# VEOLIA WATER PROJECTS LIMITED

# WATER RESOURCES MANAGEMENT PLAN

# APPENDIX 1 - LEAKAGE

## INTRODUCTION

Over the WRMP planning period of 2020 to 2025 there is an emphasis placed on reducing leakage by 15% with a long term goal by 2050 of reducing leakage by 50%.

At the time of WRMP 2014 the leakage was reported to be 1.65 Ml/d in 2012 with an average internal demand (excluding the export to Wessex Water via Leckford Bridge) of 3.86 Ml/d.

An aspirational leakage target of 1.2 Ml/d was included in the WRMP 2014 as the Sustainable Economic Level of Leakage (SELL) method could not be used due to the small size of the Tidworth network and the small number of leaks being repaired.

This Appendix identifies a realistic long term leakage target, taking into account the difficulties faced when one considers that:

- A single burst main that is difficult to find can dramatically increase leakage

- Due to the Ministry of Defence (MoD) infrastructure being embedded within the regulated water network some burst mains can be in sensitive areas where significant time is required to gain entry to effect a repair

Two methods have been considered:

- Infrastructure Leakage Index (ILI) – This looks at the Unavoidable Annual Real Leakage (UARL) below which leakage cannot be reduced and the Current Real Annual Losses (CARL). By dividing CARL by UARL it is then possible to compare leakage with networks from around the world.

- Leakage Linear Index (LLI) – This measure is used to compare leakage performance of networks at a Veolia Corporate level.

This report considers the impact of active leakage control which commenced in August 2017 and sets a target based on the Leakage Linear Index (LLI) which aims to maintain low levels of leakage. Consideration is also given to strategies that can be implemented should leakage rates increase in the future.

## 1 LEAKAGE PERFORMANCE

In 2010 a hydraulic model for Tidworth was constructed that indicated that leakage was 1.44 Ml/d.

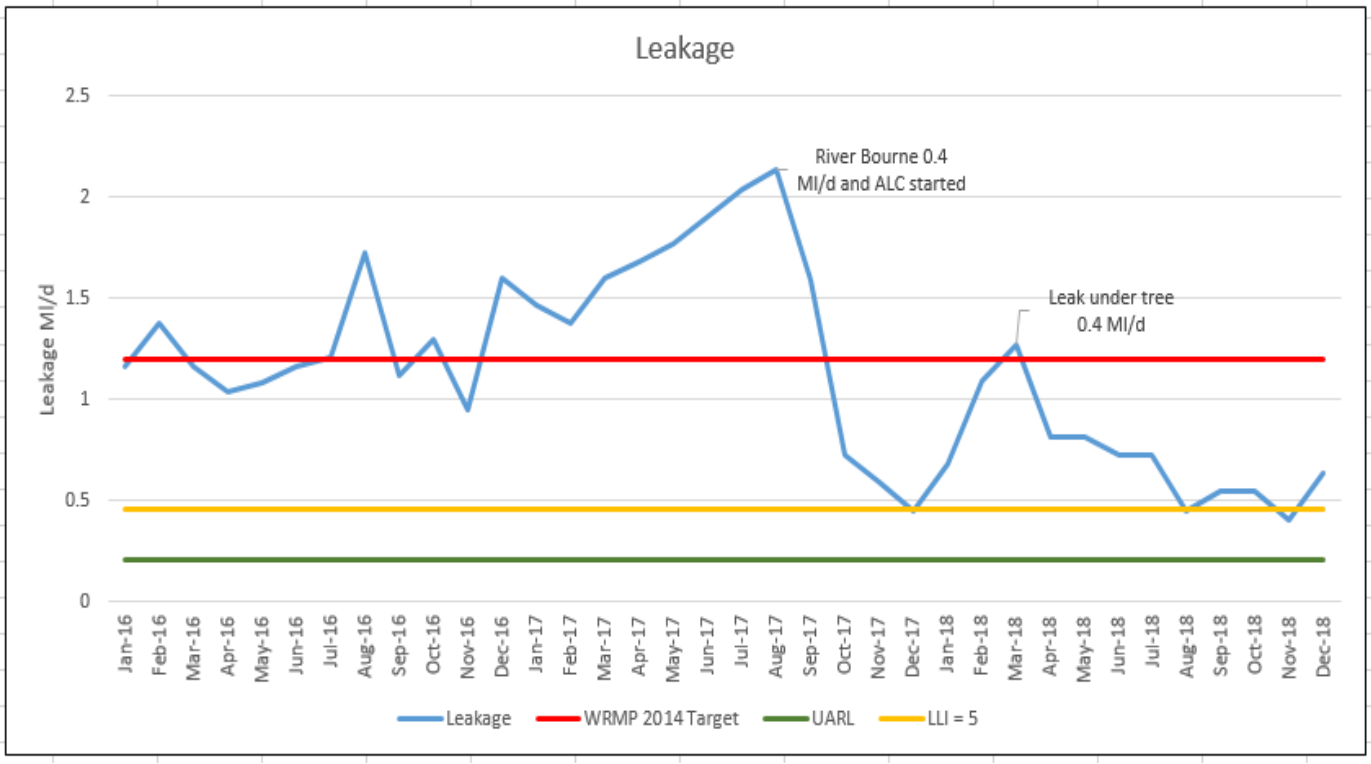
The WRMP 2014 reported leakage to be 1.65 Ml/d in 2012 with an average internal demand (excluding the export to Wessex Water via Leckford Bridge) of 3.86 Ml/d. This equates to 42.7% leakage rather than the 29% originally reported in WRMP 2014. This error is due to comparing the leakage with the deployable output of the sources and not the deployable output minus the export to Leckford Bridge. 1.2 Ml/d was listed in the WRMP 2014 as an aspirational target, but this is based upon incorrect data (shown red line in the graph below).

Therefore the historical assumption has been that leakage rates were actually at a lower level than they really were.

From the start of 2016 leakage calculations were performed monthly and the error soon became apparent.

In 2016/17 major improvements to the reporting processes were implemented so that the supply / demand balance, Water Resource Management Plan commentary and Small Business Return reported correct leakage levels. This raised concerns at board level and in August 2017 an Active Leakage Control (ALC) project was commenced.

The following graph indicates the leakage profile for 2016 to end of 2018:



Immediately after August 2017 active leakage control intervention there was a dramatic downturn in leakage level, from 2.1 Ml/d down to 0.5 Ml/d. This can be attributed to the repair of a leak under the River Bourne and a major leakage detection and repair effort as part of the active leakage control intervention.

From December 2017 to March 2018 leakage increased, possibly due to a combination of a leak under a tree that was providing difficult to repair and also a general increase in leakage over the winter period due to low temperatures.

During March 2018 the Tidworth area was impacted by a severe cold spell, although there was no interruption to supply as a result of the freeze – thaw event the number of calls to the help desk were observed to increase and it is likely that the increase in leakage to March was due to an increase in leaks on the network as a result of the adverse weather.

However, from March 2018 onwards leakage has reduced gradually with a slight upturn observed in December 2018 (again possibly due to lower temperatures and more leaks as a result).

The recent performance, with an average leakage for 2018 of 0.7 Ml/d compares favourably to the WRMP 2014 aspirational target of 1.2 Ml/d. This reduction when compared to the WRMP 2014 leakage of 1.65 Ml/d is a leakage reduction of 58% (more than halved) and one can argue that this already meets the desired reduction in leakage of 15% by 2025 and 50% by 2050.

It is further interesting to note that during the 2016 to 2018 period the internal demand (deployable output minus export to Wessex Water at Leckford Bridge) has only increased from 4.3 to 4.5 Ml/d. During this 3 year period there have been major new developments constructed, including the return of military personnel from overseas deployment to the Tidworth barracks as a result of the Army Basing Project 2020.

The reduction in leakage has therefore offset the growth of the garrison and new development areas.

Current leakage levels now stand at 15.5% compared to leakage of 42.7% in 2012 and compares favourably to other UK water companies and other Veolia Corporate contracts.

## 2. BENCHMARKING - INFRASTRUCTURE LEAKAGE INDEX (ILI)

The use of an Infrastructure Leakage Index is a recognised method of comparing leakage performance across water companies throughout the world.

Given the unique nature of VWP with 50% of the internal consumption the result of large MoD sites embedded within the regulated network such a method that has been designed to compare leakage performance globally would seem a logical approach. The method compares favourably with other commonly used methods:

| | Performance indicators (PIs) for real losses | Continuity of supply | Length of mains | Number of service connections | Location of customer meters on services | Average operating pressure |
|---|---|---|---|---|---|---|
| Traditional PIs for process benchmarking | % of volume input | No | No | No | No | No |
| | Litres/property/day | No | No | Only if 1 property/ conn | No | No |
| | Litres/service connection/day | No | No | Yes | No | No |
| | $m^3$/km mains/day | No | Yes | No | No | No |
| | $m^3$/km of system/day | No | Yes | Possibly | Yes | No |
| Metric PI | Infrastructure Leakage Index (ILI) | Yes | Yes | Yes | Yes | Yes |

Therefore ILI has been chosen as one performance measure to consider current performance and consider future aspirations for further leakage reduction.

The method involves calculating the Unavoidable Annual Real Losses (UARL). This measure is the lowest leakage rate that can be achieved, given the structure of the network modified by the average operational pressure across the network.

This is useful to VWP because:

- The network structure has been influenced by the development of the MoD site and parcels of land sold off by the MoD for development

- The network operates at a high pressure of 49m on average because of a need to meet Crown Fire Fighting Standards (20 l/s flow at 10m, raising to 75 l/s for critical buildings containing ammunition for example)

This is then compared to the Current Annual Real Losses (CARL) to determine how much above the UARL leakage levels are.

ILI = CARL / UARL where

The calculation of UARL is:

(18 x Lm + 0.8 x Co + 25 x Lp) x P

Where Lm = Total length of the network mains in km
Co = Total number of connections from the network
Lp = Total length of service pipes before the meter
P = Average operating pressure

For Veolia Lm = 91.4 km
Co = 3209
Lp = 0 km (assume meter is connected direct from mains)
P = 49 m

UARL = 208863 litres / day = 0.21 Ml/d

This is the lowest level of leakage that could be realistically achieved if absolute maximum effort was directed at leakage detection and repair given the structure of the network and average operating pressure. This has been included in the graph is section 1 of this appendix as the green line.

The current VWP average leakage for 2018 is 0.72 Ml/d.

Therefore the ILI for VWP is 3.48 and this current performance figure can then be compared in the following performance table which indicates VWP are category B when using this performance metric.

| Technical Performance Category | | ILI | Litres/connection/day (when the system is pressurised) at an average pressure of: | | | | |
|---|---|---|---|---|---|---|---|
| | | | 10 m | 20 m | 30 m | 40 m | 50 m |
| Developed Countries | A | 1 - 2 | | < 50 | < 75 | < 100 | < 125 |
| | B | 2 - 4 | | 50-100 | 75-150 | 100-200 | 125-250 |
| | C | 4 - 8 | | 100-200 | 150-300 | 200-400 | 250-500 |
| | D | > 8 | | > 200 | > 300 | > 400 | > 500 |
| Developing Countries | A | 1 – 4 | < 50 | < 100 | < 150 | < 200 | < 250 |
| | B | 4 – 8 | 50-100 | 100-200 | 150-300 | 200-400 | 250-500 |
| | C | 8 - 16 | 100-200 | 200-400 | 300-600 | 400-800 | 500-1000 |
| | D | > 16 | > 200 | > 400 | > 600 | > 800 | > 1000 |

VWP assessed current performance is rated as B.

A. Excellent – no specific intervention required
B. Good – no urgent action required although should be monitored carefully
C. Poor – requires attention
D. Very bad – requires immediate water loss reduction interventions

To improve current performance from B to A could be achieved by reducing pressure from 49m to 40m and this is considered later in this document.

## 3. BENCHMARKING – LINEAR LEAKAGE INDEX (LLI)

This method is used by Veolia Corporate to compare international contracts around the world. It is a simplified method where:

LLI = Volume of leakage per day / Network length

This metric has been considered as it aligns VWP leakage operational reporting with the wider Veolia organisation.

Volume of leakage per day = 0.72 Ml/d = 720,000 m3/d
Network length = 91.4 km

The calculated LLI for VWP is 7.95.

This can then be assessed in the following performance table, assuming that the Tidworth network is classed as Semi-Urban which would seem to be appropriate given the connection per km of network density.

| Environment | Rural | Semi-Urban | Urban |
|---|---|---|---|
| Good | LLI < 1,5 | LLI < 3 | LLI < 7 |
| Satisfactory | 1,5 < LLI < 2,5 | 3 < LLI < 5 | 7 < LLI < 10 |
| Border Line | 2,5 < LLI < 4 | 5 < LLI < 8 | 10 < LLI < 15 |
| Bad | 4 < LLI | 8 < LLI | 15 < LLI |

Using this performance measure VWP would be classified as 'Border Line' when compared to other international contracts.

To move to satisfactory (LLI = 5) would require a leakage level of 0.46 Ml/d.

This has been included in the leakage graph in section 1 of this appendix as an orange line.

## 4. BENCHMARKING – ENGLAND AND WALES WATER INDUSTRY

| Company | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|
| **Water and Sewerage Companies** | | | | | |
| Anglian | 93.83 | 89.14 | 91.11 | 89.77 | 84.47 |
| Dwr Cymru | 115.15 | 127.10 | 130.89 | 127.18 | 126.93 |
| Northumbrian | 109.82 | 114.88 | 113.22 | 114.90 | 113.80 |
| Severn Trent | 133.24 | 126.64 | 126.64 | 127.00 | 122.98 |
| South West | 101.31 | 105.06 | 105.06 | 104.31 | 103.59 |
| Southern | 75.63 | 74.71 | 78.40 | 75.21 | 76.53 |
| Thames | 172.26 | 174.70 | 174.16 | 175.60 | 170.94 |
| United Utilities | 139.98 | 141.21 | 139.67 | 139.55 | 138.01 |
| Wessex | 115.48 | 115.48 | 115.48 | 114.57 | 112.51 |
| Yorkshire | 121.64 | 117.64 | 125.19 | 127.15 | 125.22 |
| **Water only companies** | | | | | |
| Affinity | 116.42 | 129.93 | 123.93 | 125.22 | 122.64 |
| Bournemouth | 106.42 | 102.35 | 102.55 | 101.94 | 95.44 |
| Bristol | 82.67 | 80.75 | 84.59 | 85.99 | 83.83 |
| Cambridge | 91.82 | 91.60 | 94.20 | 98.87 | 95.86 |
| Dee Valley | 68.30 | 74.39 | 81.36 | 77.68 | 78.24 |
| Essex and Suffolk | 74.91 | 68.37 | 74.03 | 76.60 | 74.54 |
| Hartlepool | 94.98 | 89.06 | 87.01 | 91.66 | 98.97 |
| Portsmouth | 119.53 | 109.84 | 96.91 | 92.22 | 89.03 |
| South East | 105.02 | 102.76 | 102.10 | 94.40 | 89.97 |
| South Staffs | 117.70 | 112.70 | 115.46 | 118.23 | 119.08 |
| Sutton and East Surrey | 83.17 | 83.52 | 84.33 | 84.75 | 84.19 |

The table above shows the leakage per connection point (litres / connection / day) for each of the water companies in England and Wales. The source of this information is DEFRA – Appraisal of Sustainability of the National Policy Statement for Water Resources.

The annual average leakage for VWP in 2018 was 0.72 Ml/d and the number of connection points is 3,209 which indicates a leakage per connection point of 226 litres / connection / day which does not compare favourably to the figures for other water companies.

However, one must consider the unique nature of the VWP Tidworth network in terms of supplying many multi-occupancy buildings such as barracks in the MoD area. A single connection can supply a complex system which supplies approximately 50 soldiers. It is not possible to split out leakage in the MoD part of the network because the MoD is embedded within the regulated network with mains crossing in and out of the MoD secure area

It is therefore proposed to discount this metric due to the unique nature of the network and instead report in line with sections 2 and 3 which have been designed to compare radically different networks from around the world.

## 5. OPERATIONAL USE

The nature of the VWP network may mean that there is significant operational use that is currently being included as leakage. This is because:

- As part of Army Basing 2020 there are major changes to the network with new mains being added to the system and old mains being abandoned.

- Because of the Crown Fire Fighting Standards VWP annually tests some 162 fire hydrants to ensure that they will function adequately.

- There are 3 reservoir cells at Clarendon and it is likely that one of these could be cleaned per year.

When a main is added there is a new to flush the mains equal to 3 times their volume for water quality purposes and then the new main is charged with fresh water before being introduced to supply. Therefore knowing the volume of main added to the network in a year it is possible to calculate the volume of water utilised during this activity and include as operational usage rather than it being counted as leakage. When a main is abandoned it is likely that the volume of water currently in the main goes to waste. Again, at the moment this volume is included as leakage. Knowing the length of main abandoned and its diameter allows the calculation of the volume of water lost to waste due to operational activities.

When a hydrant is tested on average it flows for 5 minutes through a 2 ½" hydrant with an average pressure of 49m. This information is sufficient to calculate the flow through each hydrant during the testing process and total volume used during the year can also be included.

Knowing the reservoir volume at Clarendon and an assumption that one cell is cleaned each year and that the reservoir level will be dropped to 20% before the remaining water goes to waste it is possible to determine the volume lost is this manner.

- Volume going to waste due to the flushing of new mains and abandonment of old mains = 0.87 m3 / day

- Volume going to waste due to testing of hydrants = 7.59 m3 / day

- Volume going to waste due to cleaning of one reservoir cell per year = 2 m3 / day

Total impact on leakage for these activities would be 10 m3/d = 0.01 Ml/d and so operational use is very small when considered over the year. Work will continue to firm up on these initial calculations, but the impact of operational use on reported leakage is considered low and so can be discounted.

## 6. USER SUPPLY PIPE LEAKAGE (USPL)

An additional component of leakage is USPL which relates to the leakage that is on the customer supply pipe after the meter but before the boundary of the customer building.

Because this is after the meter it does not impact on VWP network leakage, but will influence the calculation of use per head of population per day, referred to as Per Capita Consumption (PCC).

Carrying out a detailed physical survey of customer connection leakage is an expensive proposition when considering that the total number of customer connections is 3,209 and the need for VWP to mirror Wessex and Southern Water charges.

However, it is possible to perform a calculation to determine a theoretical leakage figure per service connection:

The average length of service pipe after the meter to the boundary of the building has been estimated to be 7m. This is because most meters are next to the road and the average gap from the road to the building is approximately 7m. All service pipes are 20mm in diameter and this allows the surface area of the supply pipes to be calculated at 1141 m2.

The surface area of all network pipes (up to the meter location) is 39,380 m2. We know the total leakage which is currently 0.72 Ml/d for 2018. We therefore can calculate the leakage per surface area on the VWP network.

An assumption has then been made that the leakage per surface area for customer pipes is the same as for network distribution pipes.

Following this method the leakage per supply pipe comes out to be 14.5 litres / day for each connection. Average population per house can be assumed to be 2.4 so the impact on PCC is a reduction of 6 litres per head per day.

Reported PCC for 2017/18 was 112 l/h/d so this would reduce to 106 l/h/d. This adjustment will be included in future Annual Review WRMP tables and in the planning tables produced as part of WRMP 2019.

## 7. OPTIONS FOR REDUCING LEAKAGE

There are a number of obvious options for reducing leakage further:

- Replace more mains so that average age of pipes is reduced
- Locate and repair more leaks
- Reduce network pressure to reduce background leakage and subsequent burst mains.

## 7.1 New Mains

The development of the network is such that many mains are relatively new (laid after 1998) when compared to other water companies. Due to the sale of MoD land, new mains have been laid to feed new development areas. Army basing 2020 has also resulted in the MoD part of the network being redesigned and new mains being laid as a result. Due to this level of activity the widespread replacement of mains would not appear to be an appropriate strategy.

However, one needs to keep in mind that these mains have a finite asset life and a sudden surge of mains renewal will result at the end of the asset life. An age profile of mains would be useful for longer term asset management, but for current leakage strategy mains replacement would not appear to be an effective option.

## 7.2 More Repairs

The current strategy that has led to a major reduction in leakage since August 2017 is to locate and repair more leaks using a dedicated resource. Detailed monthly reporting of active leakage control effort is being produced.

It has been possible to compare the period from January 2016 to August 2017 with no active leakage control to the period from August 2017 to December 2018 after active leakage control commenced.

The period from January 2016 to August 2017 is a period of interest in terms of the Natural Rate of Rise of leakage (NRR). This is a period when VWP responded only to customer observations of suspected leaks. Over this period of time leakage gradually increased and the NRR has been calculated to be 0.03 Ml/d increase per month during that period.

Unfortunately the number of leaks located and repaired has only been reported regularly for the last 6 months. This indicates that 25 leaks were located and repaired since July 2018, a significant increase on previous activity which appears to be approximately 1 leak repaired per month.

By considering the reduction in leakage over the last 6 months of 2018 compared to the predicted performance when considering NRR (which is still believed to be occurring in the background) then the average benefit of each leak repaired has been calculated to be 0.07 Ml/d.

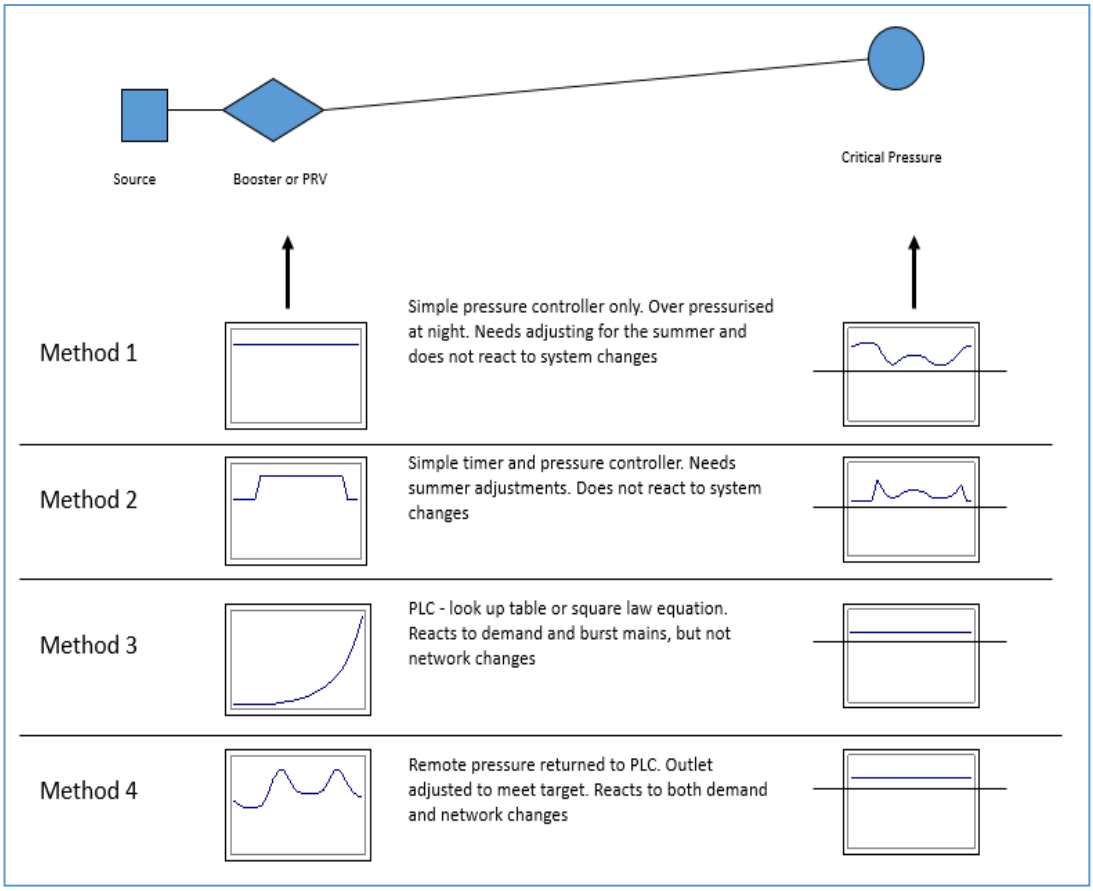
Therefore to reduce current leakage of 0.72 Ml/d for 2018 to the 0.46 Ml/d to achieve the LLI of 5 then an additional 4 leaks would need to be located and repaired per month. Recent performance is 25 repairs in 6 months (approximately 4 repaired per month) and so the current leakage detection and repair strategy would need to double in effectiveness.

There are diminishing returns when it comes to locating and repairing leaks (possibly a square law rule) and so the leakage detection team would need to double or even quadruple in size to achieve this increase in effectiveness.

This does not seem to be an economic method of reducing leakage further. The recent strategy of a dedicated resource and better reporting of performance has had a dramatic improvement on leakage performance so the current effort will be maintained.

### 7.3 Pressure Management

The average pressure on the network is 49 m. Three pressure management systems have already been installed and are on fixed delivery pressure control (control method 1 in the diagram below):




Assuming that there is a linear relationship between network pressure and leakage (e.g. halving the pressure will halve the leakage) then to reduce current leakage of 0.72 Ml/d for 2018 to the 0.46 Ml/d to achieve the LLI of 5 would require a reduction in pressure of 36% from 49 m to 31 m.

Due to the Crown Fire Fighting standards such a reduction in pressure would not be feasible.

Reducing the pressure by 10 m for the night period (applying method 2) would reduce background leakage by 6.8% a reduction of 0.05 Ml/d in leakage.

Reducing the pressure by 10 m average for the day, using pressure control method 3 to automatically respond to a fire flow scenario and so meet Crown Fire Fighting standards when a fire occurs then a 21% reduction would reduce leakage by 0.15 Ml/d. This would achieve the regulatory leakage reduction aspiration of 15% from current performance by the 2025 deadline, but not quite achieve the Veolia Corporate objective LLI of 5.

It should be noted that due to recent active leakage control VWP could be argued to have already achieved the 15% regulatory target, indeed even the 50% reduction target mentioned for 2050. However, it is best practice to aspire to exceed expectations particularly if such an action is also beneficial in terms of finance, the environment and resilience of supply to the customers.

Such small volumetric reductions in leakage do not appear to justify such pressure management schemes from a pure financial and environmental perspective. However the more advanced pressure control devices (required to achieve method 3 control) have additional benefits:

- Automatic monitoring of control valve performance allowing preventative maintenance to be planned. This is important given the need to access the control valves which are situation in the MoD part of the network.

- Burst prevention: If a single burst can be prevented in a year then the cost of the leak alone would make the installation of such a system cost effective.

- Detection of pressure surges on the network due to the sudden operation of inlet valves into customer storage – this is of particular concern in the MoD part of the network.

- Resilience will be improved due to a reduction in bursts, the prediction of maintenance requirements and the detection of activities on the network that could cause burst mains.

VWP will therefore consider the flow modulated pressure control option (method 3) by submitting a business case in Q1 of 2019 with a potential trial at the largest of the 3 sites before the end of 2019. Should this prove successful then this would be expanded to the remaining 2 sites during 2020.

## 8 LEAKAGE CALCULATION METHODOLOGY

Refer to Appendix 9 – Leakage Analysis Methodology

## 9. CONCLUSIONS

### 9.1 Leakage Performance

The active leakage control response from August 2017 onwards has reduced leakage to an average of 0.72 Ml/d during 2018 and compares favourably to the WRMP 2014 aspirational target of 1.2 Ml/d.

This reduction when compared to the WRMP 2014 leakage of 1.65 Ml/d is a leakage reduction of 58% (more than halved) and one can argue that this already meets the desired reduction in leakage of 15% by 2025 and 50% by 2050.

Current leakage levels now stand at 15.5% compared to leakage of 42.7% in 2012. This observation is supported by the fact that internal consumption in 2012 was 3.86 Ml/d and has only increased to 4.5 Ml/d in 2018. The reduction in leakage levels has helped offset the growth in demand due to the new developments in the area.

### 9.2 Benchmarking of Performance

Although there has been a dramatic improvement in performance due to the active leakage control strategy it is still useful to benchmark against internationally recognised performance standards.

The Infrastructure Leakage Index (ILI) for VWP is 3.48 and this indicates a good performance (B on an A to D scale) with no urgent action required although the situation should continue to be monitored carefully.

Using the Veolia Corporate Linear Leakage Index then VWP is rated as ‘borderline’ with a LLI of 7.95. In order to move to a satisfactory score (LLI = 5) would require a future leakage level of 0.46 Ml/d.

The metric of leakage per connection point gives a value of 226 litres / connection per day which is almost double that of the UK Water Industry norm. However, this is due to the unique nature of the VWP network having many multi-occupancy MoD barracks. Therefore ILI and LLI are a more appropriate benchmark.

### 9.3 Options for reducing leakage further

Total impact on leakage for operational activities has been calculated to be 10 m3/d = 0.01 Ml/d. Operational use is small when considered over the year. Work will continue to firm up on these initial calculations by using the output of a hydraulic model that is planned for construction and calibration during 2019.

Reported PCC for 2017/18 was 112 l/h/d so this would reduce to 106 l/h/d due to USPL inclusion in the reporting process. This adjustment will be included in future Annual Review WRMP tables and in the planning tables produced as part of WRMP 2019. However, this adjustment is after the customer meter

and will not have an impact on reported leakage, but this does indicate that VWP are already meeting the regulatory customer efficiency target of 118 l/h/d. This may be due to many of the houses being relatively new and so careful assessment will continue to ensure that the current efficiency does not drift from the long term regulatory target.

Mains renewal schemes would not appear to be effective as much of the network is relatively new (laid since 1998).

To reduce current leakage of 0.72 Ml/d for 2018 to the 0.46 Ml/d to achieve the LLI of 5 then an additional 4 leaks would need to be located and repaired per month. Recent performance is 25 repairs in 6 months, approximately 4 per month and so the current leakage detection and repair strategy would need to double in effectiveness. This could involve 4 full time employees dedicated to leakage detection and this would not seem to be cost effective given the size of the network.

Reducing the pressure by 10 m average for the day, using pressure control method 3 to automatically respond to a fire flow scenario and so meet Crown Fire Fighting standards when a fire occurs then a 21% reduction would reduce leakage by 0.15 Ml/d.

Therefore a combination of 0.01 Ml/d to take into account realistic operational water use together with 0.15 Ml/d reduction due to advanced flow modulated pressure control could reduce leakage from 0.72 Ml/d to 0.56 Ml/d (assuming existing performance continues) and would come close to achieving the Veolia Corporate objective LLI of 5.

### 9.4 Reporting of leakage

By constantly assessing leakage and the impact of repairing burst mains it is possible to identify the impact of leaks that take many months to repair due to being in a difficult location (such as in the grounds of an ammunition store, under a tree or river). These individual leaks would have a significant impact on performance which is beyond VWP ability to control. It is possible therefore to identify and set aside such leakage during the regulatory reporting process.

There are a total of 5 months that have been identified over the last 3 years where a leak of 0.4 Ml/d was known to exist but could not be accessed for repair due to its location. The likely average leakage value over the 3 years that could be attributed to such an event is 0.06 Ml/d, not excessive but still worthy of note given the relatively small size of the VWP network.

## 10 RECOMMENDATIONS

The outcome of this analysis has been fed into the WRMP 2019 planning table and will be included in future WRMP Annual Review tables.

VWP will consider the flow modulated pressure control option by submitting a business case in Q1 of 2019 with a potential trial at the largest of the 3 sites before the end of 2019. Should this prove successful then this would be expanded to the remaining 2 sites during 2020 realising a 0.15 Ml/d leakage reduction.

VWP will aim to maintain leakage rates of 0.72 Ml/d and achieve a reduction of 0.07 Ml/d due to reporting operational use and exceptional leakage with an option of 0.15 Ml/d reduction due to flow modulated pressure management (if business case is proven during 2019).

Operational use of water and User Supply Pipe Leakage (USPL) will be included in the WRMP annual return.

This would appear to meet the regulatory requirements of a 15% reduction in leakage by 2025 and a 50% reduction in leakage by 2050 as well as reducing LLI to 5 to meet Veolia Corporate aspirations and potentially move ILI category A – Excellent.

The metric of leakage per connection point will not be used to measure performance due to the unique nature of the VWP network which includes multi-occupancy MoD barracks that are embedded within the regulated network.

## 11. PLAN OF ACTION

| | Water Resources Management Plan 2019 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2019 | | | | 2020 | | | |
| S/N | Element of Work | Pre S/N Req | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| | **Leakage** | | | | | | | | | |
| 1 | Flow modulation business case | - | | | | | | | | |
| 2 | Trial site Flow Modulation | 1 | | | | | | | | |
| 3 | Additional Sites | 1 | | | | | | | | |
| 4 | Report Operational Use | - | | | | | | | | |
| 5 | Report USPL | - | | | | | | | | |