VALVE CONDITION ASSESSMENT USING NEW TECHNOLOGY

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ABSTRACT

ACTEW Water commenced and implemented a valve condition assessment program in 2012-13 using new technology, a Wachs valve exerciser. The following are findings from use of this equipment on ACTEW's water reticulation network:

- 30-40% of the valves were unusable.
- 4% of the valves were found closed and should have been open.
- Data from the valve exerciser was used to calibrate the hydraulic model.
- Broken and stiff valves were identified for replacement.
- Evidence that the program will significantly reduce the risk of shoulder injuries.

1.0 INTRODUCTION

The aim of this paper is to give an understanding of planned valve maintenance and condition assessment using the new technology that was implemented in ACTEW Water in the 2012-13 FY. This paper will discuss the findings from the valve condition assessment program using the Wachs valve exerciser.

There are approximately 20,000 water distribution and reticulation valves in the Canberra Water Supply System which have been installed between 1927 and 2013. In previous years, all hydrants and valves were inspected on a continuous five years cycle ensuring all valves can be located, accessed and operated when required. This inspection regime attempted to manually operate valves and it did not provide information on the status or condition of valves.

A new inspection regime was implemented in 2012-13, following a similar pattern to the old regime and at the same time operating the valves using the Wachs machine to determine the status and condition of valves.

Under the program, 3000 stop valves are operated every year with the valve exerciser machine. As at the end of Dec 2013, 2500 valves had been exercised with this new technology. Currently, this program is limited to planned maintenance of stop valves only and will extend to reactive works as well in the future.

The detailed results from the use of the valve exerciser are shown in Table 1.

The equipment consists of two components:

- Valve exerciser (Wachs): 4m reach, records torque required to operate the valve, GPS location and number of turns to open and shut the valve.
- Utility vacuum and high pressure jet stream for cleaning out hydrants and valves (similar to commercial hydro dig but not as powerful).

Suburbs for valve exercising were prioritised on the basis of:

- Age of infrastructure (i.e. older suburbs),
- Area where the burst frequency is high,
- Area where ACTEW Water was calibrating the water reticulation model.

2.0 ADVANTAGES OF VALVE EXERCISER (WACHS) MACHINE

- This equipment protects the Field services operators by keeping hands free from the machine while operating the valve.
- The machine operates in an automatic mode and hence no assumption about the size, direction or status is required.
- The machine follow the path of least resistance, hence prevents the breaking of valve and the sensors automatically stop the rotation and reverse in half turn increments to flush calcification from gate valve.
- The valve will be always operated at the minimum torque required to turn.

3.0 PURPOSE OF THIS PROGRAM USING NEW TECHNOLOGY

- To reduce the risk of shoulder injuries. Safety is the number one priority of ACTEW Water.
- To increase confidence that stop valves are accessible and in good working condition, reducing time taken to repair water main bursts and other reactive works.
- To reduce the number of customers interrupted during a water main burst or other related maintenance activities.
- To confirm the status of valves in the hydraulic model to reflect what is in the field
- To record the condition of the valve.
- To correlate the number of turns to check/confirm the size of valves and water mains in the mapping system/GIS.

4.0 BENEFITS OF THIS PROGRAM USING NEW TECHNOLOGY

This program will reduce the risk of shoulder injuries as valves are exercised using the machine. In addition, the valve condition is improved, reducing the risk of injury during manual operations after a burst.

Once valves are operated few times, the torque required to operate stiff valves will be minimal and hence easy to operate manually as a result of this program (As shown in Fig 2).

The accessibility and operability of valves is improved. If valves are not operable, in the case of a burst a larger area needs to be shut down impacting more customers. The need to find additional valves for isolation also causes delay and increased costs.

If the valves are operated and maintained, there will be a reduction in the number of customers out of water (As shown in Fig 1). To achieve this, the program:

- Records GPS co-ordinates of valves that are exercised. The GPS co-ordinate will be used to find the valves in future if they become inaccessible.
- Finds valves which have not been recorded in the GIS
- Uncovers buried valves and improves access by clearing dirt form spindles.
- Exercises stiff valves using the machine.
- Identifies broken valves.
- Identifies closed valves and clockwise closing valves.
- Identified scour valves that were incorrectly shown as isolation valves in the GIS.
- Extended life of valves by operating very stiff valves a few times until the torque required to operate is minimal.

The program also assists calibration of the hydraulic model of the system. It identifies where the size of water mains and valves have been incorrectly recorded in GIS. The number of turns required to operate the valve will give an indication of the size of valve and main. For example, 9 turns corresponds to DN100 (2Φ (in inch) + 1), 13 turns for DN150 etc.

5.0 FINDINGS

Valves are described as unusable if ACTEW Water cannot use those valves immediately during a water main burst. Typical problems with valves are:

- they cannot be located,
- the cover is buried,
- they need to be cleaned out inside the valve sleeve,
- the valve is stiff, or
- the valve needs replacement.

Hence, the program focuses on operating the valve and on ensuring that valves are easily accessible and operable. Under the program 2500 valves were operated and the findings were:

- 233 (9.42%) valve covers were buried and able to be recovered. "SV" metallic markers were installed on the kerb for these valves.
- 368 (14.88%) valve spindles were covered by dirt and were cleaned out with the vacuum and high pressure jet stream equipment.

Figure 4: ***Consequences if DN100 valve failed to shut, 41 houses affected instead of 20***

- 223 (9.02%) valves were very stiff. These valves were operated from fully open to closed and then back to fully open a few times until the torque required to operate the valve is minimal. They can now be safely operated manually. In fig 2, the number of turns is shown on the X axis and torque (LBFT) on the Y axis. Different colours in the graph show the number of times the valve was operated. The valve shown in Fig 2 was operated four times where the initial torque required to operate valve was around 90 LBFT but after operating four times, it required only 20 LBFT. This valve will be very easy to operate manually in the future.

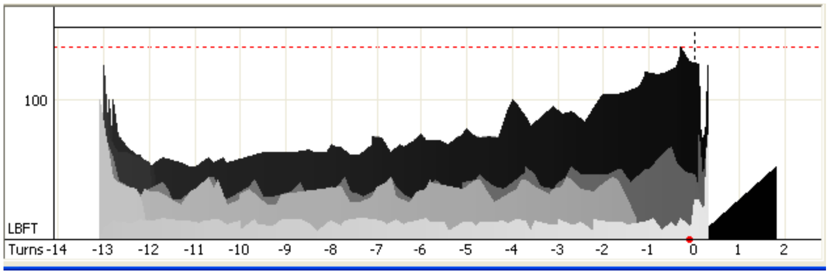


Figure 5: ***Stiff valve but smooth after operation***

- Identified 15 broken valves (1%) which couldn't be used for isolation. All the broken valves were replaced immediately.

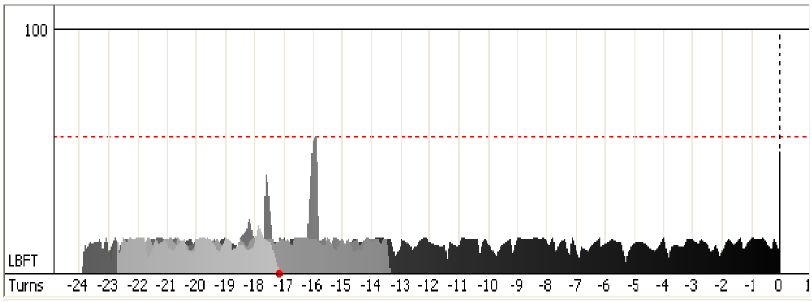


Figure 6: ***Broken valve***

Broken valves will spin indefinitely with less torque and need to stop it manually.

- 30 (1.2%) valves were very stiff and are still stiff after operating a few times. The torque required to operate those valves is still significantly high and they cannot be operated manually. These valves are listed for replacement.

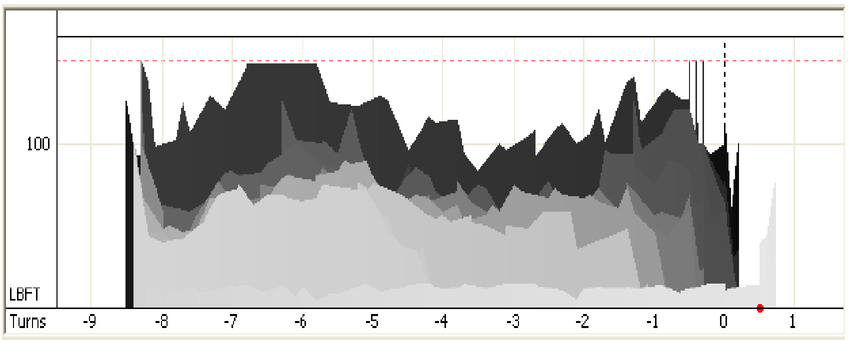


Figure 7: **Valve considered for replacement**

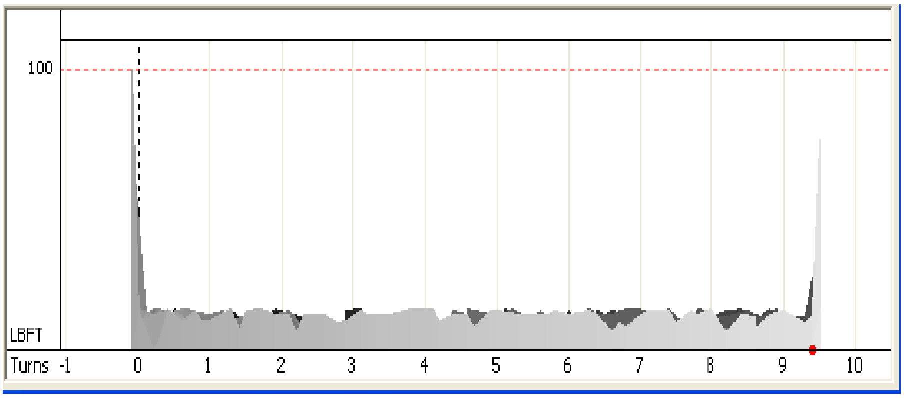
In the above figure, the valve was operated five times to see if the valve could be operated with minimal torque after operating few times. There was no sign of improvement and this valve will be very difficult to operate manually. Replacement of this valve is required.

From the above dot points, **30-40% of the valves tested were found to be unusable.**

It had been suspected that operating valves under this program would create discoloured water resulting in customer complaints. However, operating valves even in older suburbs didn't create any discoloured water and there were no customer complaints as a result of the program.
Before this exercise, it was assumed that the majority of the older valves will start to leak

from the gland if they are operated. However, the program found only less than 3% (75) of these valves leaked through the gland.

It was interesting to see that 4% (99) of the valves were left closed or partially closed after maintenance. If the valves are left shut, it creates dead ends and there may be stagnant water that will create water quality issues. All these closed valves were left open after exercising. One critical valve and a few big valves (above DN300) were also found shut and this information was also used to calibrate the water reticulation model.

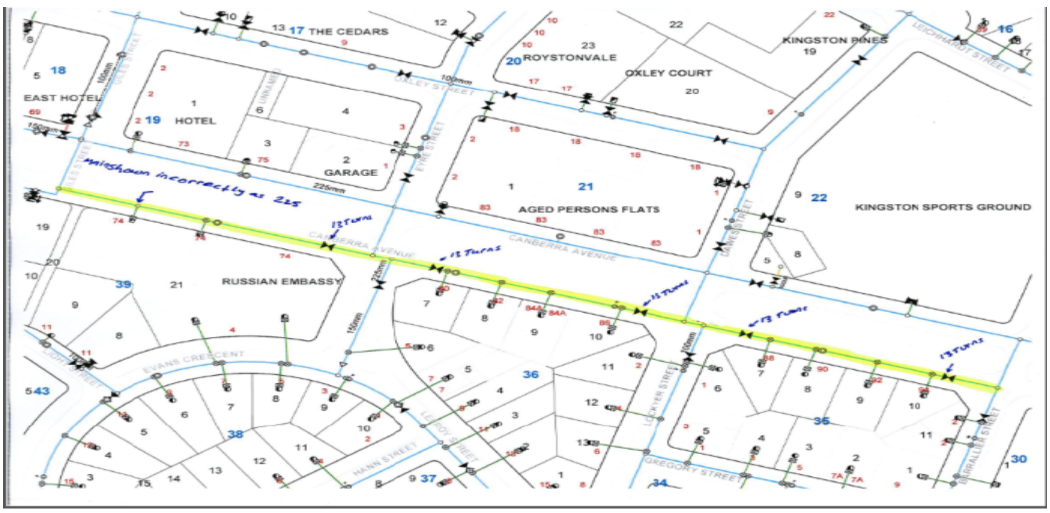


<u>Figure 8:</u> ***Closed valve and left open after exercise***

The position of "0" indicates the initial status of the valve. If the "0" is in the LHS and is spinning towards the RHS, then the valve is closing.

The program also found:

- 7% of new valves that had been replaced reactively within last five years had not been updated in the GIS.
- 85 valves and the corresponding water mains were incorrectly sized in the GIS and thus in the water reticulation model. Incorrectly sized mains can be critical for fire flow analysis. The number of turns is used to verify the size of water main and valve information within the GIS has been updated accordingly.



<u>Figure 9:</u> ***Mains and valves incorrectly shown as DN225 for DN150 main and valves***

- 6 clockwise closing valves (CCV) were identified. These unusual valves can cause confusion about the status of valve when operating. These valves will be replaced by anti CCV or will be labelled clearly in mapping system.
- 12 scour valves were incorrectly shown as isolation valves in the GIS. The GIS was updated based on this information.

6.0 CONCLUSION

The findings from the valve condition assessment program are very beneficial to fix the discrepancies that were observed in the field and in GIS & the hydraulic model. This program will surely reduce the risk of shoulder injuries as the big valves and stiff valves are operated with this equipment hence preventing the manual operation. Once the status of valves are confirmed in field, hydraulic model can be calibrated which will give the accurate results for the analysis of discoloured water.

7.0 APPENDIX

Table 1: ***Summary of findings***

Suburb	No of Valves operated	Dirty water complaints	Cover buried	Cleaned out	New marker	Leak fixed through dispatch	Leak stopped but need to be fixed later	Stiff valves but smooth after operation	Considered for replacement	New valves found	To be updated in ESRI	Broken valve/s	found closed and left open	found closed and left closed	found partially closed and left open	LHV(Clock wise clsoing valve)
Aranda	66	0	2	5	30	7	2	3	2	1	1	1	2	2	2	0
Cook	120	0	18	22	60	9	2	13	1		8	0	2	3	2	0
Ainslie	206	0	31	4	120	1	2	33	2	11	4	6	0	1	2	1
Reid	76	0	3	11	41	2	0	7	1	6	1	1	0	0	0	0
O'Connor	167	0	37	17	92	4	0	16	8	12	3	2	3	3	4	0
Weetangera	80	0	10	24	72	1	0	9	0	1	2	1	1		1	0
Red Hill	106	0	9	25	9	2	2	6	2	6	0	0	2	0	5	0
Forrest	86	0	8	9	15	0	4	4	0	15	2	0	1	0	3	0
Braddon	110	0	4	15	65	0	1	3	1	15	1	2	6	0	1	0
Turner	89	0	6	16	54	0	0	8	0	4	4	0	3	0	0	0
Campbell	108	0	10	7	40	0	0	19	0	8	0	0	0	2	1	5
Dickson	74	0	1	4	23	0	0	10	0	5	8	0	2	0	1	0
Acton	51	0	0	1	32	0	0	11	0	6	2	0	0	0	0	0
Lyneham	112	0	1	30	63	0	0	29	2	9	1	0	2	1	4	0
Griffith	143	0	1	8	26	0	0	12	1	19	6	1	4	0	4	0
Florey	207	3	20	64	61	0	5	11	0	3	5	1	4	0	2	0
Narrabundah	179	0	29	32	35	12	2	7	9	7	3	2	4	0	6	0
Yarralumla	168	0	4	19	5	6	0	13	1	20	2	0	5	0	3	0
Kingston	140	0	5	21	23	3	0	1	0	70	2	1	8	0	5	0
Downer	82	0	19	9	8	4	0	5	0	1	0	0	1	0	1	0
Higgins	103	0	15	25	16	3	1	3	0	0	30	0	1	0	1	0
Total	2473	3	233	368	890	54	21	223	30	219	85	18	51	12	48	6
		0.12%	9.42%	14.88%	35.99%	2.18%	0.85%	9.02%	1.21%	8.86%	3.44%	0.73%	2.06%	0.49%	1.94%	0.24%