+0%	30/15 Summer				65.814
2.002	4	30 Summer	1	+0%	1/15 Summer				65.512
2.003	5	30 Summer	1	+0%	1/15 Summer				65.073
2.004	6	30 Summer	1	+0%	100/15 Summer				64.317
3.000	7	15 Summer	1	+0%	100/15 Summer				64.817
4.000	8	60 Summer	1	+0%	100/15 Summer				64.221
5.000	9	15 Summer	1	+0%					64.837
6.000	10	60 Summer	1	+0%	30/15 Summer				64.977
6.001	11	60 Summer	1	+0%	30/15 Summer				64.974
1.001	12	480 Summer	1	+0%	30/15 Summer				63.445
1.002	13	480 Summer	1	+0%	100/15 Summer				63.347
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
1.000	1	-0.200	0.000	0.24		18.0	OK	
2.000	2	-0.039	0.000	0.67		2.6	OK	
2.001	3	-0.016	0.000	1.00		3.9	OK	
2.002	4	0.012	0.000	1.15		4.5	SURCHARGED	
2.003	5	0.023	0.000	1.37		5.4	SURCHARGED	
2.004	6	-0.103	0.000	0.22		7.9	OK	
3.000	7	-0.158	0.000	0.19		25.6	OK	
4.000	8	-0.079	0.000	0.10		1.3	OK	
5.000	9	-0.113	0.000	0.14		8.3	OK	
6.000	10	-0.063	0.000	0.15		0.8	OK	
6.001	11	-0.016	0.000	0.03		0.7	OK	
1.001	12	-0.125	0.000	0.07		4.2	OK	
1.002	13	-0.148	0.000	0.10		4.2	OK	

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

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Pipe Flow	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Cap.	(l/s)	(l/s)		
1.000	1	-0.100	0.000	0.77		57.8	OK	
2.000	2	0.076	0.000	2.12		8.3	SURCHARGED	
2.001	3	0.150	0.000	2.87		11.3	SURCHARGED	
2.002	4	0.166	0.000	3.01		11.8	FLOOD RISK	
2.003	5	0.199	0.000	3.27		12.9	FLOOD RISK	
2.004	6	-0.044	0.000	0.84		30.4	OK	
3.000	7	-0.097	0.000	0.61		82.3	OK	
4.000	8	-0.039	0.000	0.67		8.9	OK	
5.000	9	-0.079	0.000	0.45		26.5	OK	
6.000	10	0.044	0.000	0.22		1.3	SURCHARGED	
6.001	11	0.089	0.000	0.04		1.1	SURCHARGED	
1.001	12	0.099	0.000	0.23		13.0	SURCHARGED	
1.002	13	-0.074	0.000	0.32		13.0	OK	

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100 year Return Period 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	8
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.311
Site Location GB 480850	165550	E (1km)	0.304
C (1km)	-0.029	F (1km)	2.678
D1 (1km)	0.269	Cv (Summer)	0.950
D2 (1km)	0.274	Cv (Winter)	0.950

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, 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	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1 60	Winter	100	+40%	100/15	Summer			64.402
2.000	2 15	Summer	100	+40%	30/15	Summer			66.555
2.001	3 15	Summer	100	+40%	30/15	Summer			66.177
2.002	4 15	Summer	100	+40%	1/15	Summer			65.845
2.003	5 15	Winter	100	+40%	1/15	Summer			65.460
2.004	6 15	Summer	100	+40%	100/15	Summer			64.546
3.000	7 15	Summer	100	+40%	100/15	Summer			65.504
4.000	8 15	Summer	100	+40%	100/15	Summer			64.337
5.000	9 15	Summer	100	+40%					64.917
6.000	10 30	Winter	100	+40%	30/15	Summer			65.275
6.001	11 30	Winter	100	+40%	30/15	Summer			65.269
1.001	12 60	Winter	100	+40%	30/15	Summer			64.397
1.002	13 60	Winter	100	+40%	100/15	Summer			63.994

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

PN	US/MH Name	Surcharged Flooded		Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)				
1.000	1	0.377	0.000	0.59	44.3	FLOOD RISK	
2.000	2	0.245	0.000	3.57	14.0	FLOOD RISK	
2.001	3	0.347	0.000	4.20	16.5	FLOOD RISK	
2.002	4	0.345	0.000	4.24	16.7	FLOOD RISK	
2.003	5	0.410	0.000	4.61	18.1	FLOOD RISK	
2.004	6	0.126	0.000	1.17	42.5	SURCHARGED	
3.000	7	0.529	0.000	1.26	169.0	FLOOD RISK	
4.000	8	0.037	0.000	1.09	14.5	SURCHARGED	
5.000	9	-0.033	0.000	0.96	56.4	OK	
6.000	10	0.235	0.000	0.31	1.8	FLOOD RISK	
6.001	11	0.279	0.000	0.06	1.5	SURCHARGED	
1.001	12	0.827	0.000	0.35	20.2	FLOOD RISK	
1.002	13	0.499	0.000	0.45	18.3	SURCHARGED	