Groundwater Asset Plans

James Glover and Rupert Dixon
Water Resources Management Team
Groundwater resources

- 50% of total demand (1400 MI / Day) supplied by groundwater abstracted from approx. 480 boreholes in 9 aquifers:
  - Chalk (Lincolnshire, Norfolk, Suffolk and Essex)
  - Lincolnshire Limestone
  - Lower Greensand, Spilsby Sandstone, Sandringham Sands
  - Crag and Sands and Gravels
  - Sherwood Sandstone
  - Magnesian Limestone

- Borehole depths from 6 to 500 m
- Yield between 2 and 180 l/s
- Borehole asset lives range from 10 to 100+ years
AWS Aquifer Locations

- Magnesian Limestone
- Sherwood Sandstone
- Lincolnshire Limestone
- Spilsby Sandstone
- Sandringham Sands
- Crag, Sands & Gravels
- Chalk
- Lower Greensand
Abstraction by Aquifer

- Chalk: 65%
- Lincolnshire Limestone: 10%
- Lower Greensand: 6%
- Magnesian Limestone: 4%
- Sandringham Sands: 2%
- Sands and Gravels: 1%
- Sherwood Sandstone: 5%
- Spilsby Sandstone: 6%
- Crag: 1%
Why Spend?

- Investment is required to maintain the serviceability of assets.
- Well maintained assets reduce unit costs.
- Asset Plans reduce the cost of asset management by highlighting areas where investment will be required, allowing timely intervention to be focused on those assets which require it most.
Rehabilitation Case Study: Lower Greensand BH

- After chemical jetting and airlifting the borehole performance increased
- For a yield of 16 l/s hydraulic performance improved by 165%
- Slots clean and 100% open
- Reduction of 60% in the unit cost of water
- Extended borehole and pump asset life
Water Quality

• Different aquifer environments produce many hydrogeological conditions.

• These conditions effect asset performance and life.

• Characterising the processes that effect water quality is a key step in developing a portfolio of evidence.

• Evidence of asset deterioration and failure can be used in conjunction with water quality information to drive investment.
In 2003 generic asset lives for the different aquifer units were generated to predict the remaining asset lives for each AWS borehole.

Evidence was drawn from existing observations on each aquifer unit to ascertain a generic asset life.

The remaining asset life for each borehole was used to support the intervention / replacement programme for the AMP4 period.

### Aquifer unit

<table>
<thead>
<tr>
<th>Aquifer unit</th>
<th>Generic Asset Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconfined Chalk</td>
<td>80</td>
</tr>
<tr>
<td>Confined Chalk</td>
<td>50</td>
</tr>
<tr>
<td>Lincolnshire Limestone</td>
<td>60</td>
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<tr>
<td>Great Oolite</td>
<td>60</td>
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<tr>
<td>Sherwood Sandstone</td>
<td>80</td>
</tr>
<tr>
<td>Lower Greensand</td>
<td>40</td>
</tr>
<tr>
<td>Spilsby Sandstone</td>
<td>40</td>
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<tr>
<td>Sandringham Sands</td>
<td>40</td>
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<tr>
<td>Crag</td>
<td>40</td>
</tr>
<tr>
<td>Sands and Gravels</td>
<td>30</td>
</tr>
</tbody>
</table>
Background to Asset Plans

- A problem with this method of asset life prediction was that many boreholes were still in operation after their predicted life.

- Some boreholes outperformed their predictions by up to 40 years.

- Each borehole is unique, both in terms of the groundwater environment in which it is situated, as well as in its construction and operation.

- Therefore a value across each aquifer may not suit every borehole and so each asset has to be considered individually.
Approach

- Characterising processes which affect asset performance, decline and failure

- Water Quality: Chemical, bacteriological
- Construction
- Operation

- Developing asset management strategies going forward

Understanding this relationship
The asset plans comprise several sections:

- Asset Summary
- Borehole information
- Supporting evidence
- Water quality
Previous Interventions

- Information on previous interventions
- Prediction on end of asset life based on new generic asset life
- Investment profile – based on intervention 1 AMP period prior to ‘the-end’, and replacement after 2 interventions
Pump Asset Plans

- Same approach as borehole asset plans
  - Water Quality
  - Construction
  - Operation

- Failure mode analysis provides evidence which informs the asset plans

- Pump Asset plans can be used to identify areas where PPM is cost effective.
“Hot Spot Mapping”

- Portfolio of asset data used to develop intelligent asset maps with different layers
- Provides easy to use method of reviewing asset data down to site level
- Clearly shows areas of high asset failure and identifies key investment areas
- Potential for mapping chemical parameters to support investment profiles
Excel GIS

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Forward Planning

- Drawn up the AMP5 rehabilitation and replacement lists

- This approach to asset management allows for a more educated approach to maintaining and planning for assets in to the future

- Moves away from the lumped model of aquifer units and looks at site specific evidence to make informed judgements for each borehole
Issues

- Continuous improvement ideas
- Matching theory to reality
- Quantifying performance deterioration due to scarcity of historic performance data
- Confidence in capturing all historic data