

Legislative Council House Committee

Lead in Drinking Water Incidents

Purpose

At the meetings on 1 September and 8 October 2015, Members were briefed on the situation that the lead level in the drinking water supply at consumers' taps mainly in the public rental housing (PRH) estates, did not comply with the "Guidelines for Drinking-Water Quality" of the World Health Organization (WHO)¹. This paper briefs Members on the latest situation of the incident of lead in drinking water, and the follow-up actions we have taken in response to the Report of the Commission of Inquiry into Excess Lead Found in Drinking Water.

Latest Situation

2. The Government has been paying very close attention to the incident of lead in drinking water. The Chief Secretary for Administration convened the first high-level inter-departmental meeting on 11 July 2015 to coordinate the follow-up actions. So far 20 meetings have been held and a number of measures have been taken promptly. The Government adheres to three principles in addressing the issue. We have kept information open and transparent, adopted a people-oriented approach and carried out thorough investigations. The latest situation and follow-up actions are set out in the following paragraphs.

Residential buildings: PRH estates

3. The Housing Authority (HA) and the Water Supplies Department (WSD) started to conduct water sampling tests for PRH estates in July 2015, and

¹ The provisional guideline value of WHO's "Guidelines for Drinking-Water Quality" (2011) is 10 micrograms per litre for lead in drinking water.

completed such tests for all PRH estates (including non-domestic portions) on 18 November 2015. The sampling test results are summarised as follows:

- (a) For PRH estates completed in and after 2005 (Annex A): HA and WSD conducted “systematic sampling tests” for a total of 46 PRH estates, involving 83 PRH developments. A total of 4 821 water samples² were taken, of which 91 samples taken from 11 PRH developments exceeded WHO’s Provisional Guideline Value (PGV) for lead.
- (b) For PRH estates completed before 2005 (Annex B): HA and WSD conducted “screening tests” of water. We took 2 635 water samples from 144 PRH estates, and all of them complied with the WHO’s PGV.

4. During the hearings of the Commission of Inquiry into Excess Lead Found in Drinking Water (the Commission), there were queries about certain water samples being discarded. HA issued a press statement on 5 February 2016 and a HA paper on 9 May 2016³ to explain why some water samples had been discarded.

5. WSD and HA had found cases where water samples “with excess lead” were suspected of contamination during the sampling process, which led to deviation in the test results. Under these circumstances, more water samples had to be taken before the water quality of the estates concerned could be determined. If, after analysis, it was concluded that the water samples “with excess lead” had been affected by environmental factors, the samples would be discarded. For example, both WSD and HA have explained to the public on various occasions in the past that a sample “with excess lead” at Shui Chuen O

² In Appendix B of our paper to the meeting of the Legislative Council Panel on Housing on 1 February 2016 (LC Paper No. CB(1)439/15-16(04)), it was reported that the water sample number was around 4 740. As some samples taken from non-domestic portions had not yet been finalised at the time, they were not included in the sample number reported in the paper. Upon finalising the numbers, the water sample number is confirmed to be 4 821. We have already published this information in our paper issued to HA on 4 March 2016 (Paper No. HA 7/2016).

³ Paper No. HA 15/2016.

Estate was discarded, as further investigation showed that it was affected by environmental factors⁴. There were also cases where it was discovered after samples had been taken that the fresh water supply systems inside the units were installed by the tenants themselves. Under these circumstances, the samples were also discarded.

6. HA confirmed with WSD that altogether 49 samples were discarded. Among them, 27⁵ were discarded for two main reasons, namely (a) the samples were affected by environmental factors, which led to deviation in the test results; or (b) the fresh water supply systems from which the samples were taken were installed by the tenants themselves. Another 22 were discarded as they had been taken inadvertently from premises that are not existing PRH estates⁶.

Measures to assist affected tenants

7. Since the incident of excess lead in water, to minimise the inconvenience caused to tenants of the 11 affected PRH developments⁷ in

⁴ One sample taken from a vacant unit at Hei Chuen House of Shui Chuen O Estate was found to have a lead level of 14 micrograms per litre, which slightly exceeded WHO's PGV. The water samples taken from the other three domestic blocks in the same estate did not exceed the PGV. WSD then took more water samples from Hei Chuen House for testing to ascertain the situation (ten samples in total), and no samples with excess lead were found. After analysis, it was concluded that the water sample which exceeded the PGV had been affected by environmental factors and should be discarded. Therefore, we concluded that no excess lead in water was found in Shui Chuen O Estate.

⁵ Among the 27 discarded samples, eight were taken from the 11 affected PRH developments.

⁶ 14 samples were taken from a block uncompleted at the time, and eight samples were taken from Link's property.

⁷ When we conducted water sampling using flushed samples last year, as long as there was a sample exceeding 10 micrograms per litre for lead, the whole PRH development would be classified as an affected estate, regardless of the number of blocks within the PRH development concerned, and a series of follow-up actions would be taken. The Commission of Inquiry into Excess Lead Found in Drinking Water considered this a cautious arrangement, given for example in the U.S.A. where the authorities will be required to take steps to reduce exposure only if the lead concentration of more than 10% of the samples collected exceeds the action level of 15 micrograms per litre.

gaining access to safe drinking water, WSD and HA have taken a series of measures including the provision of water wagons/ tanks and standpipes, supply of bottled water, requesting the contractors concerned to install temporary water points by connecting pipes from the roof-top tank to each floor, as well as to install water filters and replace filter cartridges for two years after installation for the affected domestic households free of charge. The latest developments are set out below:

- (a) Water wagons/ tanks and standpipes: Currently, only the standpipes remain in use, but water consumption has decreased gradually as tenants in the 11 affected PRH developments have been able to gain access to safe drinking water following the installation of water filters and temporary water points (see paragraph 7(c) and (d) below). HA will keep in view the usage of the standpipes and consider withdrawing them at an appropriate time, having regard to actual circumstances on the ground, tenants' sentiments and progress of rectification works, etc.
- (b) Bottled water: HA ceased the distribution of bottled water to the 11 affected PRH developments on 28 December 2015. HA had distributed a total of 9.96 million bottles of bottled water, involving a total cost of around \$60 million.
- (c) Water filters: Filter installation was completed in all 11 affected PRH developments by October 2015, save for a small number of households who refused the installation of filters and those with whom we have had difficulty in getting in touch. To ease tenants' concerns about the effectiveness of the water filters, water tests were conducted again for the units in the 11 affected PRH developments in which samples with excess lead content had been found and filters were subsequently installed by the contractors. HA announced on 2 November 2015 that such water tests had been completed, and all test results complied with WHO's PGV. Since the water filters have been used for some time, the four contractors have been cleaning the filter cartridges or replacing them for

tenants⁸ in accordance with the manufacturer's instructions for the brand of the filter.

HA and the contractors concerned have received feedback from some tenants on the use of filters, such as the outflow water capacity. HA has explained to tenants that they should follow the manufacturer's instructions on the use of the filter to ensure its function and performance, and quality of the filtered water (e.g. hot water should not be filtered, filtered water should be used for drinking or cooking only, etc.). The contractors/ manufacturers have set up a hotline for enquiries and may pay a visit to individual households where necessary.

- (d) Temporary water points on each floor: The temporary water points in all 11 affected PRH developments were put into use by 9 December 2015. In response to some tenants' queries about the milky appearance of water from the temporary water points on certain floors, HA has explained that this was attributed to air bubbles in the system; the water would become clear again after running the tap or letting the water stand in a container for a while for the bubbles to escape; this phenomenon does not affect the quality of the drinking water. As with the standpipes, HA will keep in view the usage of the temporary water points and consider withdrawing them at an appropriate time, having regard to actual circumstances on the ground, tenants' sentiments and progress of rectification works, etc.

⁸ For the households with filters installed in Wing Cheong Estate and Tung Wui Estate, Paul Y. General Contractors Limited cleans the filter cartridges about once every three months, and replaces the filters once within 12 months' time. Paul Y. has cleaned the filter cartridges for these households three times already, and the most recent round of cleaning has been substantially completed. It will replace the filter cartridges for these households in September 2016. The remaining three contractors replace the filter cartridges for the households in their affected PRH developments about once every six months. Since filters were installed in the affected PRH developments at different times, the timing for replacement of the filter cartridges varies from one estate to another. To date, replacement of filter cartridges in the households of affected PRH estates by these three contractors has been substantially completed.

8. In order to rectify the problem of excess lead in water, HA has requested the four contractors concerned **to replace the non-compliant pipes in the 11 affected PRH developments**. The four contractors concerned have started rectification works in the common areas of the 11 affected PRH developments on 14 March 2016. The contractors will replace the non-compliant water pipes in the common areas first, while those inside domestic units will only be replaced at the next stage. After works in the common areas are completed, HA will announce the arrangements for rectification works inside flats. As works will be carried out inside flats by then, the various problems that may possibly be encountered must be carefully considered to minimise any inconvenience caused to tenants. HA will also enhance communication with tenants and maintain close communication with the contractors to closely monitor and follow up the progress of works in order to ensure that the rectification works can be completed as soon as possible.

Actions against contractors

9. As for taking actions against contractors, since the excess lead in water incident, HA has all along been taking actions against the contractors for their liabilities under the contracts. Apart from installing temporary water points on each floor and filters, as well as replacing the non-compliant pipes as mentioned above, the contractors have also taken the following measures:

- (a) providing each household in the 11 affected PRH developments with a subsidy of \$660 for paying water and sewage charges within three years starting from 1 January 2016; and
- (b) providing HA with a performance bond of \$5,000 per flat. In the event that the contractors are in default of performing any of the relief measures, HA can seek recovery from the guarantor. All four contractors concerned have now provided a performance bond undertaking to HA, in respect of each of the affected PRH developments.

10. In addition, HA's Tender Committee took regulatory actions against the four contractors concerned last year based on information available at the time (see Annex C). HA is now analysing the relevant parts relating to the contractors in the Commission's report. It will collate and submit the

information to HA's Tender Committee for discussion and consideration of whether any further follow-up action needs to be taken.

Blood lead testing

11. As at 29 June 2016, the Hospital Authority conducted blood lead level tests for a total of 5 654 persons. Among them, only 165 persons (including 129 children, 28 lactating women, five pregnant women and three adults) were found to have borderline raised blood lead levels, ranging from 5 to 16.7 micrograms per decilitre, which indicates potential health risk but is far below the risk of poisoning. According to the established measures for persons whose blood lead levels were above the reference values, the Hospital Authority has arranged blood lead level reviews for 156 persons among the 165 persons above. The blood lead levels of 137 persons have returned to normal. As for the 19 persons who still have borderline raised blood lead levels (including 15 children, three lactating women and one adult), the Government will continue to follow up their situations. As for the nine persons who have defaulted or refused the blood lead level review, the Department of Health (DH) and the Hospital Authority will contact these persons through various means to confirm their decisions according to the established mechanism.

12. In addition, health evaluation and follow-up have been arranged for persons with borderline raised blood lead levels who are children aged 12 or above, adults, pregnant women and lactating women. As for children aged below 12 with borderline raised blood lead levels, DH has conducted preliminary developmental assessment for 126 children of them. Among them, 83 children show no signs of developmental problem; 33 children require re-assessment; ten children show signs of developmental delay. Subsequently, 29 of the 33 children requiring reassessment have been followed up by DH. Among them, six are assessed to be normal, 22 show features of mild developmental problem and one with developmental delay. Moreover, DH has arranged reassessment for the remaining four children. Children with mild developmental problem or developmental delay have been referred for appropriate rehabilitation services such as training, special educational support and clinical service, etc. Children showing no signs of developmental problem at this stage have already been referred to the Maternal and Child Health Centre or Student Health Service for enhanced developmental surveillance.

Schools

13. The Government attaches great importance to the safety of drinking water at schools as well as kindergartens. We have completed in November 2015 the water sampling tests for public sector and Direct Subsidy Scheme schools built with Government funding and completed in or after 2005 (the post-2005 schools) and all kindergartens. A total of 2 223 drinking water samples were taken. Except for seven samples taken from the insider service and water dispensers of a secondary school, two samples from wall-mounted dispensers from two secondary schools, and 10 samples from wall-mounted dispensers from eight kindergartens, all other samples were found to comply with WHO's PGV.

14. For the aforementioned secondary school with excess lead found in seven drinking water samples (including five samples taken from the inside service and two samples from water dispensers), the Education Bureau (EDB) has immediately installed filters certified for lead reduction for the school. As the school was built by the developer and the grantee as the works agent of the government accommodation, EDB has been liaising with the responsible works agent, architectural consultant of the school building project, contractor and the school on the proposed arrangements for replacing the potable water pipeworks. The works has commenced and is expected to be completed by September. As for the excess lead found in drinking water samples taken from the water dispensers of this secondary school, its inside service was found to be the source of excess lead after investigation. The situation will therefore be mitigated after the pipeworks are replaced. The school has also stopped using the water dispensers in question. The abovementioned eight kindergartens and two secondary schools have also immediately stopped using their wall-mounted dispensers.

15. To ensure the quality and safety of drinking water at schools, EDB has installed certified filters which can reduce lead content in water for the post-2005 schools, and assisted kindergartens and schools to order filters and cartridges through the filter suppliers appointed by the Government under open tender at the agreed prices within the tender contract period (i.e. until 11 November 2016).

16. Furthermore, to enhance the understanding over safety of drinking water and on how to reduce lead exposure, EDB has issued letters to all schools on the health advice for reducing lead exposure provided by the Centre for Health Protection of DH for schools, organised talks on “Reducing Lead Exposure and Drinking Water Safety” in collaboration with DH and WSD, and distributed to all schools and kindergartens a booklet on “Hong Kong’s Water Supply – Reducing Lead in Drinking Water” and a leaflet on “Tips for Using Wall-mounted Dispensers” compiled by WSD. EDB will maintain close liaison with schools and provide necessary support.

Welfare facilities

17. With the assistance of WSD, the Social Welfare Department (SWD) arranged water sampling tests for welfare units serving children aged below six who had to stay in the units for long hours and consume drinking water in the units. The concerned 205 welfare units include day and residential child care centres, day child care services, children’s homes, small group homes, pregnant girls’ hostel and day and residential special child care centres. All of the 400 drinking water samples collected had been found to comply with WHO’s PGV.

18. In September 2015, SWD provided water filters for lead reduction for 13 welfare units located in Government premises completed in 2005 or after and serving children aged below six who have to stay in the units for long hours and consume drinking water in the units. SWD also assisted, with the coordination of the Government Logistics Department, about 200 other subvented welfare units (including child care centres, residential care units and day care units) in purchasing water filters for lead reduction through bulk purchase directly from suppliers.

19. To enhance the welfare sector’s understanding of the ways to reduce lead exposure and maintain safety of drinking water, SWD disseminated health advice about reducing lead exposure from the Centre for Health Protection of DH and the advice on the installation and use of wall-mounted dispensers provided by WSD on 28 August and 30 September 2015 respectively to different welfare units serving service users who had to stay in the units for long hours and consume drinking water in the units, including residential care homes for the children, the elderly and the disabled. SWD also

disseminated the “Tips for Using Wall-mounted Dispensers” published by WSD to the welfare units concerned on 8 December 2015. These advices and tips were uploaded to SWD’s website. SWD has also provided enquiry hotline for the welfare units concerned to seek advice and information.

Hospitals

20. According to the risk assessment criteria, the Hospital Authority had tested the lead level in water at wards with paediatric patients aged under six in 12 specific public hospitals from September to December 2015. Out of a total of 135 samples assessed, only one sample from a hot water dispenser in Alice Ho Miu Ling Nethersole Hospital was found to have lead level exceeding WHO’s PGV. The Hospital Authority had immediately replaced the concerned hot water dispenser with one that was with international certification. In line with the recommendations of WSD, the Hospital Authority has replaced in phases wall-mounted hot water dispensers without international certification with certified ones in all Hospital Authority premises. Replacement of 710 hot water dispensers has been completed by February 2016. The last phase of installation for around 700 hot water dispensers will be completed by early July 2016.

Investigation and Review

21. In respect of the situation that excess lead was found in drinking water, the Chief Executive in Council appointed the Commission of Inquiry into Excess Lead Found in Drinking Water (the Commission) (see Annex D for its terms of reference) on 13 August 2015. The Commission submitted its report to the Chief Executive on 11 May 2016. The Government published a redacted version⁹ of the Commission’s report on 31 May 2016. As regards the Task Force led by WSD and HA’s Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates, they released the investigation and review findings on 31 October 2015 and 8 January 2016 respectively. The latest progress of the investigation and review is as follows.

⁹ With a view to avoiding any prejudice (actual or perceived) to the relevant criminal investigations and criminal prosecutions (if so decided to be justified after the relevant investigations), a very minimal part of the report have been redacted.

Task Force led by WSD (Task Force)

22. The Government set up a Task Force led by WSD on 15 July 2015 to carry out investigation in relation to incidents of lead in drinking water in PRH estates to ascertain the causes and recommend measures to prevent recurrence of similar incidents in future. The Task Force submitted its final investigation report on 31 October 2015 to the Secretary for Development. It concluded that excess lead in drinking water was caused by use of leaded solder materials in the solder joints. The Task Force also recommended a number of improvement measures. The Commission in its report also concurred that the use of leaded solder materials was the direct cause for excess lead in drinking water in the 11 affected PRH estates.

23. WSD has been implementing improvement measures since mid-July 2015 to address the related problems, including the issue of circulars to all licensed plumbers and authorised persons requiring test for four heavy metals including lead in the testing of water samples for newly installed inside services, non-destructive tests on solder joint for any presence of lead. WSD has also commenced the review of Waterworks Ordinance and Waterworks Regulations to further enhance the regulatory control on construction of inside services to ensure the safety of drinking water. Moreover, WSD is actively following up the remaining recommendations of the Task Force, including drafting of a Code of Practice for the plumbing industry with recommendations of using qualified personnel for site supervision and conducting random sample test for material delivered to site, to enhance the quality control of material.

HA's Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates (Review Committee)

24. HA's Review Committee recommended the following measures in its Report on Interim Findings and its Final Report, which were published on 6 October 2015 and 8 January 2016 respectively:

- (a) to require the main contractors to test water samples for lead and other heavy metals for newly established inside service in accordance with the Water Authority's latest requirements;

- (b) to require the main contractors to submit and comply with a management plan covering stringent plumbing subcontractor supervision and on-site monitoring, central procurement of solder materials by themselves or by the plumbing subcontractors, material submission, purchasing, delivery, storage, use of materials and on-site monitoring, and supervision of licensed plumbers;
- (c) to use quick test methods to check for the presence of lead in soldering joints;
- (d) to include soldering alloys, copper pipes and fittings etc. in the list of on-site delivery verification items; and to include soldering joints in the list of plumbing items that require checking by the site inspection staff; and
- (e) to train site inspection staff to inspect whether the main contractors have duly conducted their supervisory checks or not, and conduct audit check of the soldering joint materials.

HA has already fully implemented all of the above measures. The implementation progress of these measures is set out at Annex E.

25. In addition, the Review Committee also recommended training institutions to enhance their training programmes for licensed plumbers and workers in the plumbing trade. In this connection, prohibition of use of leaded solder in fresh water plumbing systems has already been included in the training institutions' training programmes. These training institutions i.e. the Vocational Training Council (VTC) for licensed plumbers and the Construction Industry Council (CIC) for plumbing workers have also been approached for necessary enhancement in light of the excess lead in water incident. Amongst others, VTC has highlighted the importance of materials purchasing and control to the licensed plumber trainees whilst CIC has included in the training programme for plumbing workers the latest requirements for control of the construction of inside services provided in WSD's circular letters.

Commission of Inquiry into Excess Lead Found in Drinking Water

26. The Commission conducted 67 days of substantive hearings between 2 November 2015 and 17 March 2016 and received evidence from 72 witnesses. The conclusion and recommendations contained in the Commission's report are at Annex F.

27. All relevant bureaux and departments are following up the recommendations of the Commission. Major follow-up actions are set out below.

Development Bureau (DEVB) and WSD

28. DEVB is establishing a special duties unit led by a directorate Administrative Officer to ensure that earnest and prompt efforts are made by WSD to implement the relevant recommendations of the Commission. Moreover, DEVB set up a five-member international expert panel on 1 June. In addition to two local experts, it comprises three international experts on water safety from the United Kingdom, Australia and Canada. The panel will provide objective, scientific and professional advice to DEVB and WSD in regard to the findings and recommendations of their study on water safety, so that practical follow-up actions will be taken on the various recommendations of the Commission. The terms of reference and members of the international expert panel are at Annex G.

29. In March this year, DEVB established an inter-bureau and departmental working group, including representatives from the Food and Health Bureau, the Environment Bureau, the Transport and Housing Bureau, the Commerce and Economic Development Bureau, DH and WSD, to identify a suitable regulatory regime for the safety of drinking water in Hong Kong. The working group will also consider all the relevant recommendations made by the Commission, including the delineation of the roles and responsibilities of the Water Authority and WSD, and the safeguarding of the safety and quality of drinking water from the water distribution system to consumer taps.

30. Moreover, WSD has commenced the follow-up work, including the engagement of expert consultants to conduct study on the establishment of drinking water standards in Hong Kong, implementing water safety plan and

developing water sampling protocols. The international expert panel will be consulted on the study results. Among others, the expert consultants will review the WHO's "Guidelines for Drinking-Water Quality" and the drinking water quality standard in overseas countries and their experience in establishing drinking water standard and practices, so as to assist in developing the drinking water standards in Hong Kong. In addition, apart from reviewing WSD's Water Safety Plan with a view to further optimising the existing plan, the expert consultants will assist WSD to formulate suitable guidelines and Code of Practice for developing Water Safety Plans of specific developments for the reference of relevant parties (e.g. developers), and make use of selected venues of Government (such as schools) and HA development for pilot study.

31. As to the formulation of water sampling protocols for the investigation of lead contamination in the inside service, expert consultants have commenced the study, including review of relevant sampling protocols in overseas countries. In addition to formulation of water sampling protocols, WSD will consider all the issues relating to "action level", "compliance rate" and follow-up actions in a holistic manner and consult the views of the international expert panel so as to formulate a proposal suitable for the actual situation in Hong Kong. Based on the views of the international expert panel, WSD will follow up as appropriate, including the recommendation of the Commission that the Government should undertake to test the drinking water of all PRH estates again. DEVB and WSD will strive to put forward a proposal suitable for the actual situation in Hong Kong in six to nine months.

32. On the other hand, the review of legislative amendment has commenced to examine the roles and responsibilities of all parties taking part in the design and construction of the inside service, and the relevant licensing system, etc. Specific amendments will be prioritised and carried out in phases, some of which (including the clearer definition of the duties of licensed plumbers and plumbing workers under the Waterworks Ordinance, and the revision of the current arrangements so as to set out more clearly the latest standards of plumbing materials and components applicable to the construction of the inside service) will be tabled in the Legislative Council for deliberation in the next legislative session. In the interim, WSD will take administrative measures to enhance the current system, such as publishing a code of practice for the industry, and launching a continuing education programme for licensed plumbers etc.

33. The latest situation of follow-up actions in respect of the Commission's recommendations is at Annex H.

Housing Authority

34. As for HA, after the Commission's report was published, HA immediately convened an informal meeting within the same week (3 June) to hear Members' views on Commission's report and discuss follow-up actions. HA's follow-up actions in relation to the Commission's report can be broadly categorised into three areas:

- (a) Enhancing HA's quality assurance mechanism: The Commission supports the enhancement measures put forward by the earlier established Review Committee. As mentioned above, HA has already fully implemented these measures to strengthen monitoring of contractors and subcontractors as well as the control and checking of materials (including soldering materials). The measures cover various aspects including contract specifications, delivery and verification of materials, monitoring during construction and testing upon completion.

As for enhancing HA's quality assurance mechanism, HA will review the monitoring system from time to time to ensure the quality and safety of construction as well as its effectiveness, in order to ensure that the above measures are implemented in practice. In addition, HA is considering strengthening its risk assessment and management for building materials by examining and conducting risks assessments for the materials and parts used in construction projects, and to develop suitable management and control measures, covering building contract and construction aspects, in accordance with the different risk levels.

- (b) Enhancing staff's awareness and knowledge of risks: Since the excess lead in water incident, HA has been taking steps to enhance the relevant awareness and knowledge of staff concerned. The Secretary for Transport and Housing cum HA Chairman has issued a letter to the staff of Housing Department (HD) to encourage them

to learn from the incident and to develop a culture within the department that emphasises safety and quality control with constant alertness to risks; and

- (c) Follow up work in conjunction with WSD: Some of the recommendations in the Commission's report involve HA's participation in WSD's work. HA will actively contribute to the Water Authority's work, including those relating to specifications, identification of hazards and contamination, and a Water Safety Plan; and ensure full compliance with the Water Authority's requirements. As for the issue of testing the drinking water of all PRH estates again, subject to the recommendations of the international expert panel established by DEVB, HA would fully cooperate with the Government in this aspect.

HA will follow up the above work at its committees in a timely manner, have further deliberations as necessary and oversee the implementation of the measures by HD.

Chief Secretary for Administration's Office
July 2016

Annex A

**Systematic water sampling test results for PRH developments
completed in and after 2005**

(a) Water samples with excess lead

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken	No. of samples with excess lead
1	Kwai Luen Estate Phase 2 (Luen Yat House, Luen Yuet House)	2014	1 507	Shui On Building Contractors Limited	44	5
2	Kai Ching Estate	2013	5 204	China State Construction Engineering (Hong Kong) Limited	121	7
3	Wing Cheong Estate	2013	1 488	Paul Y. General Contractors Limited	46	1
4	Lower Ngau Tau Kok Estate Phase 1 (Kwai Leung House, Kwai Yuet House, Kwai Hin House, Kwai Sun House, Kwai Fai House)	2012	4 238	Yau Lee Construction Company Limited	131	6
5	Shek Kip Mei Estate Phase 2 (Mei Wui House, Mei Leong House)	2012	1 558	Yau Lee Construction Company Limited	59	5
6	Tung Wui Estate (Wui Sum House, Wui Yan House)	2012	1 333	Paul Y. General Contractors Limited	52	4
7	Hung Hom Estate Phase 2 (Hung Yat House, Hung Yan House, Hung Yiu House)	2011	1 938	China State Construction Engineering (Hong Kong) Limited	74	16

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken	No. of samples with excess lead
8	Yan On Estate (Yan Hei House, Yan Yuet House, Yan Chung House)	2011	2 587	Yau Lee Construction Company Limited	74	5
9	Choi Fook Estate (Choi Lok House, Choi Sin House, Choi Hay House)	2010	2 524	Yau Lee Construction Company Limited	92	13
10	Un Chau Estate Phase 2 and 4 (Un Lok House, Un Nga House, Un Chi House, Un Hei House, Un Kin House)	2008	3 533	Yau Lee Construction Company Limited	135	19
11	Ching Ho Estate Phase 1 (Ching Chung House, Ching Yu House, Ching Hin House)	2008	3 167	Yau Lee Construction Company Limited	145	10

(b) Water samples that comply with WHO's PGV

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
1	Cheung Lung Wai Estate, Cheung Lung Lane and Cheung Lung Wai Estate Ancillary Facilities Block	2015	1 358	Yau Lee Construction Company Limited	49
2	Hung Fuk Estate Phase 1 and 2 (Hung Foon House, Hung Yan House, Hung Hei House, Hung Lok House, Hung Fuk Shopping Centre and Ancillary Facilities Block)	2015	2 097	Hsin Chong Construction Company Limited	163
3	Hung Fuk Estate Phase 3 (Hung Long House, Hung Yat House, Hung Yuet House, Hung Cheong House, Hung Shing House)	2015	2 808	Yau Lee Construction Company Limited	
4	Shui Chuen O Estate Phase 1 (Ching Chuen House, Long Chuen House, Yan Chuen House, Hei Chuen House) (Note)	2015	3 039	China State Construction Engineering (Hong Kong) Limited	59
5	Mei Tung Estate (Mei Tak House)	2014	990	Able Engineering Company Limited	26
6	Yee Ming Estate	2014	2 059	Hanison Construction Company Limited	108
7	Tak Long Estate, carpark block and kindergarten	2014	8 164	Yau Lee - Hsin Chong Joint Venture	208

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
8	Fung Wo Estate	2013	1 607	Hsin Chong Construction Company Limited	54
9	Cheung Sha Wan Estate and Cheung Sha Wan Estate Ancillary Facilities Block	2013	1 390	China State Construction Engineering (Hong Kong) Limited	51
10	Lung Yat Estate and Lung Yat Community Hall	2013	990	Shui On Building Contractors Limited	39
11	Mei Tin Estate (Mei Chuen House) and free standing block	2013	1 216	Hsin Chong Construction Company Limited	36
12	Shek Lei (II) Estate (Shek Foon House)	2013	839	Hip Hing Construction Company Limited	26
13	Ching Long Shopping Mall	2013	-	Zone A: China State Construction Engineering (Hong Kong) Limited Zone B: Yau Lee - Hsin Chong Joint Venture	20
14	Shek Kip Mei Estate Phase 5 (Mei Yick House, Mei Yin House, Mei Sang House, Mei Shing House)	2012	2 496	Shui On Building Contractors Limited	75
15	Un Chau Estate Phase 5 (Un Mun House, Un Wai House, Un Yat House) and Un Him House (i.e. Ancillary Facilities Block)	2012	1 486	China State Construction Engineering (Hong Kong) Limited	55

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
16	Domain and Yau Tong Community Hall	2012	-	China State Construction Engineering (Hong Kong) Limited	8
17	Choi Fook Estate (Choi Foon House)	2011	915	Hsin Chong Construction Company Limited	27
18	Choi Tak Estate (Choi Yan House, Choi Yee House)	2011	1 586	Hsin Chong Construction Company Limited	41
19	Kwai Luen Estate Phase 1 (Luen Yan House, Luen Hei House)	2011	1 470	Shui On Building Contractors Limited	43
20	Mei Tung Estate (Mei Yan House)	2010	799	China State Construction Engineering (Hong Kong) Limited	31
21	Choi Tak Estate (Choi Chun House, Choi King House, Choi Leung House, Choi Yin House) and Choi Tak Shopping Centre	2011	2,704	China State Construction Engineering (Hong Kong) Limited	83
22	Shatin Pass Estate (Wo Tin House, Shun Tin House)	2011	1 278	Chevalier (Construction) Company Limited	53
23	Yau Lai Estate Phase 5 (Cheuk Lai House, Yung Lai House) and carpark block	2011	2 002	Shui On Building Contractors Limited	39
24	Yau Lai Estate Phase 6 (i.e. Yau Lai Shopping Centre)	2011	-	Shui On Building Contractors Limited	4
25	Shin Ming Estate (Shin Chi House, Shin Lai House)	2011	1 974	Shui On Building Contractors Limited	50
26	Tin Ching Estate Tin Ching Amenity and Community Building	2011	-	Paul Y. General Contractors Limited	24

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
27	Chai Wan Estate (Wan Poon House, Wan Ying House)	2010	1 600	Nishimatsu Construction Co., Limited	46
28	Choi Tak Estate (Choi Shing House, Choi Shun House)	2010	1 462	Hanison Construction Company Limited	69
29	Upper Ngau Tau Kok Estate Phase 2 and 3 (Sheung Hing House, Sheung Shing House, Sheung Fu House, Sheung Wing House, Sheung Hong House, Sheung Tai House), Upper Ngau Tau Kok Shopping Centre and Integrated Service Centre	2009	4 584	Paul Y. General Contractors Limited	124
30	Tin Ching Estate Phase 3 (Ching Moon House, Ching Hei House, Ching Yuet House)	2009	2 365	Paul Y. General Contractors Limited	65
31	Shek Kip Mei Estate Phase 1 (Mei Yue House, Mei Ying House)	2006	2 033	Paul Y. General Contractors Limited	55
32	Sau Mau Ping (South) Estate (Sau Ho House, Sau Wong House)	2009	1 598	Chatwin Engineering Limited	130
33	Sau Mau Ping (South) Estate (Sau Mei House, Sau Tak House, Sau Sin House)	2009	2 397	Hanison Construction Company Limited	
34	Upper Wong Tai Sin Estate (Wing Sin House)	2009	714	Chun Wo Construction and Engineering Company Limited	22
35	Yau Lai Estate Phase 4 (Tsui Lai House, Hong Lai House, Yan Lai House)	2009	2 369	Shui On Building Contractors Limited	121
36	Yau Lai Estate Phase 3 (Ying Lai House, Fung Lai House)	2008	1 598	China State Construction Engineering (Hong Kong) Limited	

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
37	Shek Mun Estate Phase 1 (Kin Shek House, Mei Shek House) and supermarket	2009	1 958	Paul Y. General Contractors Limited	45
38	Lam Tin Estate (Lam Fai House, Lam Tai House, Lam Bik House, Lam Wai House)	2009	3 036	Shui On Building Contractors Limited	102
39	Mei Tin Estate Phase 3 (Mei Lok House, Mei Mun House, Mei Ting House) and Mei Tin Community Hall	2008	2 333	Hanison Construction Company Limited	71
40	Tin Ching Estate Phase 1 (Ching Pik House, Ching Hoi House) and Tin Ching Community Hall	2008	1 918	China State Construction Engineering (Hong Kong) Limited	98
41	Tin Ching Estate Phase 2 (Ching Choi House, Ching Wan House), Tin Ching Shopping Centre and Tin Ching Ancillary Facilities Block	2008	1 918	Nishimatsu Construction Co., Limited	
42	Choi Ying Estate Phase 1 (Ying Fu House, Ying On House)	2008	1 598	China State Construction Engineering (Hong Kong) Limited	137
43	Choi Ying Estate Phase 2 (Ying Hong House, Ying Lok House, Ying Shun House)	2008	2 397	China State Construction Engineering (Hong Kong) Limited	
44	Choi Ying Estate Phase 3 (i.e. Choi Ying Place)	2008	-	Shui On Building Contractors Limited	
45	Ching Ho Estate Phase 1 Ching Ho Shopping Centre	2008	-	Yau Lee Construction Company Limited	3

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
46	Ching Ho Estate Phase 2 (Ching Ping House, Ching Yun House)	2008	1 598	China State Construction Engineering (Hong Kong) Limited	54
47	Tung Wui Estate Tung Tau Community Centre	2012	-	Paul Y. General Contractors Limited	1
48	Shek Kip Mei Estate Phase 2 Ancillary Facilities Block	2012	-	Yau Lee Construction Company Limited	6
49	Lower Ngau Tau Kok Estate Phase 1 Lower Ngau Tau Kok Estate Plaza	2012	-	Yau Lee Construction Company Limited	3
50	Yan On Estate Yan On Shopping Centre	2011	-	Yau Lee Construction Company Limited	2
51	Oi Tung Estate (Oi Yat House)	2008	716	Nishimatsu Construction Co., Limited	23
52	Shek Pai Wan Estate Phase 2 (Pik Shan House, Pik Yuen House, Pik Wai House, Pik Luk House)	2007	2 398	Hanison Construction Company Limited	95
53	Lei Yue Mun Estate Phase 2 (Lei Lung House)	2007	799	Paul Y. General Contractors Limited	27
54	Shek Lei (II) Estate (Shek Wai House, Shek Yi House)	2007	1 598	Nishimatsu Construction Co., Limited	48
55	Ching Ho Estate Phase 3 (Ching Chak House, Ching Long House, Ching Chiu House)	2006	2 397	Shui On Building Contractors Limited	81

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
56	Kwai Chung Estate (Pak Kwai House, Hop Kwai House)	2008	1 983	Yau Lee Construction Company Limited	81
57	Mei Tin Estate Phase 1 and 2 (Mei Sau House, Mei Lai House, Mei King House, Mei Chi House) and Mei Tin Shopping Centre	2005	3 164	Nishimatsu Construction Co., Limited	95
58	Hoi Lai Estate Phase 3 (i.e. Hoi Lai Shopping Centre) and Phase 4 (Hoi Shui House)	2005	558	China State Construction Engineering (Hong Kong) Limited	29
59	Kwai Chung Estate Phase 3 (Chui Kwai House, Pik Kwai House, Luk Kwai House)	2005	2 742	Yau Lee Construction Company Limited	84
60	Hin Yiu Estate (Hin Yiu House)	2005	799	Shui On Building Contractors Limited	26
61	Shek Yam Estate Phase 5 (Lai Shek House)	2005	340	Hanison Construction Company Limited	9
62	Kwai Shing (East) Estate (Shing Wo House)	2003	362	Hsin Chong Construction Company Limited	59
63	Tsz Lok Estate (Lok Foon House)	2003	265	China State Construction Engineering (Hong Kong) Limited	23
64	Lok Fu Estate (Lok Tsui House)	1994	360	Hung Wan Construction Co Ltd	16
65	Yat Tung (II) Estate (Mei Yat House, Mun Yat House, Kui Yat House)	2005	2 782	Yau Lee Construction Company Limited	108

	Name of PRH development	Year of completion	No. of units	Main contractor	No. of samples taken
66	Lei Muk Shue Estate Phase 3 (Chui Shue House, Wing Shue House) and Lei Muk Shue Shopping Centre	2005	1 983	Hip Hing Construction Company Limited	66
67	Lei Muk Shue Estate Phase 4 (Hong Shue House, Lok Shue House, Kin Shue House)	2005	1 918	China State Construction Engineering (Hong Kong) Limited	54
68	Yau Lai Estate Phase 1 (Bik Lai House, Sau Lai House, Yi Lai House, Nga Lai House, Chi Lai House, Yat Lai House)	2005	2 550	Leighton Contractors (Asia) Limited	78
69	Shek Pai Wan Estate Phase 1 (Pik Long House, Pik Yuet House, Pik Ngan House, Pik Fai House) and Shek Pai Wan Shopping Centre	2005	2 877	Shui On Building Contractors Limited	92
70	Kwai Chung Estate Phase 3 Kwai Chung Shopping Centre	2005	-	Yau Lee Construction Company Limited	6
71	Kwai Chung Estate Phase 4 (Chin Kwai House, Tsz Kwai House)	2005	1 983	China State Construction Engineering (Hong Kong) Limited	70
72	Kwai Chung Estate Phase 5 (Hui Kwai House, Ying Kwai House, Yuk Kwai House, Nga Kwai House, Yat Kwai House)	2005	4 515	Hip Hing Construction Company Limited	152

(Note) One sample taken from a vacant unit at Hei Chuen House of Shui Chuen O Estate was found to have a lead level of 14 micrograms per litre, which slightly exceeded WHO's PGV. The water samples taken from the rest of the three domestic blocks did not exceed the value. WSD took more water samples from Hei Chuen House for testing to ascertain the situation. After analysis, it was concluded that the water sample which exceeded the value might have been affected by the environment.

Annex B

Screening test results for PRH estates completed before 2005

(144 PRH estates involving 2 635 water samples)

Water samples that comply with WHO's PGV

Tsui Ping (South) Estate	Lee On Estate	Butterfly Estate	Choi Fai Estate	Sai Wan Estate	Choi Yuen Estate	Tin Yan Estate	Tsz Lok Estate	Oi Tung Estate
Kwai Shing (East) Estate	Kin Ming Estate	Tin Yuet Estate	Po Tat Estate	Lei Yue Mun Estate	Tin Heng Estate	Tin Chak Estate	Sau Mau Ping Estate	Fu Tai Estate
Wang Tau Hom Estate	Ap Lei Chau Estate	Lei Muk Shue (I) Estate	Chun Shek Estate	Pak Tin Estate	Ka Fuk Estate	On Yam Estate	Sheung Tak Estate	Cheung Hang Estate
Yiu Tung Estate	Tsz Man Estate	Wah Sum Estate	Shek Lei (I) Estate	Tin Wan Estate	Ko Yee Estate	Wan Hon Estate	Sheung Lok Estate	Tsz Ching Estate
Kwai Fong Estate	Chung On Estate	Ho Man Tin Estate	Ko Cheung Court (the PRH portion)	Upper Wong Tai Sin Estate	Tin Shui (II) Estate	Tai Wo Hau Estate	Cheung Hong Estate	Hau Tak Estate
Shun Tin Estate	Wan Tsui Estate	Sun Chui Estate	Mei Lam Estate	Kwong Fuk Estate	Shek Kip Mei Estate	Lung Hang Estate	Lei Muk Shue (II) Estate	Hing Wah (I) Estate
Shek Wai Kok Estate	Oi Man Estate	Yau Oi Estate	Lai Kok Estate	Sam Shing Estate	Kwai Shing West Estate	Lek Yuen Estate	Lai King Estate	Kai Yip Estate
Un Chau Estate	Siu Sai Wan Estate	Hing Man Estate	Chuk Yuen (South) Estate	Cheung Ching Estate	Sha Kok Estate	Tai Yuen Estate	Choi Wan (I) Estate	Cheung Wang Estate

Shui Pin Wai Estate	Ping Shek Estate	Ma Tau Wai Estate	Shek Lei (II) Estate	Tsz Hong Estate	Wah Lai Estate	Kwai Chung Estate	Ping Tin Estate	Lok Fu Estate
Shek Yam East Estate	Wah Fu (II) Estate	Fu Shan Estate	Lai Yiu Estate	Tin Tsz Estate	Hing Tung Estate	Tin Shui (I) Estate	Wu King Estate	Tin Yiu (I) Estate
Tin Yiu (II) Estate	Wah Fu (I) Estate	Mei Tung Estate	Yat Tung (I) Estate	On Ting Estate	Tai Hing Estate	Wo Che Estate	Shun On Estate	Choi Hung Estate
Lung Tin Estate	On Tin Estate	Yau Tong Estate	Cheung Shan Estate	Fuk Loi Estate	Hoi Lai Estate	Tai Hang Tung Estate	Lower Wong Tai Sin (II) Estate	Ma Hang Estate
Shek Yam Estate	Tin Wah Estate	Upper Ngau Tau Kok Estate	Lok Wah (North) Estate	Yat Tung (II) Estate	Fu Cheong Estate	Tin Yat Estate	High Prosperity Terrace	Easeful Court
Shek Lei Interim Housing	Hong Tung Estate	Fu Tung Estate	Ming Tak Estate	Shun Lee Estate	Grandeur Terrace	Po Tin Estate	Kam Peng Estate	Ngan Wan Estate
Lok Wah (South) Estate	Yue Wan Estate	Nga Ning Court	Tsui Lok Estate	Kai Tin Estate	Lai On Estate	Kwong Tin Estate	Cheung Kwai Estate	Chak On Estate
Sun Tin Wai Estate	Wo Lok Estate	Hung Hom Estate	Choi Wan (II) Estate	Fortune Estate	Nam Shan Estate	Model Housing Estate	Hing Wah (II) Estate	Long Bin Interim Housing

Regulatory Actions Taken Against the Contractors Concerned

HA's Tender Committee announced on 30 September and 6 November 2015 to take regulatory actions against the contractors at list management level. Details are as follows –

- (a) The total length of period during which the four contractors concerned (and two related companies) would not be considered for new works tenders invited by HA starting from 1 March 2015, are set out below respectively –
 - (i) Shui On Building Contractors Limited: 8 months (involving 8 tender opportunities);
 - (ii) China State Construction Engineering (Hong Kong) Limited (and related company China Overseas Building Construction Limited) and Paul Y. General Contractors Limited (and related company Paul Y. Construction Company Limited): 10 months (involving 11 tender opportunities); and
 - (iii) Yau Lee Construction Company Limited: 12 months (involving 12 tender opportunities).
- (b) China State Construction Engineering (Hong Kong) Limited, Shui On Building Contractors Limited and Yau Lee Construction Company Limited were removed from HA's Premier League of contractors with effect from 1 October 2015.

**The Commission of Inquiry into Excess Lead
Found in Drinking Water**

Terms of Reference

- (a) ascertain the causes of excess lead found in drinking water in public rental housing developments;
- (b) review and evaluate the adequacy of the present regulatory and monitoring system in respect of drinking water in Hong Kong; and
- (c) make recommendations with regard to the safety of drinking water in Hong Kong.

**Implementation of the Recommendations of the Housing Authority’s
“Review Committee on Quality Assurance Issues Relating to
Fresh Water Supply of Public Housing Estates”**

Review Committee’s Recommendations	Latest Progress
<u>Monitoring of contractors and subcontractors</u>	
<p>(1) The Housing Authority (HA) should contractually require the main contractors to submit and comply with a management plan covering stringent plumbing subcontractors supervision and on-site monitoring. This plan should include measures such as central procurement of soldering materials by the main contractors or domestic sub-contractors, checking soldering materials upon delivery to site and putting them under quarantine before releasing them for use by workers, recording the works completed by individual workers so that they become more traceable etc. HA should also require the main contractors to ensure that workers receive sufficient training on soldering joint requirements before work starts, and to require the Licensed Plumber (LP) to supervise plumbing installation works, submit regular reports</p>	<ul style="list-style-type: none"> • HA has enhanced building contract specifications to require the main contractors to submit and implement a management plan covering stringent plumbing subcontractors and LP supervision and on-site monitoring. The measures already implemented cover approval, procurement, delivery, storage and use of materials, including - <ul style="list-style-type: none"> - Central procurement of soldering materials by the main contractors or domestic sub-contractors - Only soldering materials approved by HA and the Water Authority (WA) are permitted for use during construction - Soldering materials are verified upon delivery to site, and are properly stored and quarantined before use - On-site movement and use of soldering materials by workers are recorded - On-site construction mock-up for the use of soldering materials, and posters are displayed reminding workers of the proper procedures in using soldering materials for jointing pipes - Provision of training on quality of work to workers • The main contractors will also enhance supervision of their LPs. The contractors

<p>and attend regular meetings, thus ensuring that the concerned works are in compliance with specifications.</p>	<p>have requested their LPs to -</p> <ul style="list-style-type: none"> - ensure that the materials used comply with the specifications - supervise plumbing installation works - attend site meetings and submit regular reports
<p>(2) The main contractors should test water samples for the contents of lead and the three heavy metals (i.e. cadmium, chromium and nickel) for newly installed inside service in accordance with the WA's latest requirements.</p>	<ul style="list-style-type: none"> • For those recently completed construction projects, the main contractors have tested water samples for lead and the three heavy metals for newly installed inside service in accordance with the WA's latest requirements. HA has also requested the main contractors to take additional water samples for additional tests to ensure the safety of drinking water. HA will keep in view and comply with the Water Supplies Department (WSD)'s latest requirements to enhance the quality of plumbing works. In addition, the Housing Department (HD) will actively take part in WSD's Advisory Committee on Water Supplies and its various working groups to understand the various measures put in place by WSD to improve water quality.
<p><u>Control and monitoring of materials</u></p>	
<p>(3) To include soldering alloys, copper pipes and fittings, etc. in the list of on-site delivery verification items. Soldering joints should also be included in the list of plumbing items that require checking by HD's site inspection staff.</p>	<ul style="list-style-type: none"> • Soldering alloys, copper pipes and fittings, etc. have been included in the list of on-site delivery verification items. • Soldering joints have also been included in the list of plumbing items that require 10% checking by HD's site inspection staff. For those recently completed construction projects, HA has conducted the above checks and tests in the presence of the

	contractors.
(4) HA should use quick test methods to check the presence of lead in soldering joints at any stage of the construction period.	<ul style="list-style-type: none"> • For current contracts, HA has requested the main contractors to use quick test methods to check the presence of lead in soldering joints. When conducting checks for plumbing items that require 10% checking, HD's site inspection team will also conduct sampling tests to check for the presence of lead in soldering joints. In case of any non-compliance, HA will require the main contractors to rectify it immediately and conduct testing of water samples towards completion of the plumbing works.
(5) HA should train site inspection staff to inspect whether the main contractors have duly conducted their supervisory checks or not.	<ul style="list-style-type: none"> • HA has already stepped up training for site inspection staff on conducting inspection for plumbing works.

V. CONCLUSION

451. We are satisfied that leaded solder is the direct cause of excess lead found in drinking water in all the 11 affected PRH estates. This is a finding made by the WSD Task Force, accepted by Professor John Fawell and verified by Professor Joseph Lee in his independent investigation conducted on behalf of the Commission.

452. Arrays of literature and evidence presented to the Commission, including Professor David Bellinger's expert report, have pointed out the adverse effects of lead on human health. It is a known fact that children, pregnant women and lactating mothers are particularly vulnerable to the health effects of lead. However, given the relatively low blood lead levels of the residents, the general components of current care plan implemented by Department of Health are considered to be appropriate.

453. From the perspective of public health, lead in drinking water is not to be tolerated. Lead concentration in drinking water should always be kept as low as is feasible. Since lead does not normally come from the contamination of source water and that lead pipes and leaded solder have been prohibited from use in Hong Kong for decades, excess lead should not be found in our drinking water nowadays.

454. We have reviewed and evaluated the adequacy of the present regulatory and monitoring system in respect of drinking water in Hong Kong. Our findings pertaining to different involved parties are

summarised in the following paragraphs.

The Water Authority/Water Supplies Department

- (a) Lack of clear responsibility over the quality of drinking water at the tap

455. Under the existing water supplies statutory regime, there are no clear statutory provisions as to who has responsibility over the quality of drinking water beyond connection point. The situation is further complicated by the fact that neither WWO nor WWR specifies any standards or requirements over quality of drinking water in Hong Kong. As a result, a number of regulatory and monitoring inadequacies arise.

456. WSD had throughout the hearing contended that it was only responsible for the quality of water up to the connection point. WSD further argued that since the consumers were responsible for the custody, maintenance and cleanliness of the inside service under the laws, it was therefore the consumers' responsibility regarding the water quality beyond the connection point.

457. We have reservation about WSD's contentions. In our view, safety and cleanliness are two different concepts. No doubt the responsibility for maintenance and cleanliness of inside service should rest with the consumers, but the undenyng truth is that WSD ought to be the regulatory authority over the quality of drinking water across the territory.

458. Without any clear guidance and detailed stipulations on the responsibility of the consumers, it is simply unreasonable for WSD to expect and believe that the consumers would have the professional knowledge and expertise in ensuring the quality and safety of their own drinking water. Given the reluctance on the part of WSD in accepting this overarching responsibility, it is therefore not surprising to see that the present incidents escaped the attention of WSD.

(b) Inadequate understanding of the WHO guidelines and need for developing Hong Kong's own water quality standards and a comprehensive WSP

459. WSD adopted the WHO Guidelines in 1994. It was a welcome step for Hong Kong. However, WSD just stopped there and failed to appreciate that the Guidelines were intended to be a scientific point of departure for the development of our own water quality standards. To date, we still do not have our standards.

460. In 2004, WHO introduced the concept of WSPs in order to encourage a proactive preventive approach to managing risks to drinking water from the catchment to the point at which consumers receive their drinking water, i.e. the source-to-tap approach. WSD published the first WSP in 2006, pledging to adopt the Guidelines and the source-to-tap approach, and assumed responsibility over quality of drinking water throughout Hong Kong. The declared mission of WSD was to provide a reliable and adequate supply of wholesome potable water to the consumers of Hong Kong.

461. In practice, however, WSD failed to formulate or put in place a sound and effective WSP with clear engagement of external stakeholders. The current WSPs were prepared top down with little involvement of external stakeholders, such as developer, architect, main contractor, plumbing subcontractor and building manager. Besides, they were only in the form of a skeleton with little details and regarded as no more than internal documents by WSD. Worse still, WSD amended its 2011 WSP in September 2015 to retract its responsibility over quality of drinking water “from source to tap” to “from source to distribution”.

462. In addition, we noticed that WSD failed to undergo any systematic hazard assessment and risk characterisation regarding lead or other chemical contaminants likely to be found in inside service, as required.

463. Lead pipes and leaded solder have been prohibited against their use in potable water supply system in Hong Kong since 1938 and 1987 respectively. Therefore, unlike the situation in other countries such as the U.S.A. and U.K., where lead pipes are common, the level of lead concentration in our drinking water should be low. Had WSD followed the Guidelines and developed our own drinking water standards, WSD would probably have adopted a lead guideline value lower than 10 µg/L for Hong Kong.

- (c) Inadequate understanding of the meaning of the WHO provisional guideline value for lead

464. It appears that WSD failed to appreciate the conceptual subtlety between “guideline value” and “provisional guideline value” adopted by WHO. Lead was given a guideline value of 10 µg/L before 2011. It was a health-based value. As a result of further evaluation in 2011, WHO concluded that there was no safe threshold for lead, as adverse effects in different organ systems, particularly the central nervous system, had been observed at blood lead levels of less than 5µg/dL. The ideal blood lead concentration for human is 0µg/dL.

465. Although the guideline value of 10 µg/L was retained, WHO designated it as “provisional” on the basis of treatment performance and analytical achievability. In essence, the value had changed from health-based to non-health-based, and WSD should not be looking at exposure with the WHO guideline value as the benchmark. WSD seemingly failed to understand the difference in between. It is therefore no surprise for WSD to have adopted 10 µg/L without taking into account the local circumstances as required by WHO. This misunderstanding also contributed to its failure to adopt a proper sampling protocol to identify the extent of lead contamination in PRH estates.

- (d) Failure to update legislation to keep up with changes in British Standards

466. WSD failed to update technical standards as stipulated in

WWO, WWR and the Form WWO 46 for years, which created unnecessary misunderstandings and confusion for the plumbing industry.

467. In respect of the use of solder, BS 864-2:1983 was superseded by BS EN 1254-1:1998 in 1998. The maximum permissible lead content in solder was reduced from over 50% in 1983 to 0.07% at present. Yet the same old British Standard still stays on our statute book. Except three, all British Standards on the Form WWO 46 are outdated. Explanations given by WSD were inconsistent with its past practice.

(e) Failure to uphold a robust LP regime

468. WSD failed to uphold the robustness of the LP regime, including the responsibilities, competency and working strength of the LPs. Under the existing statutory provisions, no inside service shall be constructed or installed by a person other than a LP. In reality, WSD permitted workers other than LPs to undertake plumbing works, provided those workers were supervised by LPs. Supervision however did not entail the physical presence of LPs. None of the three LPs called to testify personally performed any installation work.

469. The responsibility of LPs is an important issue because poor workmanship was one factor which contributed to the present incidents. There is a huge gap between the language of the law and the industry practice permitted by WSD.

470. WA as the licensing authority also failed to ensure the continued competency of LPs. Once plumber licences are issued, LPs

are not required to update their knowledge of the plumbing trade. There is also no restriction as to the number of projects that a LP may take at any given time. For instance, only one LP was engaged for the plumbing works of over 5,000 housing apartments in Kai Ching. It is difficult to imagine how well the LP could divide his time to supervise plumbing works of such scale.

(f) Failure to exercise its legal powers to ensure compliance by the trade

471. WWO and WWR confer on WSD a number of powers. For example, WSD can require (under regulations 20 and 21 of WWR) any pipes or fittings to be tested before installation. However, WSD does not have material testing facilities for any plumbing materials. We doubt if WSD has ever conducted any test or taken any enforcement action against LPs for failing to comply with these two statutory technical requirements.

472. WSD argued that any enforcement action in the form of random checks would amount to just a further layer of sporadic checks. Given this mindset, it is no wonder that WSD in its final inspection of newly constructed plumbing work focused exclusively on functionality without any regards to material safety and water quality.

473. Similarly, the purpose of taking water samples at final inspection, hence the determination of testing parameters, was targeted solely towards the prevention of possible contamination of the

Government's water supply. This practice was proved to be inadequate.

(g) Failure to adopt a proper sampling protocol

474. Regarding the decision of Director of Water Supplies to sample only flushed water, we believe that Chief Waterworks Chemist played a dominating role. This sampling protocol, however, was insufficient to ascertain the full extent of the problem of lead contamination in the drinking water of all PRH estates. Despite the numerous occasions on which good and sound advice was given to WSD, it was unfortunate that WSD insisted on using its own sampling protocol. As a result, nobody can say now with any degree of certainty the number of PRH estates that are truly unaffected by lead in drinking water.

The Hong Kong Housing Authority/Housing Department

475. Throughout the inquiry, HA repeatedly told us that there had been a lack of or inadequate awareness in HA on the use of leaded solder and its implications on the quality of drinking water. Our view is that HA, as an entity, was aware of the harmful effect of the use of leaded solder and its adverse implications on human health. This is borne out by the fact that HA had all along specified in its contracts the requirement of the use of lead-free category solder.

476. Besides, as a routine practice, HA's site staff had required sample submission of solder by main contractors. Evidence also showed that HA's site staff were familiar with the risks associated with lead. However, there was no effective mechanism whereby such

knowledge would be shared across divisions and with the senior management, resulting in the absence of a holistic assurance programme that could effectively prevent the use of non-lead-free solder.

477. HA failed to conduct any systematic risk assessment back in 2002 after HA decided to allow its main contractors to use copper pipes for fresh water plumbing installation, which in turn resulted in the glaring absence of an effective supervisory and monitoring system for solder. The attention of HA tended to focus on the functionality of the construction works, with insufficient emphasis on potential health risks which might arise.

478. HA failed to include solder as one of the items under its “On-site Delivery Verification” mechanism. No check was conducted when solder was delivered to site. Further, HD’s Site Inspection Team which was responsible for quality assurance programme was also not required to check the use of solder under the Architectural Site Inspection Guide.

479. Consequentially, HA failed to ensure the solder used in joining copper pipes and fittings would conform to the approved sample. There had been a systemic failure within HA as to the use of solder in the construction of the inside service. HA appeared to rely heavily on document check in order to control the quality of the construction works undertaken by the main contractors. We accept that it is not practicable or cost-effective for HA to micromanage all its PRH projects, that does not however mean that HA should not put in place more effective

measures to forestall possible failure on the part of its main contractors in fulfilling their contractual obligations.

480. As the largest developer in Hong Kong, HA should always be vigilant to every possible health hazard associated to drinking water, with or without alerts from WSD.

Main Contractors

481. All four main contractors were well aware of HA's requirement on the use of lead-free solder, judging by the fact that they imposed the same requirement on their sub-contractors and arranged for the submission of the correct type of solder for approval. However, they all failed to put in place effective mechanisms to ensure that only the approved solder would be used by their subcontractors. The sample approval process turned out to be just a formality.

482. The situation was aggravated by the fact that under the existing regulatory regime, the main contractors did not have any role to play in the construction of inside service. For example, they were not featured in either Form WWO 46 or Form WWO 132.

483. No doubt all four main contractors failed to fulfil their contractual obligations with HA. We believe, however, that there was little incentive for them to deliberately use leaded solder for all the plumbing works. They suffered the consequence for not putting in place a proper system of supervision and mistakenly placing their entire trust in the subcontractors.

Plumbing Subcontractors and Licensed Plumbers

484. We are of the view that all plumbing subcontractors knew that only lead-free solder should be used in PRH projects. We believe that leaded solder was intentionally used or caused to be used by some subcontractors and/or their staff. Apart from financial incentive, there was attraction for some workers to use leaded solder which has a lower melting point.

485. The LPs are the plumbing specialists in Hong Kong. They are intended to be a pool of professionals, suitably qualified and have the competency and up-to-date knowledge to design, install and maintain plumbing systems. They also have a key role in managing risks and ensuring compliance with relevant statutory requirements and applicable standards. The reality however is that inside service has been rarely constructed by LPs themselves, or even by other workers in the presence or under the supervision of LPs. Some LPs play the role of no more than affixing their signatures on WSD documents.

486. All in all, what we have seen is a collective failure on the part of all stakeholders to guard against the use of non-compliant solder in the plumbing system. On the surface, there was in place a perfect multi-barrier checking system: HA specified in its contracts with the main contractors that only lead-free solder should be used; a similar provision was repeated in the contracts between the main contractors and their subcontractors; the main contractors even took the initiative of submitting solder sample to HA for approval which was actually not part

of the requirements; and WA had in place statutory requirements on building materials and demanded AP/LP certification before allowing water supply. In practice, however, this multi-barrier checking system turned out to be no more than a paper system in which every party transferred the duty of supervision to the other(s), resulting in a classic case of buck-passing. Trust was misplaced and in the end it was the residents who suffered the most.

VI. RECOMMENDATIONS

487. The following are measures we would recommend in order to prevent the recurrence of similar incidents in future –

- (1) Given the inadequacy of the sampling protocol adopted by WSD and in order to put the minds of all PRH residents at ease, the Government should undertake to test the drinking water of all PRH estates again using an appropriate sampling protocol that would include the testing of stagnant water as well.
- (2) Given the ever increasing complexity of modern buildings, the Government should, at the policy level, review the adequacy of the existing legislative framework and regulatory regime in safeguarding the safety and quality of drinking water in Hong Kong. The review should cover :
 - (i) the need for delineating the role of WA (as regulator of water quality) and the role of WSD (as water supplier); and
 - (ii) WSD's roles and responsibilities in effectively safeguarding the quality and safety of drinking water in Hong Kong, in particular whether its responsibilities are only confined to the quality of drinking water up to the connection points.

- (3) The Government should set up an independent body to overlook the performance of WSD and water quality in Hong Kong generally. This body should be empowered to conduct independent inspections and auditing when necessary.
- (4) We support WA/WSD's proposal to set up an international expert panel on water safety to provide expert advice to Hong Kong on matters including water quality standard, water quality regulatory and monitoring regime, water sampling protocol etc.
- (5) WA/WSD should undertake a comprehensive study with a view to establishing the "Hong Kong Drinking Water Standards", taking into account overseas experience and practices.
- (6) WA/WSD should define, preferably by way of legislation, the roles, involvements and responsibilities of other parties such as developers, contractors and APs who are in practice involved in the design, construction and maintenance of inside service but are currently not prescribed with any duties under WWO and WWR.
- (7) With the involvement of all relevant stakeholders including experts, professionals of different related disciplines and the general public, WA/WSD should establish and implement a WSP for Hong Kong in general and WSPs specifically for other developments in Hong Kong (e.g. public and private housing

developments, hospitals, elderly homes, schools), with clear indication of :

- (i) how to identify potential hazards and conduct risk assessment of contamination at different sections of the water distribution system, i.e. waterworks, communal service and inside service; and
 - (ii) the responsibilities of stakeholders at different sections of the water distribution system.
- (8) WA/WSD should set out clearly, in the legislation or appropriate medium, the latest approved pipes and fittings as well as the latest standards for all plumbing material and components to be used in the construction of inside service, and update the same regularly and periodically.
- (9) WA/WSD should devise and uphold a robust licensing / registration regime for parties responsible for plumbing installations, including to:
- (i) define the duties of LPs under WWO, taking into account the relevant provisions of the Construction Workers Registration Ordinance (Cap. 583) (CWRO) which allows skilled workers to perform plumbing installations;
 - (ii) review the adequacy of the existing arrangement where an individual LP can be responsible for

plumbing installations of any scale (e.g. up to thousands of household units) at any given time;

- (iii) review the competency and manpower development of LPs, and consider the need for continuous professional education for LPs on a compulsory basis as part of the conditions for renewal of licences;
 - (iv) ensure that LPs and skilled plumbing workers under CWRO would be taught in their training, certification and professional development the potential causes and hazards of drinking water contaminations, and precautionary measures; and
 - (v) consider the need and feasibility to include other professionals (such as building services engineers) and specialised contractors (such as in the form of a registration system for plumbing contractors) in the design and construction of inside service.
- (10) HA should review its control mechanism on the construction projects with emphasis not only on the functionality of the plumbing system but also the quality and safety of water.
- (11) HA should equip its CA (Design and Standard) with necessary expertise on plumbing installations and strengthen its research capability to identify the existing

and emerging risks to the quality and safety of water in developing and managing PRH estates.

- (12) HA should, in consultation with WSD, review all the materials to be used in the construction of PRH estates with a view to identifying the potential hazards and contamination in the drinking water, and revising the project specifications as necessary.
- (13) HA should put in place a robust system to monitor the compliance of the plumbing installations with the project specifications by main contractors and their subcontractors.
- (14) We support all the control measures put forward by the Review Committee regarding the purchase, use and testing of solder in the construction of all new PRH projects. It is important not to relegate these control measures into yet another document check exercise.
- (15) HA should contribute proactively to the establishment of a WSP for PRH estates under (7) above.
- (16) At all times and especially before the establishment of a WSP for PRH estates, HA should ensure all its staff, in particular all the CAs who are responsible for signing WWO certifications and documents, are aware of all the potential causes and hazards of drinking water contamination and precautionary measures.

(17) At all times and before WA/WSD has defined the specific roles of all involved parties, the developers and main contractors, when contracting out the plumbing work, should devise and execute an effective management plan for making sure that :

(i) only the approved/compliant materials would be used in plumbing installations; and

(ii) the plumbing work would be carried out under appropriate supervision and inspection by competent personnel;

so that the control measures would not be relegated into another document check exercise.

488. We believe that if these recommendations are implemented, not only PRH estates, but also other developments in Hong Kong and our community as a whole will be benefited.

International Expert Panel on Drinking Water Safety

Terms of Reference

To provide advice on research findings and suggestions of Development Bureau and Water Supplies Department relating to drinking water safety, and to report to the Secretary for Development, including -

- (1) Hong Kong drinking water quality;
- (2) sampling protocol, including water sampling method, action level, compliance rate and follow-up action in order to investigate the extent of lead contamination in the plumbing system;
- (3) 'Water Safety Plan' including specific 'Water Safety Plan' applicable to individual buildings; and
- (4) water quality regulatory and monitoring regime.

Members

Professor Jennifer Colbourne

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Latest situation of follow up actions of Development Bureau and Water Supplies Department in response to recommendations made by the Commission of Inquiry into Excess Lead Found in Drinking Water

Recommendations by Commission of Inquiry	Latest situation of follow up actions
<p>1. The Government should undertake to test the drinking water of all PRH estates again using an appropriate sampling protocol that would include the testing of stagnant water as well.</p>	<p>✧ Water Supplies Department (WSD) has commenced the follow-up work, including the review of relevant sampling protocols in overseas countries (including North America, UK and Australia), and engaged overseas expert consultants. A set of water sampling protocol applicable to Hong Kong, and associated “action level”, “compliance rate” and follow-up actions will be developed as soon as possible for investigating the extent of lead contamination in inside service. WSD will seek advice from the International Expert Panel (see recommendation item (4) for details) on the proposed sampling protocol.</p>
<p>2. The Government should, at the policy level, review the adequacy of the existing legislative framework and regulatory regime in safeguarding the safety and quality of drinking water in Hong Kong.</p> <p>3. The Government should set up an independent body to overlook the performance of WSD and water quality in Hong Kong generally.</p>	<p>✧ The Development Bureau has set up an Inter-Bureau/ Departmental Working Group (including WSD) and has engaged consultant to commission a study to compare the water safety regime and associated mode of operation in advanced countries, so as to formulate the regulatory regime of Hong Kong.</p> <p>✧ The consultant will also study the role of Water Authority (WA) in safeguarding the drinking water quality beyond the connection point. The study will also review the regulatory framework to oversee WSD’s performance and water quality in Hong Kong.</p> <p>✧ The Development Bureau will seek advice from the International Expert Panel on the findings and recommendations of the above study.</p>

Recommendations by Commission of Inquiry	Latest situation of follow up actions
<p>4. The Commission supports WA/WSD's proposal to set up an international expert panel on water safety.</p>	<p>✧ The Development Bureau has set up an International Expert Panel on 1 June 2016 to provide advice on matters related to drinking water safety, which comprises three overseas experts on water safety from North America, the UK and Australia and two local experts. Three overseas experts possess a wealth of knowledge and experience and have been involved in the work on water safety for WHO and international water industry associations. Besides, two local experts are water quality expert and medical professor.</p>
<p>5. WA/WSD should undertake a comprehensive study with a view to establishing the "Hong Kong Drinking Water Standards".</p>	<p>✧ WSD has commenced the follow-up work, including the review of the WHO Guidelines for drinking-water quality and the drinking water quality standard in overseas countries (including North America, UK and Australia) and their experience in establishing drinking water standard and practices. Moreover, WSD has engaged overseas expert consultants to establish Hong Kong Drinking Water Standards. The result of the study will be discussed in the Inter-Bureau/ Departmental Working Group (mentioned in recommendations (2) (3) above) set up by the Development Bureau. Advice from the expert panel will be sought.</p>
<p>6. WA/WSD should define the roles, involvements and responsibilities of other parties, who are in practice involved in the design, construction and maintenance of inside service.</p>	<p>✧ WSD has commenced the review of the Waterworks Ordinance (WWO) and Waterworks Regulations (WWR). The review includes delineation of roles, involvement and responsibilities of relevant parties (which include developers, qualified persons, plumbing contractors and licensed plumbers) who are involved in the design and construction of inside service with a view to amending the relevant legislation.</p> <p>✧ Pending completion of legislative review, WSD</p>

Recommendations by Commission of Inquiry	Latest situation of follow up actions
	<p>will initiate administrative measures to strengthen the current system. WSD has prepared a preliminary draft proposal on the Code of Practice for the plumbing industry encompassing recommendation of the engagement of specialist plumbing subcontractors to undertake large-scale plumbing works, and deployment of qualified personnel (e.g. building services engineers) to supervise the works. WSD has also set up a Technical Committee on Plumbing with the participation of the industry to provide advice and recommendations on various issues on plumbing works. WSD consulted the Technical Committee in June 2016 on the draft Code of Practice and will refine the draft taking account of the comments from the Technical Committee.</p>
<p>7. WA/WSD should establish and implement a WSP for Hong Kong in general and WSPs specifically for other developments in Hong Kong (e.g. public and private housing developments, hospitals, elderly homes, schools)</p>	<ul style="list-style-type: none"> ✧ WSD is undertaking a comprehensive review of the department's Water Safety Plan (WSP) with a view to further improving the Plan. The review includes strengthening hazard identification, risk assessment and control measures, operational monitoring and audit mechanism. ✧ WSD is studying relevant overseas experience (including North America, UK and Australia) on the implementation of WSPs in specific developments. WSD has engaged overseas experts to undertake detailed study on related issues. WSD will also seek advice from the International Expert Panel. ✧ An initial plan is to formulate suitable guidelines and Code of Practice for developing WSPs of specific developments for the reference of relevant parties (e.g. developers). WSD will study to identify suitable newly completed government and Housing Authority developments as pilot projects.

Recommendations by Commission of Inquiry	Latest situation of follow up actions
<p>8. WA/WSD should set out clearly the latest approved pipes and fittings as well as the latest standards for all plumbing material and components to be used in the construction of inside service, and update the same regularly and periodically.</p>	<ul style="list-style-type: none"> ✧ WSD has uploaded to the WSD’s website the approved pipes and fittings and latest applicable standards of pipes and fittings. The industry has also been informed via WSD circular letters. ✧ WSD has revised the form WWO46 to specify clearly the pipes and fittings that are required to be reported, and the pipes and fittings shall comply with relevant British Standards listed out on WSD’s website. ✧ As for the British Standards listed in the WWR, WSD has started the drafting of the Draft Drafting Instruction (DDI) for the amendment of the Regulations as soon as possible. All standards stipulated in the WWR will be removed and a Code of Practice will be issued under the legislative framework to inform users the latest applicable standards.
<p>9. WA/WSD should devise and uphold a robust licensing/ registration regime for parties responsible for plumbing installations, including to:</p> <ul style="list-style-type: none"> (i) define the duties of LPs under WWO, taking into account the relevant provisions of the Construction Workers Registration Ordinance (CWRO), which allows skilled workers to perform plumbing installations; (ii) review the existing arrangement where an individual LP can be 	<ul style="list-style-type: none"> (i) WSD has completed the draft drafting instruction for the amendment of Section 15 of the WWO to define the responsibilities of licensed plumber under the Ordinance. (ii) WSD is exploring the feasibility of amending the legislation to require large-scale plumbing works to be installed by specialist plumbing subcontractors. As mentioned in recommendation item (6) above, pending the completion of legislative review and amendment, WSD will recommend in the Code of Practice the engagement of professional plumbing subcontractors to undertake sizable plumbing works. WSD will also review the current system of inspection and checking of inside service, and step up surveillance with risk based consideration of a number of factors. (iii) WSD is exploring the option to amend legislation

Recommendations by Commission of Inquiry	Latest situation of follow up actions
<p>responsible for plumbing installations of any scale at any given time;</p> <p>(iii) review the competency and manpower development of LPs;</p> <p>(iv) ensure that LPs and skilled plumbing workers under CWRO would be taught the potential causes and hazards of drinking water contaminations, and precautionary measures; and</p> <p>(v) consider the need and feasibility to include other professionals and specialised contractors in the design and construction of inside service.</p>	<p>to require licensed plumber for mandatory continuing professional development. Pending the completion of legislative review and amendment, WSD plans to implement continuing professional development scheme for licensed plumbers on voluntary basis. WSD consulted the Advisory Board on Licensing of Plumbers in June 2016 on the draft plan and will refine the draft taking account of the comments from the Advisory Board.</p> <p>(iv) Upon the request by WSD, the Vocational Training Council has included the management of plumbing works in its course for the training of licensed plumbers. The Construction Industry Council also agreed to include the latest water safety measures implemented by WSD in its course for the training of plumbing workers. WSD will discuss with related organisations to include in their training courses the potential causes and hazards of drinking water contaminations and precautionary measures.</p> <p>(v) As mentioned in recommendation item (6) above, WSD has commenced the review of the legislation. The review includes delineation of roles, involvement and responsibilities of relevant parties who are involved in the design and construction of inside service. WSD will also review the need and feasibility of the related registration system as recommended by the Commission.</p>