

**For information**

**Legislative Council  
Panel on Development**

**Repair and Replacement of Aged Water Mains  
And Temporary Water Supply**

**PURPOSE**

This paper provides Members with an update on the progress of the repair and replacement of aged water mains; and a report on the current arrangements for handling water main burst and provision of temporary water supply by the Water Supplies Department (WSD). Observations related to recent water main burst incidents at Tsing Yi and Wong Nai Chung Road, and recommendations for improvement in handling water main burst and provisions of temporary water supply are also included in the paper.

**REPAIR AND REPLACEMENT OF AGED WATER MAINS**

2. The water mains replacement and rehabilitation (R & R) programme, which aims at replacing/rehabilitating 3,000 km of aged water mains out of the 7,800 km water distribution network, is a key element in reduction of water main burst and active leakage control. The programme was originally planned to be implemented in phases for completion within a 20-year period by end 2020. To bring about earlier improvement to the supply system and minimise inconvenience to the public due to frequent main bursts, we decided in 2005 to compress the programme from a 20-year to a 15-year period targeting for an earlier completion by end 2015.

3. We advised Members on the progress of R&R works vide Paper No. CB(1)1919/09-10(03) entitled "Progress of Total Water Management Initiatives". The paper was discussed at the Development Panel Meeting held on 25 May 2010.

4. Among others, we reported that the R&R programme has passed through the difficult initialisation period and has been achieving a steady progress. As of end

April 2011, a total of 1,557 km of pipes has been replaced/rehabilitated under stages 1, 2 and 3 of the R&R programme.

5. Stage 4 Phase 1 R&R works has commenced as scheduled in March 2011. We plan to seek funding support for Stage 4 Phase 2 in November 2011 for commencement of the remaining R&R works such that completion of the whole R&R programme can be completed by end 2015 as scheduled.

6. In prioritizing the R&R works, we have considered the probability of failure of individual sections of water mains and the consequence of their failure. We have also established a procedure to investigate each water main burst case in details. If necessary, the concerned section of water mains will be injected into the R&R programme or re-prioritized under the programme to an earlier stage. This approach has provided good flexibility for us to promptly handle the repair/replacement of specific section of water mains which are found to be deteriorating faster than expected.

## **EFFORTS TO REDUCE MAIN BURST**

7. To enhance leakage detection as a preventive measure to reduce main burst, we have migrated from the traditional waste detection based leakage detection<sup>1</sup> to the proactive burst prevention based leakage detection<sup>2</sup> with the advancement of technology. Firstly, GSM noise loggers with wireless data transmission capability have been installed at selected critical pipe sections for continuous monitoring of the flow condition and providing prompt for attending to possible leakage. Secondly, we also completed a pilot scheme on the new “Sahara” technology in February 2011 for detecting leakage of in-service pressurized water mains. The technology makes use of instrument comprising a CCTV camera and an acoustic sensor for insertion via access point into water main not less than 300 mm in diameter to inspect its internal conditions or detect leakage points. The pilot scheme has proved to be very effective in locating leak spots, but the cost for the scheme is very high. We are now searching

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<sup>1</sup> Waste detection based leakage detection is the detection of water loss in a selected water supply zone with follow up search for leakage spots within the supply zone.

<sup>2</sup> Proactive burst preventive based leakage detection is the direct checking of water mains for locating leakage points on the water mains. Critical water main sections are often closely monitored under such an approach. The more advanced technology also includes an appraisal of the general condition of the water mains inspected.

for comparable alternatives worldwide in a bid to drive down the cost through competitive tendering should the technology be adopted as one of the regular tools for leakage detection. Thirdly, leakage detection by Leak Noise Correlator has achieved good improvement as specialist contractors/suppliers keep on refining the algorithm of the equipment to filter off background and traffic noise and improving the accuracy on non-metal pipe leak detection. The advanced leakage control, monitoring and detection works are illustrated in **Annex 1**.

8. We have commissioned a specialist contractor for leakage detection work for North Point and Shau Kei Wan for remuneration on an outcome basis, i.e. payment would only be made for leaks verified on site. If prove successful, this contract form will be considered for wider application.

9. Separately, implementation of pressure management works is being carried out for installation of flow-modulated pressure reducing valves at strategic locations of the distribution network. The valves help regulate water pressure and hence reduce water main leaks and bursts.

10. With the R & R works completed to-date, coupled with the implementation of leakage control and pressure management measures, the annual number of bursts has reduced from the peak of about 2,500 in 2000-01 to 609 in 2010-11 as shown in **Annex 2**. The water main leakage rate has also reduced from 25% in 2001 to 20% in 2010. We anticipate that the water main leakage rate will further decrease to 15% upon completion of the R & R programme.

## **CURRENT ARRANGEMENT FOR HANDLING MAIN BURSTS AND PROVISION OF TEMPORARY WATER SUPPLY**

11. At present, WSD has established 35 designated teams with 188 number of staff and 10 designated teams with 60 number of staff during and outside office hours respectively for handling incidents related to the water supply networks including main bursts. Term contractors of WSD have also set up 33 designated teams with 330 number of staff and 18 designated teams with 180 number of staff during and outside office hours respectively for carrying out related works. Details of the designated teams for serving various areas are as follows :-

	<b>No. of WSD Designated Teams</b>	<b>No. of Term Contractors Designated Teams</b>
During Office Hours	HK Island – 6 Kowloon – 8 New Territories East – 9 New Territories West – 10 Lantau & Outlying Islands – 2	HK Island – 6 Kowloon – 11 New Territories East – 5 New Territories West – 8 Lantau & Outlying Islands – 3
Outside Office Hours	HK Island – 2 Kowloon – 2 New Territories East – 3 New Territories West – 2 Lantau & Outlying Islands – 1	HK Island – 3 Kowloon – 4 New Territories East – 3 New Territories West – 5 Lantau & Outlying Islands – 3

12. Upon receipt of a report on main burst incident, the WSD's designated teams will be mobilized to site immediately to isolate the concerned water main for subsequent repair work. Should the incident affect existing traffic, WSD will liaise with the concerned parties such as the Police, Transport Department and Highways Department for necessary traffic arrangement to facilitate the carrying out of the repair work. We will also liaise with other utility undertakers for protection of their existing utility services which may be affected by the repair work.

13. After isolation of the bursting main, the emergency repair work may affect water supply to consumers. The following steps will be taken to mitigate the impact on consumers:-

(A) Fresh Water Mains

(i) As the first priority, we will maintain uninterrupted supply by arrangement of alternative water supply to the affected area from other water supply zones wherever possible. Amongst the 129 fresh water supply zones in Hong Kong, complete alternative supply can be arranged to 64 supply zones. 30 supply zones cannot be supplemented by any alternative source. In the remaining 35 supply

zones, part of the areas within the zone can be supplemented by alternative supply sources.

(ii) If alternative water supply from other supply zones is not possible, temporary emergency fresh water supply will be provided to meet the basic need of the affected consumers as given below in descending orders of preference:-

- (a) installation of standpipes at fire hydrants at convenient locations; and
- (b) deployment of water wagons and placing of water tanks within the affected areas.

(B) Salt Water Mains

Generally speaking, provision of temporary salt water supply from alternative supply zones is not possible as the network is less inter-connected as compared with the fresh water supply network. Consumers could use recycled fresh water for toilet flushing during the period of supply interruption.

14. The public can obtain the latest information about main burst incidents through WSD's Customer and Telephone Enquiry Centre (CTEC) hotline. For incidents affecting water supply to large number of consumers, notifications will be uploaded on to WSD's webpage. In addition, radio announcement and press release will be made for serious incidents.

15. Information of all water suspension incidents due to emergency and planned works are entered into the WSD's Water Suspension Management System (WSMS) for reference by staff of CTEC for answering telephone enquiries from customers. The information in the WSMS include details of the water suspension such as the start time and anticipated end time, affected area, type of water supply affected, cause of the suspension, the locations of standpipes installed, and water tanks/water wagons deployed in the area. CTEC staff also upload such information to the Interactive Voice Recognition System (IVRS) of the WSD's hotline and the department's internet page for reference of consumers. During the incident, close coordination is

maintained between CTEC and site staff on the latest development for updating of information.

## PERFORMANCE PLEDGES AND ACHIEVEMENTS

16. WSD has performance pledges relating to emergency water main burst repair work in respect of:-

- (a) the time for isolation of the burst main – this refers to the time for shutting off valves to enable repair work to commence; and
- (b) the duration of supply interruption – this refers to the time taken for resuming the service of the burst water main.

Details of performance pledges and achievements in 2010-11 are as follows:-

Performance Pledges		Achievements in 2010/2011
Services	Targets	
Time for isolation of burst main upon receipt of report		
- for pipe diameter up to 300mm	(i) 94% within 1.5 hours (ii) 75% within 1 hour and 15 minutes	99% 89%
- for pipe diameter above 300mm to 600mm	(i) 94% within 2.5 hours (ii) 75% within 2 hours	94% 90%
Maximum duration of supply interruption due to fresh water main burst	85% within 8 hours 70% within 7 hours	92% 89%

17. The actual time to repair a burst water main is affected by a number of factors such as the presence of various utility services and other installations adjacent to the burst water main, the need to break up the concrete surround of the burst water main, the need for temporary closure of existing road and whether night works is permitted.

In 2010-11, the average time for resuming water supply in respect of fresh water mains was 4.1 hours.

18. At the moment, WSD has five water wagons (ranging from six to eight cubic metres each) and 104 water tanks. The capacity of most of the water tanks is one cubic metre and there is a small number of one and half cubic metres size tanks.

19. The five water wagons are stationed geographically in Hong Kong (1 number), Kowloon (1 number), New Territories East (1 number) and New Territories West (2 numbers) so that quick response can be made for any emergency occurred within the corresponding WSD operational region. When situation warrants, mobilization of water wagons across regions can also be arranged.

20. The utilization rate for four of the five water wagons in 2010 stands at 10% to 12% and the one serving Kowloon is 5%. This smaller figure is due to the fact that the supply zones of Kowloon are better inter-connected and alternative water supply to an affected area by means of other supply zones can be readily made at times of emergency.

## **OBSERVATIONS DURING RECENT WATER MAIN BURST INCIDENTS**

21. The main burst incident that occurred on 14 February 2011 at Cheung Hang Estate, Tsing Yi is one related to the inside service of the estate maintained by the Housing Department (HD). We received request for assistance for provision of temporary water supply to the estate by HD at 6:46 pm. At 7:00 pm, we installed a standpipe at a fire hydrant within the estate and dispatched a water wagon to site at 8:24 pm. The assessment at then was that the provisions made should be adequate. Notwithstanding, with the note of acute demand, we installed an additional standpipe at 10:59 pm and dispatched another water wagon at 12:10 pm to site.

22. For the main burst at Wong Nai Chung Road on 1 March 2011, we received report of main burst at 04:56 am and our staff arrived on site at 05:43 am for isolation of the burst main. The large number of mains within the flooded road section and the extensive connections between the mains therein have presented challenges in isolation of the burst main. WSD needed to close a total of 22 number of valves for complete isolation of the burst main at 10:30 am.

23. After isolation of the burst main, water wagons and water tanks were mobilized to provide temporary water supply. The first water wagon departed North Point Regional Office at 10:30 am and arrived at Leighton Hill at 11:00 am. A total of four water wagons and 21 water tanks were progressively deployed to temporarily supply water to the affected areas.

24. We have an established practice of reviewing major supply events for checking compliance with our set targets and performance pledges for seeking opportunities for improvement. Reviews were accordingly conducted for the above-mentioned incidents and the main observations are as follows:-

#### Cheung Hang Estate

(i) Adequacy of temporary water supply needs to be reviewed more closely so that augmentation could be more promptly provided.

(ii) For request for assistance of the provision of temporary water supply made by third party, we should also take note of the short temporary notice of suspension made by the third party which do not allow the affected consumers to have time to store water and hence more provision of temporary water supply should be provided.

#### Wong Nai Chung Road

(i) For complicated water supply network, additional sectional valves would have to be installed at strategic locations to reduce the number of valves, in particular side branch valves, that need to be closed in case of a main burst.

(ii) Whilst the critical dispatch of water wagons and water tanks to site was almost imminent upon isolation of burst main and assessment of areas affected, provision of temporary water supply could be further expedited by earlier mobilization before completion of isolating the burst main and assessment of affected areas, in case prolonged isolation is anticipated due to site difficulties and network complications.

(iii) If the area affected is large, the extent of temporary water supply should be reviewed regularly and refilled timely till resumption of supply.

## RECOMMENDATIONS FOR IMPROVEMENTS

25. We plan to refine the procedures for handling of water main bursts and provisions of temporary water supply as follows :-

- (i) We would deploy more resources to water main burst site when it is envisaged that the target time for isolation of burst main will not be met.
- (ii) Arrangement of alternative water supply from other supply zones, installation of standpipes or deployment of water wagons and water tanks should be initialized at the target time for isolation of burst main; i.e. 1 hour and 15 minutes for pipes up to 300 mm diameter or 2 hours for pipes above 300 mm diameter or complete isolation of the burst main, whichever is the earlier.
- (iii) Provisions of water wagons and water tanks should be closely monitored and augmentation provided when unmet demand is noted.
- (iv) For optimal use of resources, more efficient and expeditious cross-regional deployment should be facilitated by appointing a designated officer at the region of the burst incident to act as the coordinator. Contact officers in the other operational regions for receiving requests from the coordinator would be appointed for providing cross-regional supports. The coordinator will be the central command in marshalling the work of the term contractors and the other operational regions in provision of temporary water supply.
- (v) Whilst adequate stock of water tanks is in place, more water wagons should be acquired. To meet the need at emergency situations for providing the initial round of supply and refilling of depleted water tanks subsequently, we may need to increase the number of water wagons in the individual WSD operational regions, providing a total of 10 water wagons for dealing with individual burst incident by cross regional deployment as necessary.

- (vi) The need for refilling depleted water tanks will be closely monitored by on site patrol teams for reporting to the coordinator for direction particularly if a large number of water tanks are deployed to provide temporary water supply and the time of depletion of the water tanks placed at different locations may vary. The aim is to ensure that water tanks could be refilled before depletion.

## **THE WAY FORWARD**

26. With the high water supply pressure due to the hilly topography of Hong Kong and the placement of service reservoirs at high level for optimal use of scarce land resources; ground movements and external disturbances, bursts and leaks inevitably occurred in our aged water supply networks. We well appreciate the inconvenience to the public arising from water supply interruption and in cases, the associated traffic disruption.

27. As mentioned above, we are taking a multi-pronged approach to tackle the issue, including proactive burst prevention by leakage detection, replacement of the aged water mains under the R&R programme and implementation of pressure management. We are also putting in place refined procedures for handling water main burst incident and provision of temporary water supply, during supply interruption. We will strive to continue to improve the reliability of our water supply networks despite the challenges posed by the congested urban setting and the large number of underground utility services.

**Development Bureau**  
**Water Supplies Department**  
**May 2011**

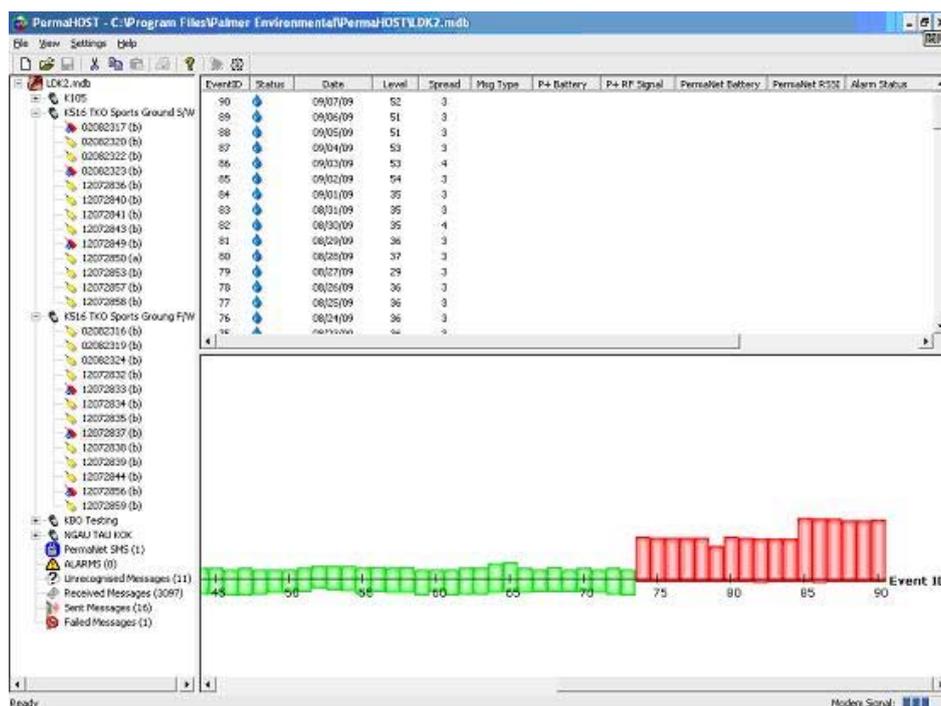
## Advanced Leakage Control, Monitoring and Detection Works

### I. Locating leak with Noise Loggers



Typical Equipment

Typical Set-up



Illustrative Result

Note:

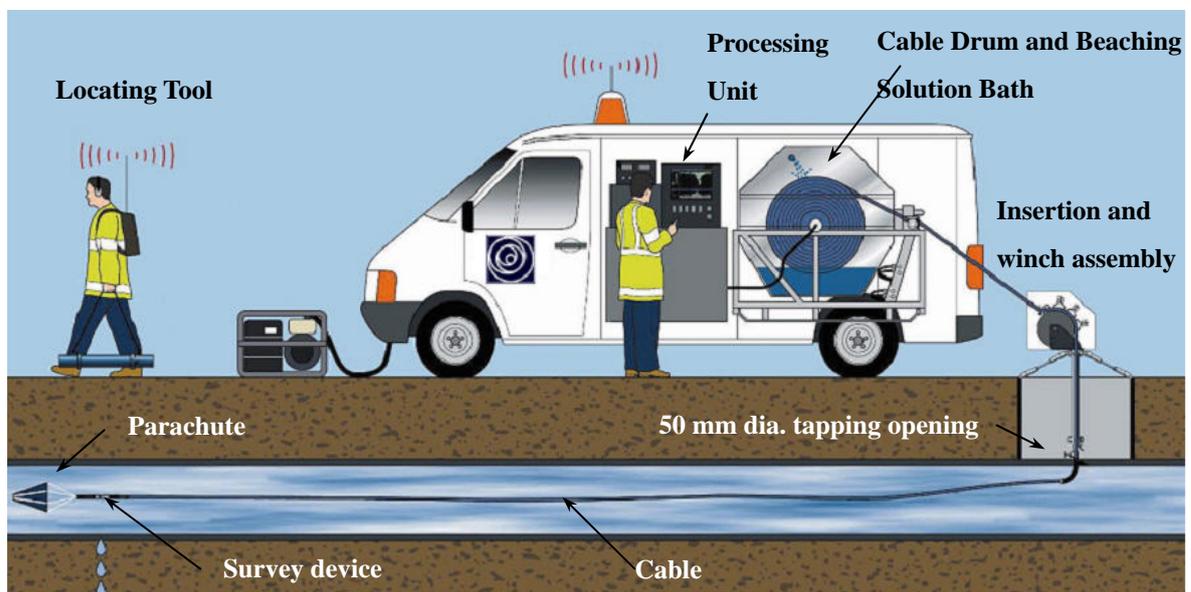
The bar above the horizontal axis represents the main noise level. The bar below the horizontal axis represents the spread of the noise level distribution. A high main noise level and narrow noise spread indicates a possible leak and is highlighted in red. A low main noise level and wide noise spread indicates “no leak” and is highlighted in green.

## II. New Technology for Condition Assessment of Water Mains

The new technology is a non-destructive, condition assessment tool that is used to inspect the interior and detect leaks in large diameter (300 mm dia. and above) pressurised water mains without interruption of service.

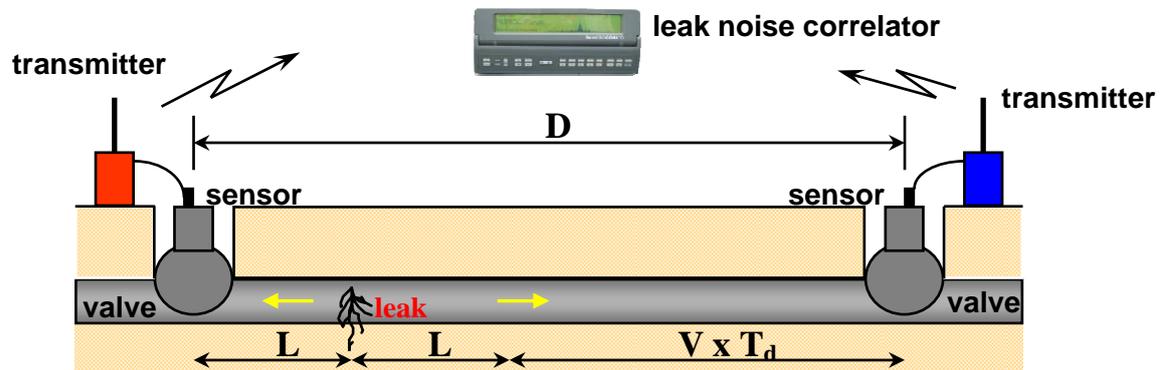
The system will be able to operate in an in-service pressurised water main by insertion of a cable with the survey device (a CCTV camera or acoustic sensor) through any tapping opening that is at least 50 mm in diameter. Under the flow of water, the parachute at the front end of the cable will carry the survey device and cable through the section of water main to be surveyed, providing real-time inspection of the internal conditions of the water main and detection of any leak in the water main. The position of defect or leak can then be marked on the ground surface, facilitating subsequent repairs.

Since the cable is connected to the control equipment on the ground surface and can be controlled to permit halting of the survey device at any position, it not only transmits the survey signal in real time, but also increases substantially the sensitivity, accuracy and effectiveness of detecting defects or leaks.



Typical Set-up of the System

### III. Pinpointing Leak with Leak Noise Correlator



#### Pinpoint Leak Location in a Pipe

Note:

- (1) A leak noise correlator is used to pinpoint the location of a leak along a section of water main. Two sensors are deployed on the valves on either side of the suspected leak location. Before carrying out the pinpointing by using leak noise corrector, the distance between the two sensors (D), pipe diameter and the pipe material are required to be input to the leak noise corrector.
- (2) When there is a leak, the leak noise will propagate along the water main and reach the two sensors with a time difference  $T_d$  and then to the correlator via the transmitters. A correlation peak will be shown on the display screen of the correlator, indicating a possible leak.
- (3) The leak position is calculated by the correlator using the formula  $L = (D - V \times T_d) / 2$ , where  $T_d$  is the time difference and V is the sound velocity along the water main based on the input data.



Taking Measurement

