SEWERAGE MANAGEMENT PLANS IN UNITED UTILITIES – THE OLDHAM PILOT STUDY

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BACKGROUND

United Utilities (UU) now carries out their long term planning using their Integrated Asset Planning (IAP) Processes. The key elements of the process are:-

- A defined process for the development and implementation of Integrated Asset Plans.
- A prioritised comprehensive Integrated Asset Plan is the focal point for business planning.
- Asset plans will be aligned regionally and will look at whole life asset performance and include prioritised plans for operation, maintenance and investment.
- Plans will focus on performance and serviceability issues ensuring good compliance performance and an increase in customer service levels.
- It is the process that we use to analyse regulatory drivers and business targets to identify optimum solutions and drive the PR14 business planning process.
- A focus on developing integrated and efficient solutions and ensuring that solutions are not compromised by future regulatory requirements.
- Key Performance Indicators (KPI's) are used to monitor and manage the performance of the IAP's.

An integral part of the Integrated Asset Planning Process is the wastewater network. UU have decided that the wastewater network element of IAPs will be developed using the Sewerage Risk Manual (SRM) approaches with the development of Sewerage Management Plans (SMPs). These will then feed into the IAP process.

Adoption of the SMP process by UU, as outlined within the SRM represents a step change in strategic catchment planning from the traditional Drainage Area Planning (DAP) process based solely on asset performance. The two key features, amongst others, are that it is risk based and 'live'.

MWH were commissioned in October 2010 in conjunction with UU Engineering to develop processes and procedures detailing the 11 steps of the SRM procedure and how this could be embedded within UU as part of its overarching Integrated Asset Plan. These procedures were then applied to the pilot study catchment of Oldham which was completed in April 2011.

The ultimate goal being to produce a risk based assessment of all sewerage related assets in accordance with the principals of the Common Framework and the SRM which can easily be fed in to UU's business planning tool (OPTIMUS) in order to generate the PR14 submission.

The UU SMP process follows the proposed methodology within the SRM, which in essence consists of a risk based approach to sewerage management and providing serviceability in accordance with the 11 step process outlined below:

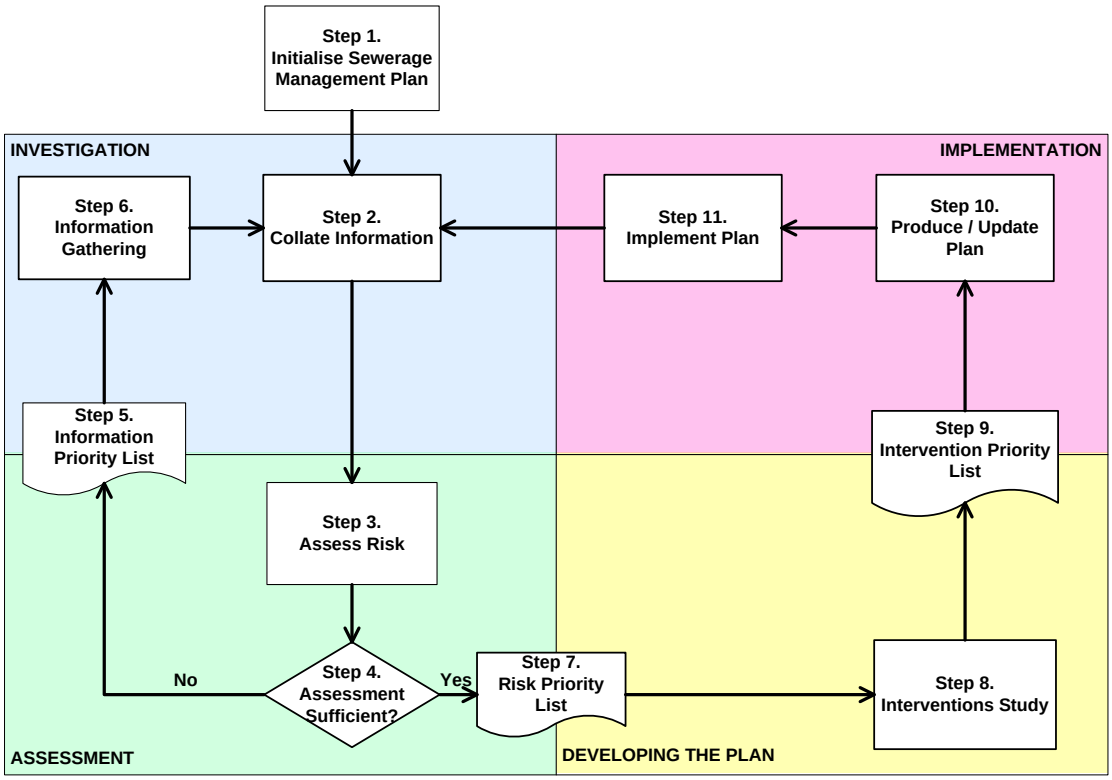

Fig 1 - SRM procedure – Flow diagram[1]

PROJECT DESCRIPTION

This first step of the SRM Procedure is to initialise the SMP. This involved the division of UU into relevant and defined spatial units for each of which a SMP is prepared.

Based around UU's existing sub catchment areas, these generally follow the Environment Agency River Basin Catchment boundaries with local adjustment to include sewerage catchments which are outside of the River Basin but drain to that part of the network.

The 60 UU sub catchment areas provide a useful key unit to which all risks and interventions can be related in order to inform the business planning process and PR14 submission. However, it is important to highlight that as part of any SMP program there may be many valid reasons to consider a number of sub catchment areas together, for example when considering receiving water quality issues for a major watercourse or coastal / estuarine situation. Conversely, isolated problems might be dealt with on an individual basis.

The Oldham sub Catchment was selected for the pilot study as it contained many of the features and performance issues typical of a semi urban catchment. It also had a 2010 InfoWorks hydraulic model available which was suitable for 2D flood risk analysis. The sewerage network draining to Oldham WwTW consists of 15 Drainage Areas, has 17210 nodes and covers an area of 3309ha. The modelled population in InfoWorks is 134,483.

[1] From SRM website.

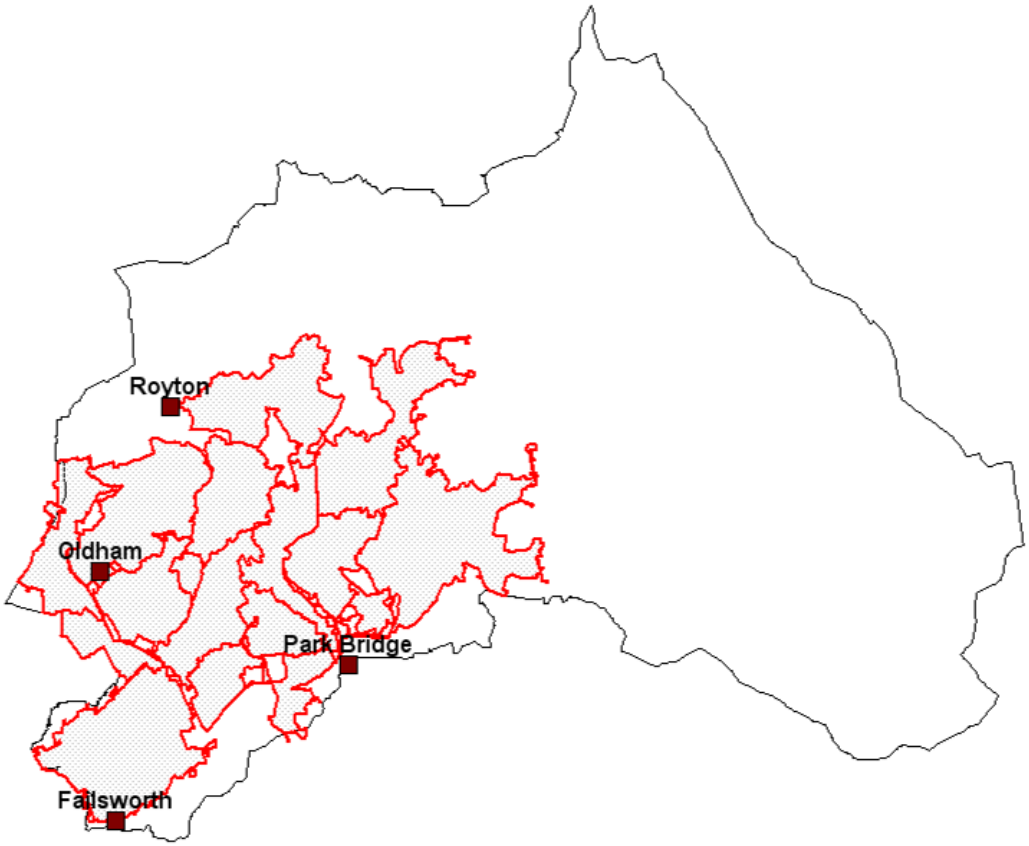

Fig 2 – Oldham Spatial Unit

Following discussions with UU the planning horizons used in the development of the Oldham SMP were:

Present year
Short term - 2020 (end of AMP6)
Long term – 2036 (Present year + 25 years)

Once the SMP objectives for a spatial unit have been defined in Step 1, all available information relating to the past and current performance of the assets in the spatial unit must be identified and collated. This is step 2 of the process.

The following datasets were identified and collated for use in the Oldham pilot study:

- PIONEER – Predicted risk of internal & external flooding, pollution, blockage and collapse for each pipe.
- DG5 Register – Properties known to be at risk of internal & external flooding.
- Postal Address File (PAF) Data – to identify “critical features”.
- InfoWorks 2010 MM (Model Maintenance) model.
- Development data – to update the IW model for Horizon 2020 and 2036: UU development data and Local Authority data.
- Digital Terrain Model (DTM) - Lidar data.
- Hydraulics data, Maintenance and performance data, consented flow for CSO/pump rate, details on completed wastewater schemes.

The data which has been collated, reviewed and data cleansed is then assigned a confidence grade. The confidence grading system adopted consists of a reliability band and an accuracy band in line with those used for OFWAT reporting. Reliability bands using a lettering system (A-D) should be selected based on the system which supplied the data. The accuracy band is determined using a

numbering system (1-6) based on the quality of the data. Reference should be made to the level of confidence applied to data sources which also feed in to the OFWAT June Return process.

In this confidence grading system, a grade of A1 represents the most reliable and accurate source of data, and D6 represents the least reliable and accurate source of data. A weighted scoring system is then used to assign each confidence grade a score. The score is allocated based on both the accuracy band representing the quality of the data, and the reliability band representing the source of the data. The weighting score is calculated by multiplying the accuracy score by the reliability weighting factor.

Data confidence grades were assigned to the data input to the SMP using the above methodology. For the purposes of the Oldham Pilot Study, all data was reviewed and considered to be fit for use as part of the SMP trial.

Step 3 takes the outputs of Steps 1 and 2 and uses them to evaluate the risk of performance failure for each element within each spatial unit. If required an initial risk assessment can be carried out for all spatial units to enable a ranked list of spatial units to be produced for prioritisation prior to detailed assessment and progress into the Interventions stage.

The objective of the Oldham pilot study was to undertake a detailed risk assessment, at asset level, in order to identify the assets which presented the highest risk of serviceability failures. For each horizon and each asset in the spatial unit, a detailed risk assessment was undertaken based on the following criteria:

- PIONEER predictions of asset failure. PIONEER predicts the probability and consequence of failure of each pipe in the sewer network based on a number of factors including pipe material, age, and performance history of similar pipes based on incident record data. (For more details on PIONEER see WaPUG past paper presented at the WaPUG Autumn Conference 2009).
- DG5 Register properties
- Critical infrastructure ("High consequence" features) in proximity to sewers
- Assets predicted to cause a risk of sewer flooding from a detailed 2D hydraulic flood risk analysis

A hydraulic flood risk assessment was carried out for all 3 horizons using InfoWorks CS 2D v10 and the MWH in-house software Data Manager (DM). The flood risk assessment is based on modelled hydraulic parameters such as water depth in the modelled pipes and 2D flood depth on the 2D mesh.

The objective of this assessment was to identify present and future flood risk for critical infrastructure, areas and properties at risk from hydraulic sewer flooding. Critical infrastructure was defined using the categories from the (PAF) database and critical areas identified by UU as follows:

Chemical	Education	Government	Health	Hospitals
Emergency Services	Leisure	Military	Railway	Religious
Retail	Tourist	Critical Roads	Wildlife	

Table 1 – critical infrastructure

Step 3 will have generated a list of spatial units or individual risks ranked according to their relative overall scores.

It is important that the known or predicted performance failures within the spatial unit are adequately understood to ensure that the ranking is correct, to identify any need for further information collection and to provide a robust basis for later intervention planning. This is step 4.

As part of the risk based approach, a confidence assessment is required on data within a defined spatial unit and relative to the Spatial Unit Granularity. This enables different levels of data assessment for SMP Level 1, Level 2 and Level 3. These data assessment can be across an entire network (coarse level of granularity) or at a more detailed local level (fine level of granularity) e.g. within a specific flow monitor zone or CSO catchment.

The output will be a risk score for each spatial unit which can be used to decide whether there is an acceptable level of risk before proceeding to the interventions stage (step 7).

A matrix similar to the one below can be used to prioritise the Information Priority List (IPL) in step 5 i.e. highest level of risks with the lowest data confidence (red) will be top priority for further data collection (taking into account cost of data collection).

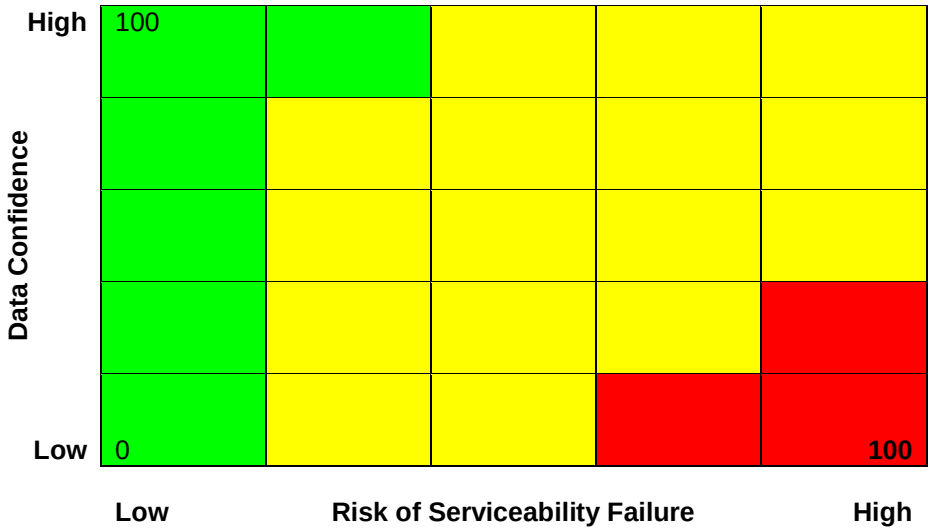

Fig 3 – Risk Matrix

Green – onto Risk Priority List (RPL) in step 7, Yellow & Red – onto Information Priority List (IPL) step 5.

For the Oldham pilot study no additional data collection was required.

The IPL generated by step 5 is a risk and spatially based list of information that is required in order to further identify and understand the risk of specific known or potential performance related issues.

Each IPL entry will define the information required, together with the potential sources, the estimated collection costs and timescales. It will also be ranked according to its risk scores and uncertainties and issues such as information collection costs and timescales will be allowed for in setting the priority.

This step was not required for the Oldham study.

The information gathering exercise in step 6 involves collecting whatever further data and information is identified as being needed from the initial risk assessment. Using the IPL ranking and available funds, information should be collected to address the gaps identified. This process ensures that targeted investigations and information collection is undertaken based on a priority ranked list determined from a risk based approach.

It is anticipated that standard UU processes and procedures will be adopted for any asset survey requirements identified but was not undertaken as part of the Oldham study.

For all spatial units where the answer to the question in Step 4 is YES, the risk of performance failure and the cost of generation of optimised interventions for that spatial unit should be tabulated and prioritised. The Risk Priority List (RPL) generated by step 7 uses the risk based data from Step 3 to

justify a place in the regional ranking list for undertaking detailed Interventions Study i.e. Step 8, within each relevant SMP based spatial unit.

The RPL is a risk based list of spatial units in priority order that are ready for detailed interventions investigation. The RPL builds on the fact that for each spatial unit the associated performance (actual and potential), uncertainties and costs are sufficiently understood to justify a reasonably confident ranking of expenditure on regional interventions investigations.

The Oldham risk priority list has been created by summing the components of the total risk score, where for each asset:

Total risk = PIONEER risk score + DG5 risk score + Hydraulic flood risk score

The asset database can then be sorted in descending order to identify the sewers with the highest risk at the top of the list as shown in the table below.

Table 2 - Highest predicted risks in the Oldham Risk Priority List

Asset ID	PIONEER Risk Score	DG5 Risk Score	Flood Risk Score	Total Risk Score
33304160	0.1399	0	1091.946	1092.086
33306824	0.0029	0	962.976	962.979
33299281	0.0335	0	765.222	765.255
33299262	0.0028	0	748.026	748.029
33294834	0.1905	0	584.664	584.854

The Risk Priority List can also be represented using a thematic map of the total risk score in GIS, as shown in the example below. This enables the highest risk assets to be reviewed spatially and should be the first step in identifying groups of assets for which one intervention might be appropriate to mitigate the associated risk(s).

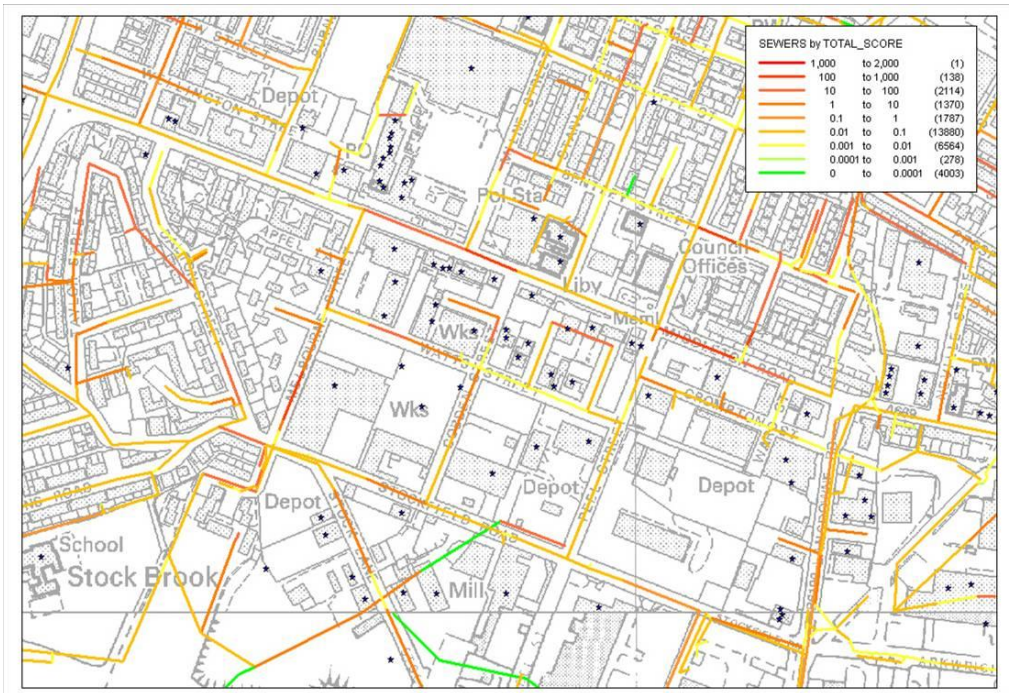

Fig 4 – Predicted flood risk scores

Combined Sewer Overflow (CSO) Risk Assessment

The CSO (Combined Sewer Overflow) risk assessment assesses the performance of each overflow in the Oldham network. The performance results were assessed in terms of:

- passing the consented flow
- spilling during dry weather flow
- with inadequate screening provision
- passing formula A
- CSOs likely to operate frequently.

CSO Risk Assessment methodology

The CSO analysis was carried out following the guidance in section 8.3 of the UU-AMP5 Model Maintenance- Model Library Guidelines. The CSO analysis focuses on CSO performance only. CSO performance data was generated by running the following rainfall simulations:

- STORMPAC typical year rainfall series with evaporation
- TSR rainfall event
- RP 5 and RP 30 Design events

The CSO risk analysis developed for the SMP is a staged process which enables various levels of detail to be included in the analysis in order to focus time and resources on the highest risk overflows.

Stage 1: Desktop Data Collection

- Identification of unconsented CSOs.
- Identification of CSOs without screens.
- Identification of known / agreed & historical UIDs.

Stage 2: Basic Hydraulic Analysis

- CSOs spilling in DWF
- CSO not passing consented flow.
- CSO not passing Formula A.
- CSOs with potentially inadequate screening provision.
- CSOs likely to operate regularly (more than once a year).

Stage 3: Time series rainfall analysis

- Predicted spill regime at each modelled CSO

The procedures for steps 8 through to 10 of the SMP process sit within UU's current procedures for solutions development, optioneering and delivery and were therefore excluded from the Oldham trial.

The outputs from Step 8 will be a list of costed interventions for the spatial unit in a suitable format which can be loaded directly into UUs Business Planning tool OPTIMUS in order to be ranked to ascertain company investment priorities.

The IntPL generated in step 9 is a list of all interventions identified in the spatial units which have been prioritised using information generated in Step 8. This step of the procedure will be undertaken by OPTIMUS as part of the UU business planning process and rather than being a list of solely sewerage related investment it will incorporate all investment across the whole company.

The IntPL data is the primary output from Step 9 for all detailed SMPs across UU.

The individual SMPs will be used to inform the regional sewerage business plan detailed in step 10 whilst Step 11 will deliver the interventions approved for investment through OPTIMUS and UU's capital investment processes. Data from "as built" schemes will then be updated in the SMP database

and UU's asset database in order to generate a 'live' assessment of changes to risk within each of the spatial units. .

The SMP will underpin many of the daily organisation and operational aspects of sewerage management in UU as well as capital construction projects and will form an integral part of UU's Integrated Asset Plan (IAP).

SUMMARY

The Oldham pilot study has demonstrated that the processes and procedures developed can be used to develop a Risk Priority List as detailed by step 7 of the Sewerage Risk Management guidance, suitable for detailed intervention development as part of UUs capital investment processes. These processes are now being developed further for the whole of the UU region to enable a risk based assessment to be undertaken of all sewerage assets in line with the 'Common Framework' and the principles of the SRM in preparation for the PR14 submission.

Wherever possible the SMP procedures have been aligned to UU's existing business processes and procedures to enable them to be easily adopted without the need to radically change its existing business planning processes.

Data generated by SMPs will be stored centrally on the corporate GIS such that the use of this becomes part of UU's business as usual process for investment and asset planning so that users can be confident that the decisions they are required to make are based on the best and most up to date data available as part of the Integrated Asset Plan.

The results show that the risks in Oldham will have increased in some areas over time and that there are a number of properties/areas already at a high risk of flooding which were previously unknown to UU.

The results also show that the majority of changes to the risk scores occur between the current and 2020 horizon. This is as expected due to the number of development changes which occur in this time in addition to the changes in consumption and climate.

It has to be acknowledged that a number of issues were encountered which have affected the completion and confidence in the outputs of the study and there are a number of business decisions required in order to enable a full programme of SMPs to be rolled out across the whole UU region.

The most significant areas requiring further work are related to factors to be adopted across the business e.g. weighting factors for the various service impacts used in the risk assessment scoring process. These discussions are ongoing. The process has been developed in a way that enables easy adjustment of these factors in the future.

UU have now commenced the development of SMPs for every catchment in the North West.

References/acknowledgements

Squibbs G., and Forrester G., (United Utilities)

Terry, D. J., Kinston, D., Margetts, J., Hale, J., - Sewerage management Plans and SRM5 – What it means to a water company, WaPUG Autumn Conference 2009.

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