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The Use of Clementine at South West Water to reduce sewer flooding incidents

Tony Hoar - Business Performance Manager

Ben Plastow - Data Quality Analyst

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Presentation Topics (Tony)

- Overview of South West Water (SWW)
- The Business Performance role
- Capital asset statistics
- The analysis weakness we faced
- Why we selected SPSS Clementine
- Why we selected DG5 as our first project

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Presentation Topics (Ben)

- The solution applied
- The implementation process:
  - Defining risk
  - Verifying model accuracy
  - Excel reports
  - SWWIM (digital mapping) integration
- The results achieved
- Future developments
- Current and Future projects

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Who are South West Water?

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The 10 UK Water & Sewerage companies

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SWW Key Facts (1)

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- Formed in 1989
- 1,330 employees
- Turnover of £351m in 2006-07
- Our customer base comprises:
  - 1.6 million residents
  - 750,000 billed customers
  - 8 million visitors

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Pennon Group Plc

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SWW Key Facts (2)

- We provide:
  - Clean water to 97% of homes
  - Sewerage collection and treatment to 88% of homes
- The regulators:
  - The Water Services Regulatory Authority (OFWAT)
  - Environment Agency
  - Drinking Water Inspectorate (DWI)

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The Business Performance Role

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- Business Performance (BP) is part of the Asset Management & Development department in SWW
- BP undertake the following capital asset related activities:
  - Business efficiency investigations
  - Key Performance Indicator (KPI) reporting
  - Information provision
  - Data analysis
  - Dataset and data quality management
  - New business processes

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Asset Management & Development

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Our Asset Base (1)

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Clean Water

- 22 impounding reservoirs
- 32 treatment works
- 320 service reservoirs
- 15,000 km of water pipes
- 230 pumping stations

Waste Water

- 600+ treatment works
- 8,700 km of public sewers
- 800+ pumping stations
- 2,000 storm overflows
- 300,000 manholes

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Our Asset Base (2)

- Gross replacement cost of capital assets is £8.4bn
- Over £2.5bn invested in our capital assets since privatisation
- Capital expenditure circa £200m per annum

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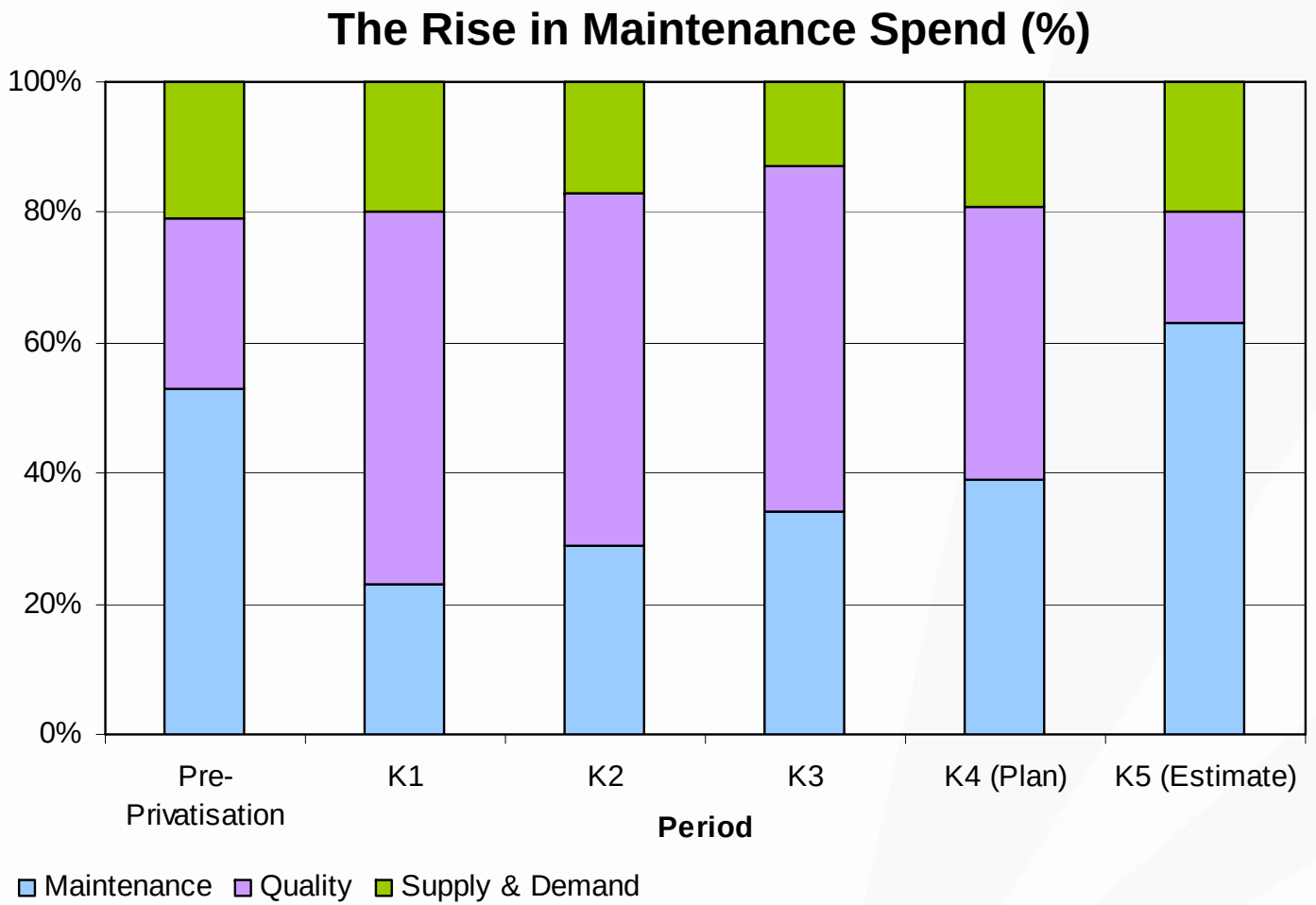
Changing Information Requirements



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Why SPSS Clementine?

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- The initial presentations by SPSS
- Subsequent contact and presentations
- A review of similar software
- Requirement for a non-specific predictive analysis tool
- The SPSS people we met
- Use of Clementine within the water industry

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Why DG5 Sewer Flooding?

- 6,000 blockages per year
- 75 customer properties and 300 gardens flooded with sewage per year
- Lost Operational Performance Assessment (OPA) points
- Pollution of rivers and other water courses
- Risk of prosecution
- SPSS experience in this area

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The Project Objectives

- The prime objectives are to:
  - Identify areas most at risk of sewer flooding, the underlying factors, and changing risk over time.
  - To better prioritise investigations, sewer cleansing, and repairs.
  - Reduce the number of sewer flooding incidents in the most cost effective way.
  - Increase confidence in the level of capital maintenance expenditure required.

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Defining Risk: Fixed Factors

- Risk is based on the following **fixed factors** which do not change over time:
  - Sewer assets (depth, criticality, capacity, length, quality)
  - Sewer cleansing (historic build up rates of fat, silt, sand, & roots)
  - Commercial food properties (restaurants, takeaways)
  - Older properties (aged pre-1896)
  - Socio-economic factors (rateable value of properties)

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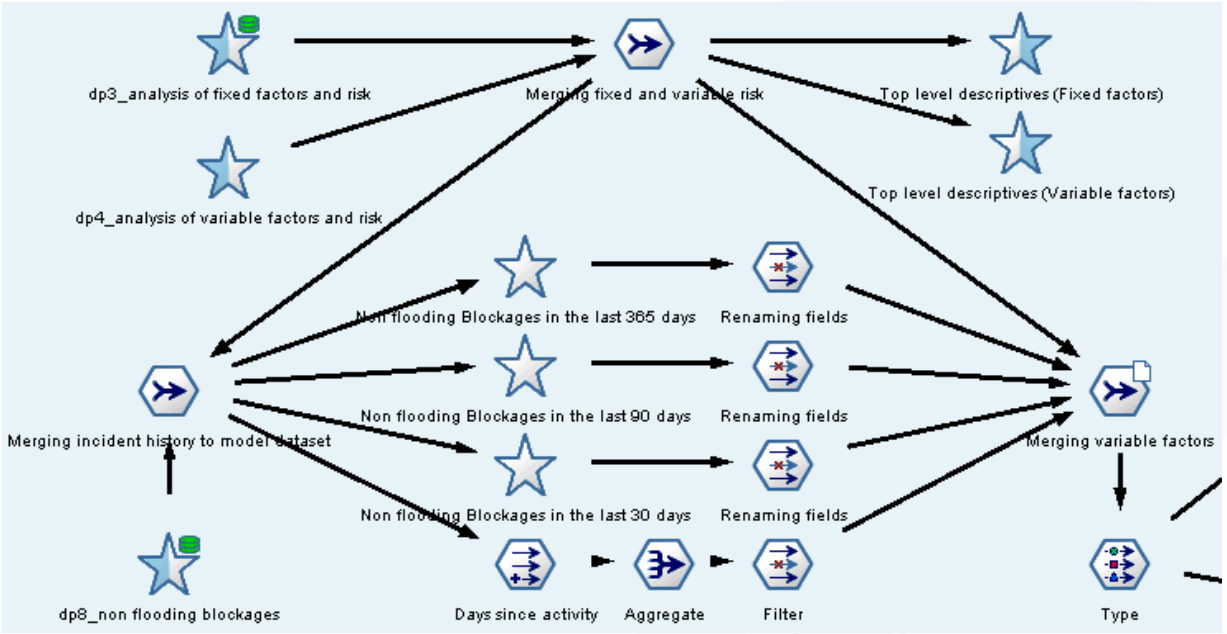
Defining Risk: Variable Factors

- And the following **variable factors**:
  - Previous internal flooding incidents
  - Previous external flooding incidents
  - Previous non-flooding blockages



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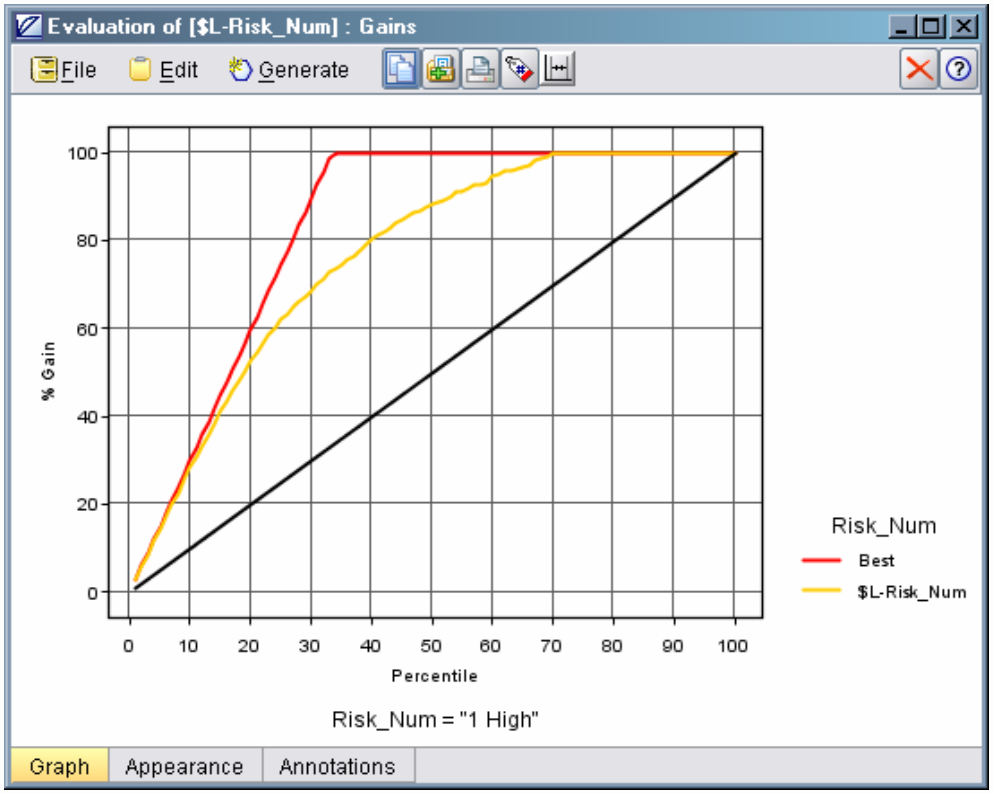
Verifying Model Accuracy

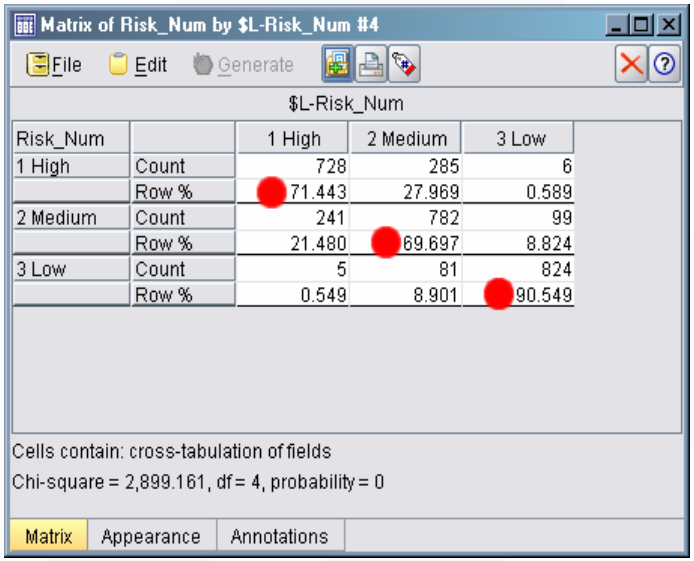
One Year Variable Risk Model



Black diagonal line = base rate (model predicting outcome at chance level)

Red line (Best) = results if perfect model applied to data

$L-Risk_Num = model results



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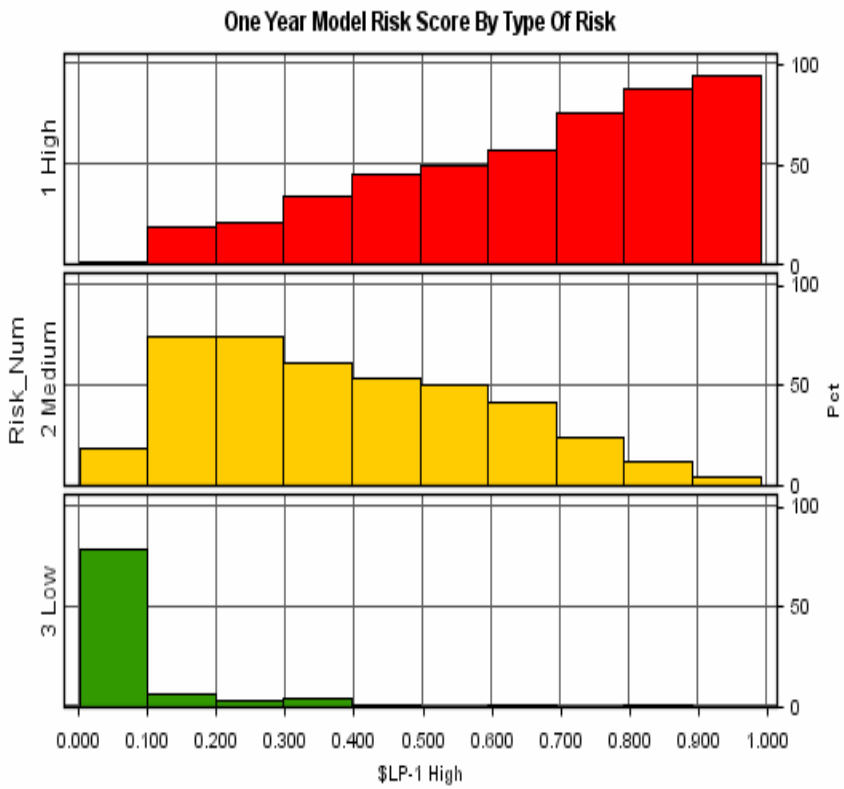
One Year Model By Type Of Risk



Predictive factors (by weight)

- Internal flooding (23.1%)
- External flooding (20.3%)
- Fat build up rate (14.5%)
- Non-flooding blockages (10.5%)
- Sewer length and quality grade (6.4%)
- Socio-economic factors (5.5%)
- Sewer Criticality Group A (4.8%)
- Sewer capacity (length/depth) (3.9%)
- Commercial food properties (3.7%)
- Older properties (pre-1896) (3.6%)
- Sewer depth (3.5%)

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One Year Model: Leading Factors

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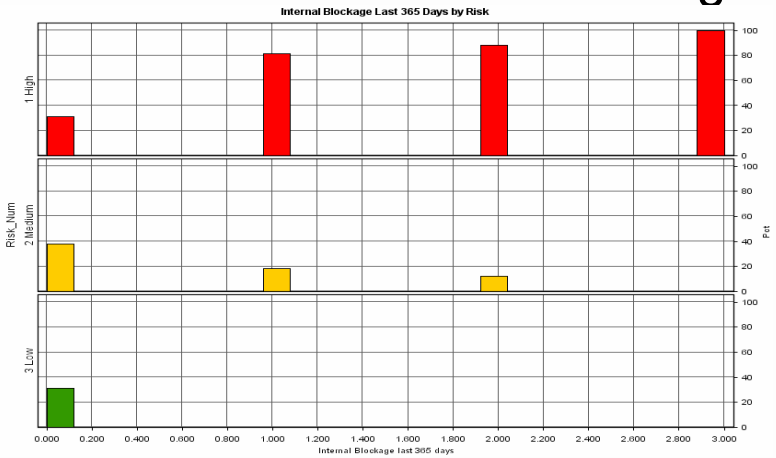
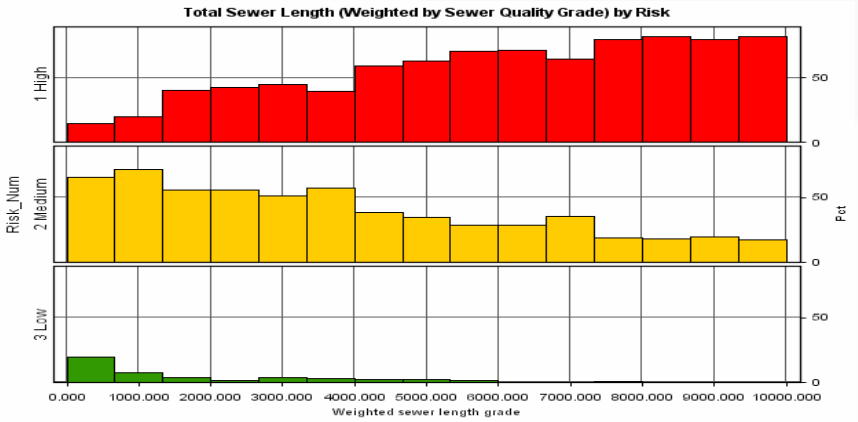
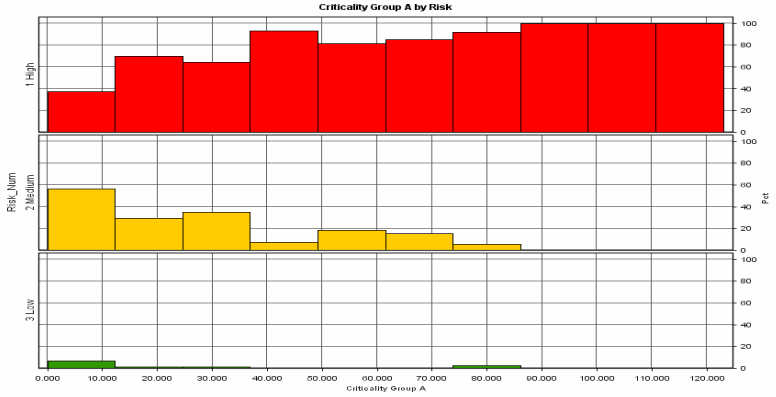
Number of Internal Blockages



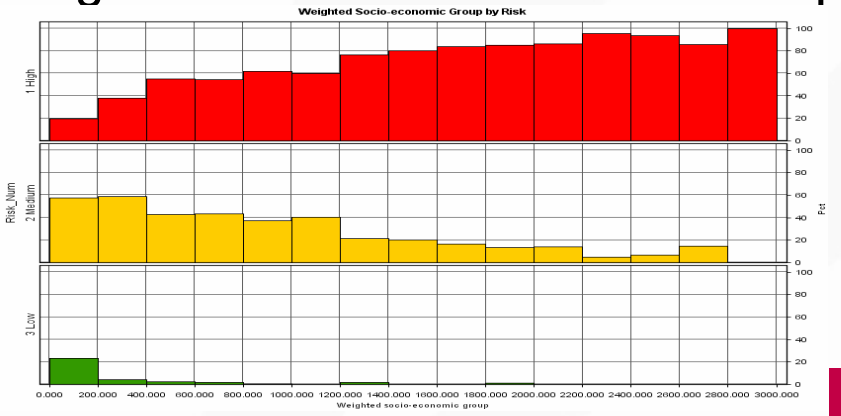
Weighted Sewer Length Grade



Number of Critical A Sewers



Weighted Socio-economic Group



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Excel: Executive Summary Sheet

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- Shows the main league positions including counts of number of internal, external and non-flooding blockages and recency

One year risk - Executive Summary

Analysis Date is Sunday 18 March 2007

	Risk rank			Risk score			Geographical location				Activity			Recency		
	Risk rank	Risk rank last period (30 days ago)	Change in rank	Risk score	Risk score last period (30 days ago)	Change in risk score	MapQuadrant	Town/City	County	Catchment	Total no of internal floods in last 365 days	Total no of external floods in last 365 days	Total no of non flooding blockages in last 365 days	Days since last internal flood last 365 days	Days since last External flood last 365 days	Days since last non flood blockage last 365 days
1	1	2	1	0.992	0.992	0.000	SX9191NW	EXETER	DEVON	COUNTESS WEAR STW	0	2	5	NA	193	71
2	2	1	-1	0.992	0.992	0.000	SY3492SW	LYME REGIS	DORSET	UPLYME STW	1	2	7	316	279	122
3	3	5	2	0.987	0.987	0.000	SX8060SW	TOTNES	DEVON	TOTNES STW	1	1	0	117	328	NA
4	4	4	0	0.987	0.988	-0.001	SX9256SW	BRIXHAM	DEVON	SHARKHAM POINT OUTFALL	2	3	7	89	39	44
5	5	10	5	0.986	0.980	0.006	SS5633NW	BARNSTAPLE	DEVON	ASHFORD STW	4	3	5	158	13	5
6	6	6	0	0.985	0.985	0.000	SX9163NE	TORQUAY	DEVON	HOPES NOSE SCREEN	3	0	8	165	NA	32
7	7	8	1	0.985	0.982	0.003	SW7042SW	REDRUTH	CORNWALL	POLTREATH SCREENS	0	2	9	NA	17	8
8	8	11	3	0.984	0.980	0.004	SX9192SE	EXETER	DEVON	COUNTESS WEAR STW	2	1	2	53	181	25
9	9	3	-6	0.981	0.990	-0.009	SX8860NW	PAIGNTON	DEVON	SHARKHAM POINT OUTFALL	0	5	4	NA	37	52
10	10	35	25	0.981	0.964	0.017	SW4729NW	PENZANCE	CORNWALL	HAYLE STW	2	1	2	12	349	310
11	11	9	-2	0.981	0.981	0.000	SW6440SE	CAMBORNE	CORNWALL	NORTH CLIFF KIEV MILLS SCREEN	1	1	4	77	193	37
12	12	14	2	0.980	0.978	0.002	SY0080NW	EXMOUTH	DEVON	MAER LANE STW	1	4	5	331	48	19
13	13	12	-1	0.979	0.979	0.000	SW6942SE	REDRUTH	CORNWALL	POLTREATH SCREENS	0	5	5	NA	45	3
14	14	13	-1	0.979	0.979	0.000	SX7569NE	NEWTON ABBOT	DEVON	KILBURY STW	2	1	5	96	301	42
15	15	15	0	0.978	0.978	0.000	SW7041NW	REDRUTH	CORNWALL	POLTREATH SCREENS	0	5	10	NA	95	34
16	16	28	12	0.978	0.973	0.005	SW5140SE	ST. IVES	CORNWALL	HAYLE STW	3	1	2	37	326	21
17	17	17	0	0.977	0.978	-0.001	SX8751SE	DARTMOUTH	DEVON	DARTMOUTH STW	2	4	1	219	146	16
18	18	19	1	0.976	0.977	-0.001	SX0052NE	ST. AUSTELL	CORNWALL	MENAGWINS STW	1	3	8	37	121	12
19	19	22	3	0.976	0.976	0.000	SX4556SE	PLYMOUTH	DEVON	ALBERT ST OUTFALL	2	3	3	239	189	142
20	20	23	3	0.976	0.976	0.000	SX9263SW	TORQUAY	DEVON	HOPES NOSE SCREEN	1	3	1	156	105	87
21	21	24	3	0.976	0.976	0.000	SS5019SW	TORRINGTON	DEVON	TORRINGTON STW	0	2	1	NA	178	106
22	22	25	3	0.975	0.975	0.000	SW6941NE	REDRUTH	CORNWALL	POLTREATH SCREENS	0	2	5	NA	105	204
23	23	27	4	0.973	0.973	0.000	SX7344SE	KINGSBRIDGE	DEVON	KINGSBRIDGE STW	0	2	2	NA	362	55
24	24	18	-6	0.973	0.978	-0.005	SS9512NE	TIVERTON	DEVON	TIVERTON STW	2	2	1	145	241	300
25	25	7	-18	0.972	0.985	-0.013	SY0081SW	EXMOUTH	DEVON	MAER LANE STW	0	2	2	NA	109	59
26	26	33	7	0.971	0.966	0.005	SW4730SW	PENZANCE	CORNWALL	HAYLE STW	0	1	3	NA	67	10
27	27	16	-11	0.970	0.978	-0.008	SS4919SE	TORRINGTON	DEVON	TORRINGTON STW	1	3	0	346	12	NA
28	28	31	3	0.970	0.967	0.004	SS4426SE	BIDEFORD	DEVON	BIDEFORD SCREENS	1	1	4	172	158	26
29	29	32	3	0.970	0.967	0.004	SW8244NW	TRURO	CORNWALL	NEWHAM STW	0	1	4	NA	115	27
30	30	21	-9	0.970	0.976	-0.006	SW6627NW	HELSTON	CORNWALL	HELSTON STW	1	1	2	337	34	213
31	31	30	-1	0.969	0.969	0.000	SX9293SW	EXETER	DEVON	COUNTESS WEAR STW	0	2	1	NA	93	79
32	32	29	-3	0.969	0.971	-0.003	SW5637NE	HAYLE	CORNWALL	HAYLE STW	0	1	1	NA	147	292

One year ES | One year LT

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New Business Process

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MIMS-Ellipse

Work Orders

Feedback

SynchroWeb

SYNCHROWEB

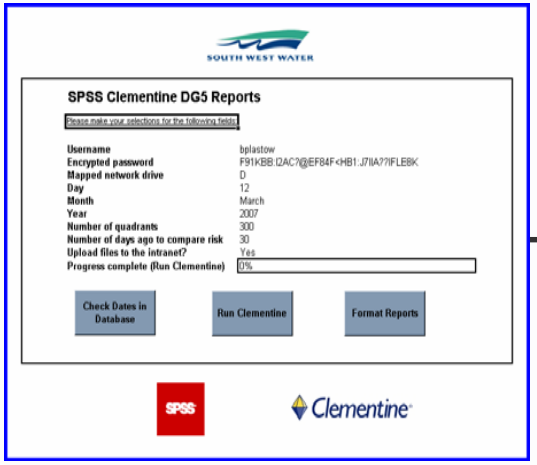
Open Source . Enterprise . Solutions

Work Orders

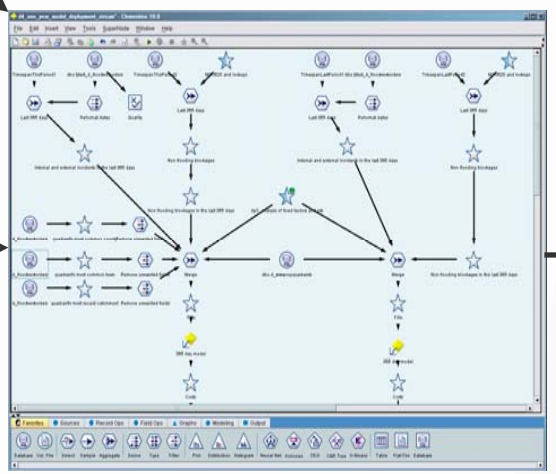
Feedback

TaskMaster

Excel Interface



Clementine



Intranet

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SWWIM Quadrant Risk Analysis

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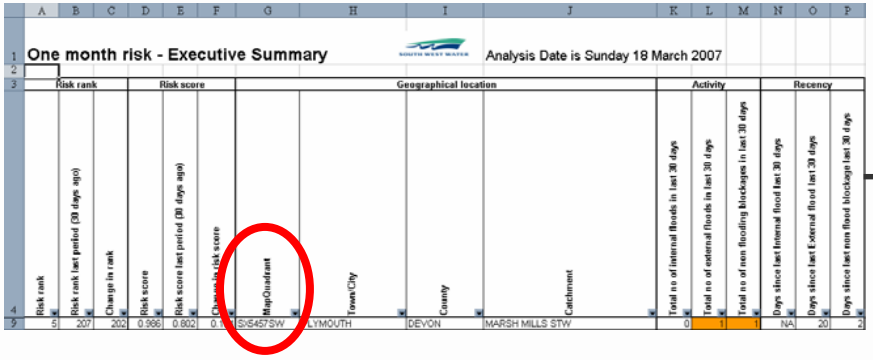

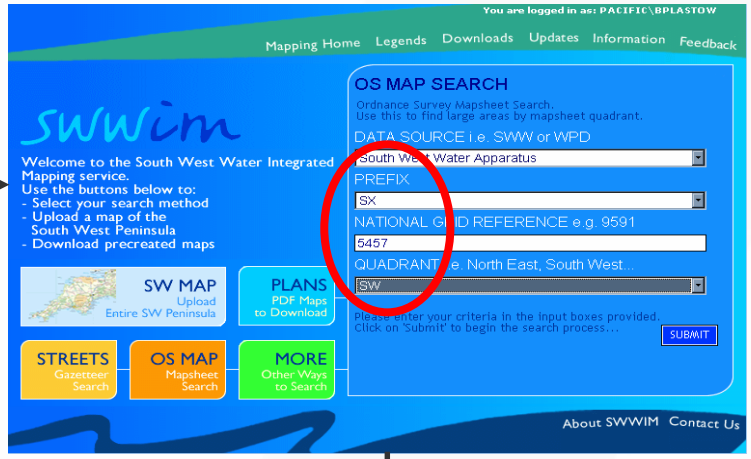

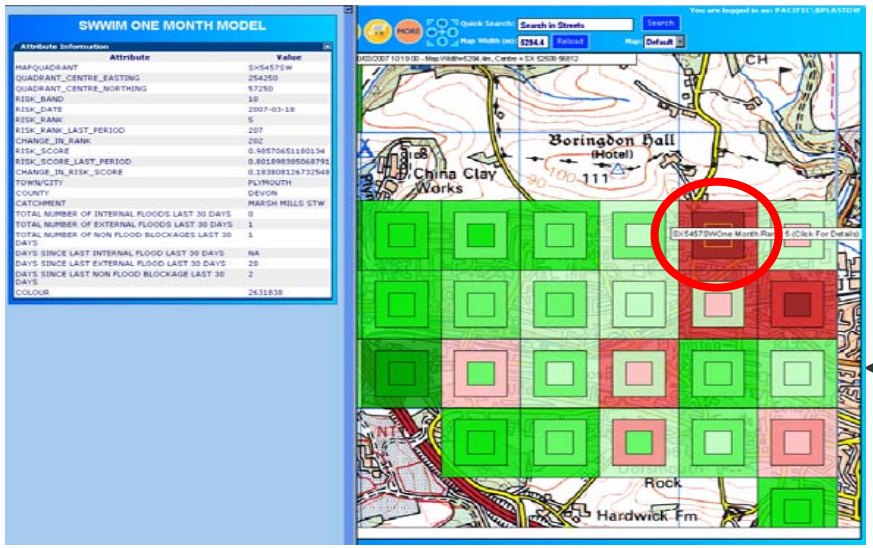

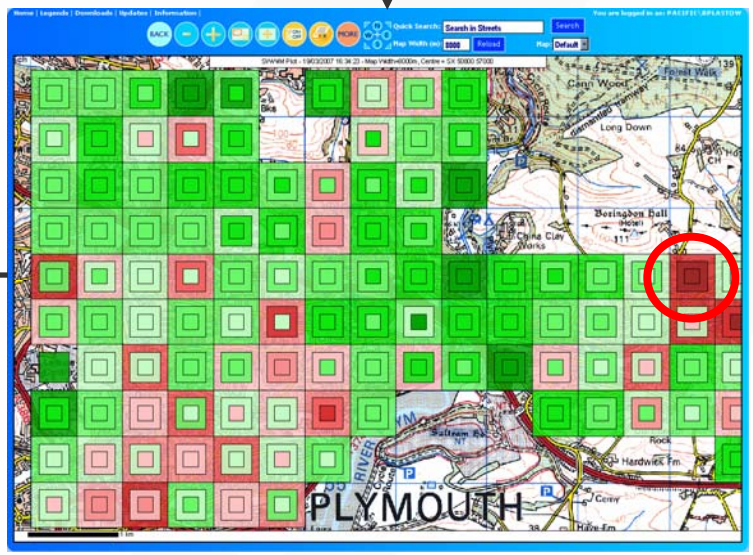

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SWWIM Legend (user guide)

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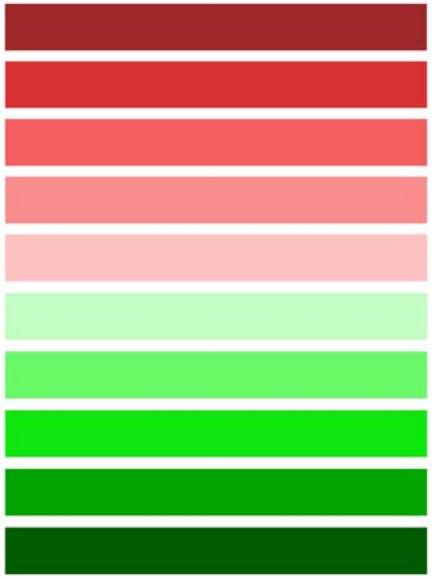
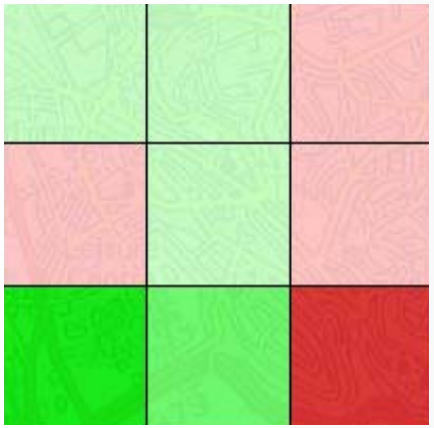
Risk Bands

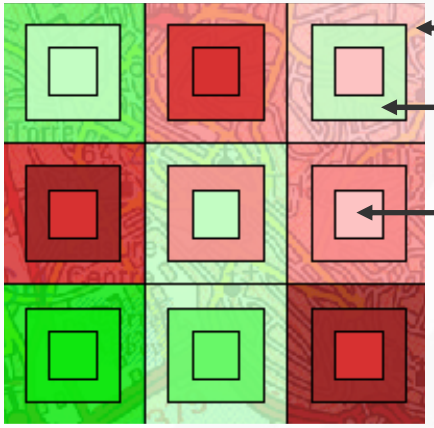


Band 10 High Risk
Band 9
Band 8
Band 7
Band 6
Band 5
Band 4
Band 3
Band 2
Band 1 Low Risk

Fixed Risk Quadrants



Variable Risk Quadrants



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Measurable Business Success Criteria

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- The following business results are expected:
  - A significant increase in the blockage detection rate (month on month) recorded through Work Orders.
  - A reduction in the level of quadrant risk scoring.
  - Evidence of a more proactive (and less reactive) approach to sewer maintenance investigations.
  - A reduction in the number of sewer flooding incidents in targeted quadrants.

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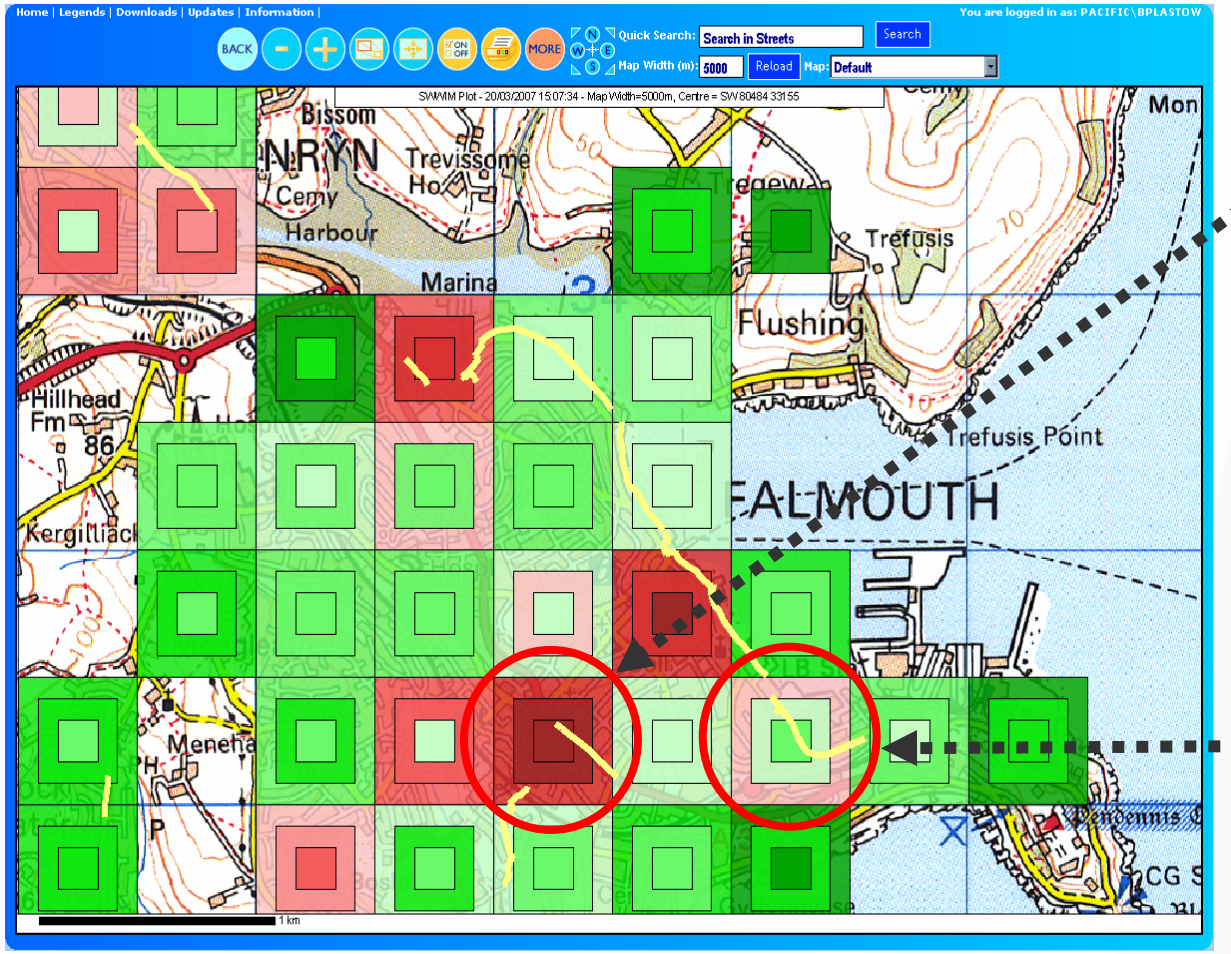
SWWIM Variable Risk Analysis



Variable risk increasing over time = risk is greater as problems remain or are not fixed

Variable risk decreasing over time = risk reduces as problems are fixed by the maintenance teams

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Business Results Achieved

- More comprehensive and proactive approach.
- Sewage Maintenance Team Leader is co-ordinating the sewer maintenance plans using the output of Clementine Reports.
- Initial increase in sewer cleansing budget for 2007-08 by 34%.
  - This is an increase in proactive (rather than reactive) expenditure.
- Planned allocation of 2 inspection crews to carry out minor quick repairs to the sewer pipe system.

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Future Developments

- Integration of rainfall data into the 3 variable risk models.
- Integration of customer address details to quadrants risk ranked in SWWIM.
- Ongoing monitoring of the quadrant league table reports.
- Close liaison with the Operations Department and the Contractors.

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Clean Water Mains Bursts

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- Project objective:
  - Predict the likelihood of a clean water main to burst and any potential consequence (including financial costs).
- Key outputs:
  - Likelihood of a pipe to burst (logistic regression).
  - Predicted mode of failure (decision tree).
  - Costs: (1) Cost of repair to fix the burst;
  - (2) Estimated customer cost to the company (loss of supply, poor publicity, compensation).

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Current and Future projects

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- Current projects (All assets & Clean Water):
  - Mean Time Between Asset Failure
  - Clean Water Network Mains Bursts
- Future projects (Clean & Waste water):
  - Clean Water Mains Deterioration
  - Sewer Pumping Station Failure
  - Sewage Treatment Works Failure
  - Sewer Network Asset Failure

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