

|                                 |                  |                                                                                     |
|---------------------------------|------------------|-------------------------------------------------------------------------------------|
| William Saunders                |                  | Page 1                                                                              |
| Sheppard Lockton House          | 11974            |  |
| Cafferata Way                   | Hilljet Quadring |                                                                                     |
| Newark, NG24 2TN                | FEH with crates  |                                                                                     |
| Date 31/10/2019                 | Designed by PAE  |                                                                                     |
| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
| Innovyze                        | Network 2019.1   |                                                                                     |

### STORM SEWER DESIGN by the Modified Rational Method

#### Design Criteria for Storm

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)           | 0.000 |
| Maximum Rainfall (mm/hr)             | 100    | Maximum Backdrop Height (m)           | 1.500 |
| Maximum Time of Concentration (mins) | 60     | 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 Storm

| PN     | Length<br>(m) | Fall<br>(m) | Slope<br>(1:X) | I.Area<br>(ha) | T.E.<br>(mins) | Base<br>Flow (l/s) | k<br>(mm) | HYD<br>SECT | DIA<br>(mm) | Section Type | Auto<br>Design                                                                        |
|--------|---------------|-------------|----------------|----------------|----------------|--------------------|-----------|-------------|-------------|--------------|---------------------------------------------------------------------------------------|
| S1.000 | 24.701        | 0.050       | 494.0          | 0.074          | 5.00           | 0.0                | 0.600     | o           | 750         | Pipe/Conduit |  |
| S1.001 | 23.046        | 0.050       | 460.9          | 0.055          | 0.00           | 0.0                | 0.600     | o           | 750         | Pipe/Conduit |  |
| S2.000 | 32.000        | 0.065       | 492.3          | 0.039          | 5.00           | 0.0                | 0.600     | o           | 750         | Pipe/Conduit |  |
| S1.002 | 32.117        | 0.065       | 494.1          | 0.025          | 0.00           | 0.0                | 0.600     | o           | 750         | Pipe/Conduit |  |
| S3.000 | 6.000         | 0.025       | 240.0          | 0.000          | 5.00           | 0.0                | 0.600     | o           | 450         | Pipe/Conduit |  |
| S1.003 | 3.818         | 0.050       | 76.4           | 0.037          | 0.00           | 0.0                | 0.600     | o           | 225         | Pipe/Conduit |  |

#### Network Results Table

| PN     | Rain<br>(mm/hr) | T.C.<br>(mins) | US/IL<br>(m) | I.Area<br>(ha) | Σ Base<br>Flow (l/s) | Foul<br>(l/s) | Add Flow<br>(l/s) | Vel<br>(m/s) | Cap<br>(l/s) | Flow<br>(l/s) |
|--------|-----------------|----------------|--------------|----------------|----------------------|---------------|-------------------|--------------|--------------|---------------|
| S1.000 | 64.95           | 5.33           | 2.340        | 0.074          | 0.0                  | 0.0           | 0.0               | 1.25         | 553.2        | 13.0          |
| S1.001 | 63.42           | 5.62           | 2.290        | 0.129          | 0.0                  | 0.0           | 0.0               | 1.30         | 572.9        | 22.2          |
| S2.000 | 64.44           | 5.43           | 2.305        | 0.039          | 0.0                  | 0.0           | 0.0               | 1.25         | 554.2        | 6.8           |
| S1.002 | 61.36           | 6.05           | 2.240        | 0.193          | 0.0                  | 0.0           | 0.0               | 1.25         | 553.2        | 32.1          |
| S3.000 | 66.32           | 5.08           | 2.500        | 0.000          | 0.0                  | 0.0           | 0.0               | 1.31         | 208.0        | 0.0           |
| S1.003 | 61.16           | 6.09           | 2.175        | 0.229          | 0.0                  | 0.0           | 0.0               | 1.50         | 59.6         | 38.0          |

|                                 |                  |                                                                                     |
|---------------------------------|------------------|-------------------------------------------------------------------------------------|
| William Saunders                |                  | Page 2                                                                              |
| Sheppard Lockton House          | 11974            |  |
| Cafferata Way                   | Hilljet Quadring |                                                                                     |
| Newark, NG24 2TN                | FEH with crates  |                                                                                     |
| Date 31/10/2019                 | Designed by PAE  |                                                                                     |
| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
| Innovyze                        | Network 2019.1   |                                                                                     |

#### 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 | 0.000 |
| 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 Offline Controls 0    |       |                                            |       |
| Number of Time/Area Diagrams 0  |       |                                            |       |
| Number of Online Controls 1     |       |                                            |       |
| Number of Storage Structures 1  |       |                                            |       |
| 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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| Innovyze                        | Network 2019.1   |                                                                                     |

### Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS5, DS/PN: S1.003, Volume (m³): 18.1

|                                   |                            |
|-----------------------------------|----------------------------|
| Unit Reference                    | MD-SHE-0103-5000-1156-5000 |
| Design Head (m)                   | 1.156                      |
| Design Flow (l/s)                 | 5.0                        |
| Flush-Flo™                        | Calculated                 |
| Objective                         | Minimise upstream storage  |
| Application                       | Surface                    |
| Sump Available                    | Yes                        |
| Diameter (mm)                     | 103                        |
| Invert Level (m)                  | 2.175                      |
| Minimum Outlet Pipe Diameter (mm) | 150                        |
| Suggested Manhole Diameter (mm)   | 1200                       |

| Control Points            | Head (m) | Flow (l/s) | Control Points            | Head (m) | Flow (l/s) |
|---------------------------|----------|------------|---------------------------|----------|------------|
| Design Point (Calculated) | 1.156    | 5.0        | Kick-Flo®                 | 0.721    | 4.0        |
| Flush-Flo™                | 0.341    | 5.0        | Mean Flow over Head Range | -        | 4.4        |

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     | 3.5        | 1.200     | 5.1        | 3.000     | 7.8        | 7.000     | 11.7       |
| 0.200     | 4.8        | 1.400     | 5.5        | 3.500     | 8.4        | 7.500     | 12.1       |
| 0.300     | 5.0        | 1.600     | 5.8        | 4.000     | 8.9        | 8.000     | 12.4       |
| 0.400     | 5.0        | 1.800     | 6.1        | 4.500     | 9.5        | 8.500     | 12.8       |
| 0.500     | 4.9        | 2.000     | 6.5        | 5.000     | 9.9        | 9.000     | 13.2       |
| 0.600     | 4.6        | 2.200     | 6.8        | 5.500     | 10.4       | 9.500     | 13.5       |
| 0.800     | 4.2        | 2.400     | 7.0        | 6.000     | 10.8       |           |            |
| 1.000     | 4.7        | 2.600     | 7.3        | 6.500     | 11.3       |           |            |

|                                 |                  |                                                                                     |
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| Newark, NG24 2TN                | FEH with crates  |                                                                                     |
| Date 31/10/2019                 | Designed by PAE  |                                                                                     |
| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
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### Storage Structures for Storm

#### Cellular Storage Manhole: SS40, DS/PN: S3.000

Invert Level (m)    2.525    Safety Factor    2.0  
 Infiltration Coefficient Base (m/hr)    0.00000    Porosity    0.95  
 Infiltration Coefficient Side (m/hr)    0.00000

| Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000     | 165.0                  | 165.0                       | 0.401     | 0.0                    | 195.4                       |
| 0.400     | 165.0                  | 195.4                       |           |                        |                             |

|                                 |                  |                                                                                     |
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| Innovyze                        | Network 2019.1   |                                                                                     |

2 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 \* 10m<sup>3</sup>/ha Storage 0.000  
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 Offline Controls 0    Number of Time/Area Diagrams 0  
Number of Online Controls 1    Number of Storage Structures 1    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) 450.0  
Analysis Timestep 2.5 Second Increment (Extended)  
DTS Status OFF  
DVD Status OFF  
Inertia Status OFF

Profile(s) Summer and Winter  
Duration(s) (mins) 15, 30, 60  
Return Period(s) (years) 2, 30, 100  
Climate Change (%) 0, 0, 40

|        | US/MH |           | Return | Climate | First (X)   | First (Y) | First (Z) | Overflow | Water |
|--------|-------|-----------|--------|---------|-------------|-----------|-----------|----------|-------|
| PN     | Name  | Storm     | Period | Change  | Surcharge   | Flood     | Overflow  | Act.     | Level |
|        |       |           |        |         |             |           |           |          | (m)   |
| S1.000 | SS1   | 30 Winter | 2      | +0%     |             |           |           |          | 2.546 |
| S1.001 | SS2   | 30 Winter | 2      | +0%     |             |           |           |          | 2.546 |
| S2.000 | SS3   | 30 Winter | 2      | +0%     |             |           |           |          | 2.546 |
| S1.002 | SS4   | 30 Winter | 2      | +0%     |             |           |           |          | 2.546 |
| S3.000 | SS40  | 60 Winter | 2      | +0%     |             |           |           |          | 2.526 |
| S1.003 | SS5   | 30 Winter | 2      | +0%     | 2/15 Summer |           |           |          | 2.546 |

|        | US/MH | Surcharged | Flooded           |        | Pipe  |        |  | Level    |
|--------|-------|------------|-------------------|--------|-------|--------|--|----------|
| PN     | Name  | Depth      | Volume            | Flow / | Flow  | Status |  | Exceeded |
|        |       | (m)        | (m <sup>3</sup> ) | Cap.   | (l/s) |        |  |          |
| S1.000 | SS1   | -0.544     | 0.000             | 0.02   | 9.1   | OK     |  |          |
| S1.001 | SS2   | -0.494     | 0.000             | 0.03   | 11.9  | OK     |  |          |

|                                 |                  |                                                                                     |
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| Newark, NG24 2TN                | FEH with crates  |                                                                                     |
| Date 31/10/2019                 | Designed by PAE  |                                                                                     |
| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
| Innovyze                        | Network 2019.1   |                                                                                     |

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

| PN     | US/MH<br>Name | Surcharged   |                | Flooded        |                   | Pipe<br>Flow<br>(l/s) | Status     | Level<br>Exceeded |
|--------|---------------|--------------|----------------|----------------|-------------------|-----------------------|------------|-------------------|
|        |               | Depth<br>(m) | Volume<br>(m³) | Flow /<br>Cap. | Overflow<br>(l/s) |                       |            |                   |
| S2.000 | SS3           | -0.509       | 0.000          | 0.01           |                   | 4.1                   | OK         |                   |
| S1.002 | SS4           | -0.444       | 0.000          | 0.02           |                   | 9.5                   | OK         |                   |
| S3.000 | SS40          | -0.424       | 0.000          | 0.01           |                   | 1.1                   | OK         |                   |
| S1.003 | SS5           | 0.146        | 0.000          | 0.16           |                   | 5.0                   | SURCHARGED |                   |

|                                 |                  |                                                                                     |
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| Cafferata Way                   | Hilljet Quadring |                                                                                     |
| Newark, NG24 2TN                | FEH with crates  |                                                                                     |
| Date 31/10/2019                 | Designed by PAE  |                                                                                     |
| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
| Innovyze                        | Network 2019.1   |                                                                                     |

### 30 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 \* 10m<sup>3</sup>/ha Storage 0.000  
 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 Offline Controls 0    Number of Time/Area Diagrams 0  
 Number of Online Controls 1    Number of Storage Structures 1    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) 450.0  
 Analysis Timestep 2.5 Second Increment (Extended)  
 DTS Status OFF  
 DVD Status OFF  
 Inertia Status OFF

Profile(s) Summer and Winter  
 Duration(s) (mins) 15, 30, 60  
 Return Period(s) (years) 2, 30, 100  
 Climate Change (%) 0, 0, 40

|        |            |           |               |                |                 |                 |                    |               |           | Water |
|--------|------------|-----------|---------------|----------------|-----------------|-----------------|--------------------|---------------|-----------|-------|
| PN     | US/MH Name | Storm     | Return Period | Climate Change | First (X) Surge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Level (m) |       |
| S1.000 | SS1        | 30 Winter | 30            | +0%            |                 |                 |                    |               | 2.696     |       |
| S1.001 | SS2        | 30 Winter | 30            | +0%            |                 |                 |                    |               | 2.695     |       |
| S2.000 | SS3        | 30 Winter | 30            | +0%            |                 |                 |                    |               | 2.694     |       |
| S1.002 | SS4        | 30 Winter | 30            | +0%            |                 |                 |                    |               | 2.694     |       |
| S3.000 | SS40       | 60 Winter | 30            | +0%            |                 |                 |                    |               | 2.627     |       |
| S1.003 | SS5        | 30 Winter | 30            | +0%            | 2/15 Summer     |                 |                    |               | 2.691     |       |

|        |            | Surcharged |                          | Flooded     |                |                 | Pipe   |                |  |
|--------|------------|------------|--------------------------|-------------|----------------|-----------------|--------|----------------|--|
| PN     | US/MH Name | Depth (m)  | Volume (m <sup>3</sup> ) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |  |
| S1.000 | SS1        | -0.394     | 0.000                    | 0.04        |                | 17.0            | OK     |                |  |
| S1.001 | SS2        | -0.345     | 0.000                    | 0.05        |                | 20.9            | OK     |                |  |

|                                 |                  |                                                                                     |
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| William Saunders                |                  | Page 8                                                                              |
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| Newark, NG24 2TN                | FEH with crates  |                                                                                     |
| Date 31/10/2019                 | Designed by PAE  |                                                                                     |
| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
| Innovyze                        | Network 2019.1   |                                                                                     |

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

|           |                       | <b>Surcharged</b>    | <b>Flooded</b>         |                        |                           | <b>Pipe</b>           |               |                           |
|-----------|-----------------------|----------------------|------------------------|------------------------|---------------------------|-----------------------|---------------|---------------------------|
| <b>PN</b> | <b>US/MH<br/>Name</b> | <b>Depth<br/>(m)</b> | <b>Volume<br/>(m³)</b> | <b>Flow /<br/>Cap.</b> | <b>Overflow<br/>(l/s)</b> | <b>Flow<br/>(l/s)</b> | <b>Status</b> | <b>Level<br/>Exceeded</b> |
| S2.000    | SS3                   | -0.361               | 0.000                  | 0.02                   |                           | 8.2                   | OK            |                           |
| S1.002    | SS4                   | -0.296               | 0.000                  | 0.04                   |                           | 18.4                  | OK            |                           |
| S3.000    | SS40                  | -0.323               | 0.000                  | 0.03                   |                           | 3.2                   | OK            |                           |
| S1.003    | SS5                   | 0.291                | 0.000                  | 0.16                   |                           | 5.0                   | SURCHARGED    |                           |

|                                 |                  |                                                                                     |
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| Date 31/10/2019                 | Designed by PAE  |                                                                                     |
| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
| Innovyze                        | Network 2019.1   |                                                                                     |

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 \* 10m<sup>3</sup>/ha Storage 0.000  
 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 Offline Controls 0    Number of Time/Area Diagrams 0  
 Number of Online Controls 1    Number of Storage Structures 1    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) 450.0  
 Analysis Timestep 2.5 Second Increment (Extended)  
 DTS Status OFF  
 DVD Status OFF  
 Inertia Status OFF

Profile(s) Summer and Winter  
 Duration(s) (mins) 15, 30, 60  
 Return Period(s) (years) 2, 30, 100  
 Climate Change (%) 0, 0, 40

|        | US/MH |           | Return | Climate | First (X)   | First (Y) | First (Z) | Overflow | Water |
|--------|-------|-----------|--------|---------|-------------|-----------|-----------|----------|-------|
| PN     | Name  | Storm     | Period | Change  | Surcharge   | Flood     | Overflow  | Act.     | Level |
|        |       |           |        |         |             |           |           |          | (m)   |
| S1.000 | SS1   | 30 Winter | 100    | +40%    |             |           |           |          | 2.887 |
| S1.001 | SS2   | 30 Winter | 100    | +40%    |             |           |           |          | 2.885 |
| S2.000 | SS3   | 30 Winter | 100    | +40%    |             |           |           |          | 2.882 |
| S1.002 | SS4   | 30 Winter | 100    | +40%    |             |           |           |          | 2.881 |
| S3.000 | SS40  | 60 Winter | 100    | +40%    |             |           |           |          | 2.820 |
| S1.003 | SS5   | 30 Winter | 100    | +40%    | 2/15 Summer |           |           |          | 2.874 |

|        | US/MH | Surcharged | Flooded           |        | Pipe  |        |  | Level    |
|--------|-------|------------|-------------------|--------|-------|--------|--|----------|
| PN     | Name  | Depth      | Volume            | Flow / | Flow  | Status |  | Exceeded |
|        |       | (m)        | (m <sup>3</sup> ) | Cap.   | (l/s) |        |  |          |
| S1.000 | SS1   | -0.203     | 0.000             | 0.08   | 31.8  | OK     |  |          |
| S1.001 | SS2   | -0.155     | 0.000             | 0.10   | 41.8  | OK     |  |          |

|                                 |                  |                                                                                     |
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| File 19.10.31 750 5ls fsr wi... | Checked by       |                                                                                     |
| Innovyze                        | Network 2019.1   |                                                                                     |

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

| PN     | US/MH<br>Name | Surcharged Flooded |                             | Flow /<br>Cap. | Overflow<br>(l/s) | Pipe<br>Flow<br>(l/s) | Status     | Level<br>Exceeded |
|--------|---------------|--------------------|-----------------------------|----------------|-------------------|-----------------------|------------|-------------------|
|        |               | Depth<br>(m)       | Volume<br>(m <sup>3</sup> ) |                |                   |                       |            |                   |
| S2.000 | SS3           | -0.173             | 0.000                       | 0.04           |                   | 15.7                  | OK         |                   |
| S1.002 | SS4           | -0.109             | 0.000                       | 0.11           |                   | 48.9                  | OK         |                   |
| S3.000 | SS40          | -0.130             | 0.000                       | 0.02           |                   | 3.0                   | OK         |                   |
| S1.003 | SS5           | 0.474              | 0.000                       | 0.16           |                   | 5.0                   | SURCHARGED |                   |