Memorandum for the Hong Kong Housing Authority

Test Results of Water Samples taken from Public Rental Housing Estates completed in or after 2005

PURPOSE

This paper summarises the test results of water samples taken from public rental housing (PRH) estates completed in or after 2005, and the Housing Department (HD)'s major observations about these test results.

BACKGROUND

2. On 9 to 11 July 2015, HD and Water Supplies Department (WSD) announced that excess lead [Note 1] was found in water samples from Kai Ching Estate, and that lead was found in two samples of solder used on water pipe joints. WSD then took water samples from a number of developments installed by the same Licensed Plumber (LP). Among these PRH developments, excess lead was found in samples taken from Kwai Luen Estate Phase 2, and lead was found in samples of solder. In order to address the residents' concerns, the Chairman of the Hong Kong Housing Authority (HA) announced on 15 July 2015 that water sampling tests would be carried out for all PRH estates completed since 2013, as well as for Kwai Luen Estate Phase 1 (which was completed in 2011). Among these estates, excess lead was found in a sample from Wing Cheong Estate, and lead was found in samples of solder. On 20 July 2015, the scope of water sampling tests was further extended to PRH estates completed in 2011 and 2012. Among these estates, excess lead was found in samples from five of them, and lead was again found in samples of solder. Given the public concern, the Chairman of HA announced on 24 July 2015 that the water sampling tests would be carried out for all PRH estates in a systematic way. The target was to complete such tests for PRH developments completed in or after 2005 by end September, and then taking into account experience and data consider how to do such tests for developments completed before 2005.

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

3. Separately, on request of the Commission of Inquiry, HD provided in August 2015 a paper explaining the established mechanism to ensure safety and quality of fresh water supply in HA's PRH estates. The paper is attached at **Annex A**. In the paper, HD admitted that **the then mechanism (ie. before the "excess lead in water" incidents)**, including the parts that seek to meet statutory and WSD's other requirements and the parts that are in addition to the statutory and WSD's requirements, **had been geared towards the known issues about safety and quality of fresh water**. These mainly concern the physical performance of the water supply system, the eight water test parameters (which did not include lead) then stipulated by the WSD for testing of water samples taken from newly completed inside service, and the risk of Legionnaires' disease. In gist, **the then mechanism did not focus on the issue of lead** or other heavy metals in the water supply system or in the water.

WATER SAMPLING TESTS FOR POST-2005 ESTATES

4. WSD and HD have been conducting water sampling tests systematically by batches, and conclusions on the lead content in water in the supply systems installed by HA's contractors are published as and when they have been confirmed. As at 24 September 2015, water sampling tests have been done for a total of 83 PRH developments involving 46 estates. Among these estates, the water samples taken from 11 of them have been found to contain excess lead content. The test results are summarized at **Annex B**.

5. We have now completed water sampling tests for PRH estates completed in or after 2005, and have been considering how to do such tests for PRH developments completed before 2005. We are collating and analyzing the water test results obtained so far.

Order of priority for water sampling tests

6. The year 2005 was a watershed in the construction of PRH estates. In general, water pipes in PRH estates completed before 2005 are connected mechanically and not by soldering, while water pipes in PRH estates completed in or after 2005 are mainly copper pipes joined by soldering. As solder used on water pipe joints is a cause of excess lead in drinking water, it is generally believed that there is one fewer risk factor leading to excess lead in drinking water for PRH estates completed before 2005. Therefore, **we give priority for water sampling tests to the "newer" estates which are associated with a higher risk of the presence of lead in drinking water, and we think the sampling method for pre-2005 developments, and that for developments completed in or after 2005, may not need to be identical**.

7. Notwithstanding the broad distinction mentioned above, there are exceptions. Individual PRH developments completed after 2005 did not use soldering in general, while a small number of developments completed before 2005 had used soldering in pipe connections. The latter includes three developments, namely Kwai Shing (East) Estate (Shing Wo House), Tsz Lok Estate (Lok Foon House) and Lok Fu Estate (Lok Tsui House). To ensure that our first stage of systematic water sampling tests covered all PRH estates that used soldering in pipe connections (with which a higher risk of the presence of lead in drinking water is associated), we have covered these three developments in our water sampling and testing exercise even though these estates were completed before 2005.

Non-domestic facilities in PRH estates

8. There are often non-domestic facilities used for commercial, social service, educational purposes etc. in PRH estates. As far as the supply of fresh water is concerned, some non-domestic facilities share the same water supply system as the domestic portion in the same estate. Other non-domestic facilities, which are situated in standalone buildings or the lower levels of domestic blocks, are fed by separate systems that are independent from those feeding the domestic portion. **HA's main contractors are generally responsible for the installation of the fresh water supply system in the common area of the non-domestic portion.** The water supply systems inside the non-domestic units are mostly installed by the tenants themselves.

9. While the systematic water sampling and testing exercise has focused on the domestic blocks of PRH estates, the quality of fresh water supplied to non-domestic tenants has not been neglected. In cases where the fresh water supply system of the non-domestic portion is independent from that of the domestic portion, **HD and WSD conduct separate water sampling tests for the two independent systems.** Test results for the two systems are independent from one another. Since HA's main contractors are generally responsible for the installation of the fresh water supply system in the common area of the non-domestic portion, water samples will be taken from the system in the common area for testing purpose. Consequently, **the test results will reflect the lead content in drinking water in the common area system rather than that inside the non-domestic units.** The test results for most of the separate systems tested so far have been announced in tandem with those for the domestic blocks in the same estates.

MAJOR OBSERVATIONS

10. We have the following observations about the water sampling test results obtained so far –

(a) HD and WSD had been focusing on carrying out systematic water sampling tests for PRH estates completed in or after 2005, due to the risk factor explained in paragraph 6 above (ie. the use of soldering in pipe connections). As mentioned in paragraph 6 above, we have also conducted water sampling tests for three developments completed before 2005 as soldering had been used in pipe connections therein. From the test results, we note that, even in this pool of "high-risk" estates, **the incidence of "excess lead in water" is not high** –

(i) the percentage of PRH developments in which excess lead content has been found in water samples is relatively small. Of the 83 PRH developments tested, 11 (13%) are found to have water samples exceeding the WHO's guideline value; and

(ii) in terms of the number of samples, only 91(2%) out of 4 740 water samples taken are found to have exceeded the WHO's guideline value. Among these 91 water samples with excess lead content, 63 (69%) had a lead content of between 10 to 20 micrograms per litre, 10 (11%) had a lead content of between 21 to 30 micrograms per litre, and 18 (20%) had a lead content exceeding 30 micrograms per litre[1].

(b) **The 11 estates with excess lead in drinking water are not confined to any individual main contractors, subcontractors or LPs.** There are a total of four different main contractors involved, namely Shui On Building Contractors Limited, China State Construction Engineering (Hong Kong) Limited, Paul Y. General Contractors Limited and Yau Lee Construction Company Limited. Indeed, these four contractors have been responsible for the construction of almost 70% of the 83 PRH developments which we have tested so far. As a matter of fact, out of the 72 PRH developments which have "passed" the water sampling test, 46 (64%) were constructed by these four main contractors. These 11 estates involved three different plumbing subcontractors and three different LPs;

(c) **The 11 estates with excess lead in drinking water are not confined to the most recently completed estates.** They also include estates which were completed some years ago. Indeed, the completion years for these 11 estates straddle a number of years from 2008 to 2014;

(d) As mentioned above, the year 2005 is a watershed in PRH construction, after which copper pipes with solder joints have been used in general. In our water sampling and testing exercise, we have also covered nine estates (involving 12 developments) which used **stainless steel or lined galvanized iron pipes without solder joints**, as they were also completed in or after 2005 [Note 2]. **No excess lead content has been found in any water sample taken from these nine estates.** This observation aligns with the preliminary findings of the WSD's Task Force on Excessive Lead in Drinking Water, that leaded solder joints is a cause of excess lead in drinking water (see paragraph 11 below). As a corollary, **PRH estates completed before 2005 carry lesser risks of the presence of lead in drinking water, and a smaller sampling size may be considered when these estates will be tested in the next stage of work**; and

(e) As mentioned above, in many PRH estates there are separate fresh water supply systems feeding the lower levels of the domestic blocks or standalone buildings which house many non-domestic facilities serving various commercial, social welfare and educational purposes. These separate water supply systems are independent from those feeding the domestic portion of the estates. As far as water test results for these separate systems are concerned, we note that in cases where the water samples taken from the domestic blocks have "passed" the test, the samples taken from the separate systems in the same estate have also "passed" the test. However, **for estates which have "failed" the water sampling tests (in respect of their domestic blocks), the test results for their separate systems are mixed**. For example, in Kai Ching

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Note 2 The nine estates are Tak Long Estate, Hung Fuk Estate, Shek Lei (II) Estate (Shek Foon House), Hin Yiu Estate, Shek Yam Estate Phase 5 (Lai Shek House), Lei Muk Shue Estate Phase 4 (Hong Shue House, Lok Shue House, Kin Shue House), Yau Lai Estate Phase 1 (Bik Lai House, Sau Lai House, Yi Lai House, Nga Lai House, Chi Lai House, Yat Lai House), Shek Pai Wan Estate Phase 1 (Pik Long House, Pik Yuet House, Pik Ngan House, Pik Fai House) and Shek Pai Wan Shopping Centre, and Kwai Chung Estate Phase 3 Kwai Chung Shopping Centre, Phase 4 (Chin Kwai House, Tsz Kwai House) and Phase 5 (Hiu Kwai House, Ying Kwai House, Yuk Kwai House, Nga Kwai House, Yat Kwai House).

Estate (the first "excess-lead-in-water" estate), the water samples taken from its separate systems which feed the lower floors of the main domestic blocks stay below the WHO's guideline value. Separately, water samples taken from the separate systems of Tung Wui Estate (another "excess-lead-in-water" estate) have been found to contain excess lead.

WAY FORWARD

11. As mentioned above, we will consider how best to take forward the water sampling tests for the PRH estates completed before 2005 based on data and experience. It is relevant that on 25 September 2015 the Task Force on Excessive Lead Content in Drinking Water published its preliminary findings. A copy of the powerpoint used to announce the findings at a press conference and a press statement issued that day are at **Annex C**. Among other things, the Task Force considers that excessive lead content in water samples in Kai Ching Estate and Kwai Luen Estate Phase 2 was caused by the leaded solder joints. They also consider that copper alloy fitting, including valves, meters and taps, were not the cause of excessive lead content in water.

12. In deciding on the next steps, we will consider the findings of the Task Force, and continue to collate and analyze the results of the water sampling tests that we have done for PRH estates completed in or after 2005, and for the PRH estates completed before 2005.

INFORMATION

13. This paper is issued for Members' information.

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(Development and Construction Division)
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c.c. Members of HA Committees/Sub-Committees

Annex A

COMMISSION OF INQUIRY INTO EXCESSIVE LEAD FOUND IN DRINKING WATER

Present Mechanism to Ensure Safety and Quality of Fresh Water Supply in Public Housing Estates of the Hong Kong Housing Authority

PURPOSE

This paper provides background information on the present mechanism implemented by the Hong Kong Housing Authority (HA) to ensure the safety and quality of fresh water supply in public housing estates.

2. Full description of the mechanism will involve much more details, and we thought in this first submission we should provide the Commission with an outline. Should the Commission require further details about any particular stage or aspect of the mechanism, we stand ready to provide additional information in future submissions.

3. **Annex 1** is a flow chart that shows the 18 major steps involved in the design, construction and completion of fresh water supply system, that a typical public housing project goes through. The following paragraphs highlight key parts of the mechanism that are relevant to how we seek to ensure that the installation of fresh water supply system meets water safety and quality requirements.

OUTLINE OF MECHANISM

Pre-contract Stage

4. Details of plumbing design for each public housing project vary. The plumbing design for all buildings comprises an up-feed and a down-feed system. **Annexes 2 and 3** are simplified schematic illustrations of, respectively, the up-feed and down-feed system. In HA's public housing

estates, these systems are installed by the Registered Contractor (RC)[1] and his domestic subcontractor, or in the case of the fire service and water pump installations, by the HA's nominated subcontractor (NSC)[2] –

Up-feed :

(i)	Master water meter room (by RC)
(ii)	Underground water supply pipe (by RC)
(iii)	Water meter chamber (by RC)
(iv)	Fresh water up-feed pump room (by NSC)
(v)	Up-feed water pipe (by RC)
(vi)	Twin roof water tanks (by RC)

Down-feed :

(vii)	Down-feed water pipe (by RC)
(viii)	Fresh water booster pump for top 5 to 6 floors (by NSC)
(ix)	Pressure reducing valves on intermittent floors (by RC)
(x)	Water meter cupboards at each floor (by RC)
(xi)	Fresh water pipe in corridors (by RC)
(xii)&(xiii)	Plumbing installation in domestic flats (bathroom and kitchen) (by RC)

5. The entire plumbing is designed in accordance with the requirements stipulated in the **Waterworks Regulations (Cap 102A)**, as well as **Water Supplies Department (WSD)'s handbooks and guidelines**. In order to ensure consistency among HA's projects in respect of law compliance, the Housing Department (HD) promulgates in-house design guidelines through the Building Services Technical Guide for Water Pump and Water Services Installations, and the Technical Guide to Public Housing

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[1] Section 9 of the Buildings Ordinance (BO) (Cap. 123) specifies that person(s) for whom building works are carried out shall appoint a RC to carry out and continuously supervise the building works. HA enters into a contractual relationship with the RC, and the RC must ensure that the execution of construction works are in compliance with the BO and related requirements at all times.

[2] The RC is permitted under the Government's "General Conditions of Contract for Building Works" to sub-contract part(s) of the works. HA adopts a NSC arrangement for certain works of the building contract which require relatively high expertise in technical skills, such as building services and fire services installation works. HA selects the NSC on behalf of the RC for carrying out the specialised work. The RC then enters into contract with the NSC. The HA does not have a direct contractual relationship with the NSC. As the construction of plumbing installation work designs for public housing developments are generally considered simple and relatively straight forward, the NSC arrangement has not been adopted by the HA for plumbing installation works, and the RC has been taking up such works in line with common practice of the building industry.

Developments for Water Services Installation.

6. Referring to the flow chart in **Annex 1 -**

(a) Step 1 – The HD's Chief Architect serving the Authorized Person (AP) role of a public housing project submits Form no. WWO132 Part 1 to WSD to apply for confirmation / certificate of water supply availability and request advice on water supply pressure head.

(b) Step 2 – The HD's project team prepares plumbing drawings and specifications in compliance with statutory requirements.

(c) Step 3 – Upon receipt of WSD's confirmation pursuant to step 1 above, the HD's project team submits two sets of plumbing drawings to WSD for approval.

(d) Step 4– WSD approves plumbing proposal via a written memorandum, with comments, if any. Disapproval by WSD entails resubmission by HD's project team until approval is obtained before plumbing installation works can commence on site.

(e) Step 5 – The HD's project team prepares tender drawings and specifications for tendering of the building contract (ie. the contract with the RC) and the nominated subcontract (ie. the contract with the NSC) for fire services and water pump installations.

(f) Step 6 – The HD's project team issues tenders for building contract and nominated subcontract for fire services and water pump installations, assesses submitted tenders, and recommends approval for award of contracts by the HA's Tender Committee or the HD's Tender Board, as appropriate, in accordance with the delegated financial authority.

Post-contract Stage

7. After the contract has been awarded and an RC appointed, **upon the commencement of the contract** -

(a) Step 7 – The RC may sublet part of the works to a domestic plumbing subcontractor for execution of plumbing installation works, with the exception of the water pump installations which is to be executed by an NSC under the supervision of the RC. Both the domestic subcontractor and the NSC will appoint individual Licensed Plumbers (LP) to take charge of their respective parts of the works. **Subcontracting of plumbing installation works will not relieve the RC from any of the RC's liabilities or obligations under the contract.** The RC is responsible for the acts, defaults and neglects of the domestic subcontractor or NSC, or their agents, employees or workers.

(b) Step 8 – The HD's Chief Architect serving the AP role of the project, as well as the RC's LP, jointly sign and submit Form no. WWO46 Part I to notify WSD of the commencement date and the scope of plumbing works to be carried out, and to certify that the pipes and fittings intended to be installed (including those listed in the Annex to the Form and those not listed) are as prescribed by the Waterworks Regulations. Form no. WWO46 Part II is to be completed by the Registered Consumer/Agent/Applicant of new water supply. Omission of any details in the Form or the Annex may cause delay to the application.

(c) Step 9 – The RC (with his domestic subcontractor and NSC) submits plumbing materials to the Contract Manager (CM) [3] (including copper pipe and fittings, sink/

[3] The Contract Manager is usually the HD's Chief Architect of the respective public housing project.

shower/ basin mixers, valves, water pump etc.) for approval. Disapproval by the CM entails resubmission by the RC until approval is obtained before such material(s) can be used on site.

(d) Step 10 – WSD completes Form no. WWO46 Part III, and addresses it to the LP (**not** to the AP) to indicate that it accepts the plumbing detailed in Part I, notes the commencement date of the plumbing works, and gives permission for the LP to proceed with the plumbing works as detailed in Part I and in the Annex.

8. **During construction stage -**

(a) Step 11 – The RC (with his domestic subcontractor and NSC) proceeds with the plumbing installation works on site.

(b) Step 12 – The RC is required to give continuous supervision and provide all necessary superintendence by providing a management team in the course of the works. The RC should also name a competent and authorized agent who will be constantly on the site on a full time basis dedicated to the superintendence of the works. The RC should execute the works in strict accordance with the contract to the satisfaction of the CM.

(c) Step 13 – The AP / CM and/ or his/her representatives should give periodical supervision and make such inspection as necessary to ensure that the works meet specified requirements.

9. **During completion stage -**

(a) Step 14 - The RC cleanses and disinfects fresh water inside service.

(b) Steps 15&16 – The AP confirms that the works are in compliance with Waterworks Regulations, and applies to WSD for connection of water supply by completing Form no. WWO132 Part II. At the same time, the LP notifies WSD of the completion of plumbing works, and requests that WSD inspect and approve the plumbing, by completing Form no. WWO46 Part IV, which is also signed by the AP and the applicant.

(c) Step 17 – After steps 14 to 16 above, WSD will collect water samples from water connection points for testing and analysis. **The quality of water samples is required to meet WSD's requirements. Before the promulgation of WSD's latest Circular Letter No. 1/2015, water samples had been tested against the eight parameters stipulated in WSD Circular Letter No. 2/2012, which include pH, colour, turbidity, conductivity, free residual chlorine, E.coli, total coliforms and heterotrophic plate count.**

(d) Step 18 – Upon obtaining satisfactory testing results, WSD issues the certificate for water supply connection.

Other Measures

10. On top of ensuring compliance with the statutory requirements, HA/HD has also put in place a number of measures to ensure the safety and quality of water supply -

(a) Upon completion of new estates, WSD collects water samples from water collection points for testing and analysis for the purpose of issuing the certificates for water supply connection. Concurrently, we require the RCs to carry out **additional water sample tests**. These additional tests serve dual purposes-

(i) they serve as a further test (with more samples) of the water quality standard against the parameters promulgated by WSD via its Circular Letter No. 2/2012 (and later No. 1/2015); and

(ii) these additional tests are carried out to meet the assessment criteria for water quality under Building Environmental Assessment Method (BEAM) Plus version 1.2 (a requirement which has been incorporated in the HA's contract specifications since 2012). To meet the BEAM Plus version 1.2 water quality criteria, the requirements specified in WSD's "Quality Water Supply Scheme for Buildings - Fresh Water" should be met. To achieve this, first, the water quality standard must meet the prescribed standards[4]. Secondly, all water samples should be taken in a manner described in ISO5667, ie. they should be taken at all the farthest points of use in the distribution system from the storage tank for each zone, and should include samples from each water supply tank used in the building. Also, the water tests have to be conducted by a Hong Kong Laboratory Accreditation Scheme (HOKLAS) accredited laboratory or an HA recognised laboratory.

(b) To address **the risk of Legionnaires' disease**, since 2012, HA/HD has also required the **RC to carry out an additional disinfection to the water supply system of newly completed estates** shortly before occupation. After disinfection with chlorinated water with a concentration of 50mg/L for two hours, the RC drains away the chlorinated water and flushes the water supply system with fresh water.

(c) During the course of the contract, HA/HD conducts **quarterly Performance Assessment Scoring System (PASS) assessments** with RCs on site to assess the quality of works including their

[4] The test parameters required under the Quality Water Supply Scheme for Buildings – Fresh Water are basically the same as those in WSD Circular Letter No. 2/2012 except there is one additional test parameter (iron) while two test parameters are omitted (free residual chlorine and heterotrophic plate count).

performance in plumbing installation (including type and size, pipe brackets, pipe sleeve etc.) and management of its domestic sub-contractors. PASS scores affect the allocation of future tendering opportunities to RCs and the evaluation of their submitted tenders.

IMPROVEMENT MEASURES

11. HA's mechanism outlined above, including the parts that seek to meet statutory and WSD's other requirements and the parts that are further to the statutory and WSD requirements, have been geared towards known issues with safety and quality of fresh water. These mainly concern (a) the **physical performance of the water supply system**, including the alignment of water pipes, position and quantity of brackets and whether they are firmly fixed, the adequacy and spacing of pipe sleeves, the connection of pipes, whether the materials used comply with contractual requirements, etc; (b) the **eight water test parameters** as stipulated under the WSD Circular Letter No. 2/2012, including pH, colour, turbidity, conductivity, free residual chlorine, E.coli, total coliforms and heterotrophic plate count; and (c) the **risk of Legionnaires' disease**. The mechanism **has not focused on the issue of lead (or other heavy metals)** in the water supply system or in the water. For example, the mechanism does not require examination of solder on joints between pipes for the presence of lead, or the inclusion of lead (and other heavy metals) in the water test parameters. This is consistent with the industry's practice and has not been required by law or WSD. The reason may be that the construction industry has all along believed that such widely used soldering materials should have complied with relevant requirements.

12. **On 13 July 2015, WSD issued Circular Letter No. 1/2015** to, among other things, remind about **the use of lead-free solders for copper pipes at fresh water Inside Services** as specified in the standard stipulated in the Waterworks Regulations, and **promulgate additional test parameters of water samples covering the four heavy metals of lead, chromium, cadmium and nickel** on top of the eight test parameters under WSD Circular Letter No. 2/2012.

13. In order to immediately reduce the risk of recurrence of the presence of lead in solder on joints and of excessive lead content in fresh water, HA/HD has put in place measures targeting these risks –

(a) For projects which are at the end of the construction stage, HA/HD will require the **RC to collect water samples and arrange accredited laboratory for bacteriological and chemical analysis according to the water quality requirements specified in the WSD Circular Letter Nos. 2/2012 and 1/2015**. As mentioned in paragraph 12 above, the new testing parameters as promulgated via WSD Circular Letter No. 1/2015 include four heavy metals covering lead. Concurrently, we will also require the **RC to take <u>additional</u> test samples for a <u>further water quality test</u>**;

(b) HA/HD will also require the RC to submit a subcontractor's management plan covering **stringent plumbing subcontractor supervision and on-site monitoring** to ensure that all workers will use only lead-free category of soldering/brazing materials for jointing of copper pipes including **quarantine soldering/ brazing materials**. **HA/HD staff will register the delivery of soldering/ brazing materials to site and conduct random checking** upon material delivery to site as well as after the RC has completed checking, for lead-free content in solder joint. RC is also required to define the roles of LP in supervising plumbing installation works; and

(c) At any time during construction stage, **quick test methods** will be used by the RC and HA/HD during **on-site checks for the presence of lead in solder joints**. Laboratory tests will be conducted if deemed appropriate.

14. These measures have been reported to the HA's Review Committee on Quality Assurance Issues relating to Fresh Water Supply of Public Housing Estates. The Review Committee, set up on 24 July 2015 in light of the present "lead in fresh water" incident, has yet to complete its work, and may have other findings on where our mechanism needs to be improved, and recommendations on improvement in procedures/guidelines and follow-up actions. WSD's Task Force on Excessive Lead Content in

Drinking Water may recommend measures to prevent recurrence of similar incidents in future. We shall keep in view such findings and recommendations.

BACKGROUND

15. The HA is a statutory body established under the Housing Ordinance (Cap. 283) in 1973 to develop and implement Hong Kong's public housing programme, with a mandate to help low-income families in need to gain access to affordable housing. The HD is the executive arm of the HA. It also supports the Transport and Housing Bureau in dealing with all housing-related policies and matters.

Transport and Housing Bureau
Housing Department

August 2015

FLOW CHART FOR DESIGN, CONSTRUCTION AND COMPLETION OF FRESH WATER SUPPLY SYSTEM IN HOUSING AUTHORITY'S PUBLIC HOUSING DEVELOPMENTS

ANNEX 1

Second Issue: 17 August 2015

Pre-Contract

Design Stage

Appoint Chief Architect as equivalent AP (also as Project Manager, Design Manager, Contract Manager)
By **HA**
(HA Paper No. RC3/2015 Para.5)

Submit Scheme Design for Client's Approval
By **PT**

Prepare GBP based on Approved Scheme Design
By **AP**

Submit GBP
By **AP**

Disapproved

Approve GBP
By **ICU**

1 Apply for Certificate Regarding Water Supply Availability
● WWO 132 Part I by **AP**

Q1
On top of compliance with the statutory requirements, HD incorporates the assessment criteria for water quality survey under BEAM Plus version 1.2 in the 2012 version of specifications.

2 Prepare Plumbing Drawings & Specifications
By **PT**

3 Submit Plumbing Proposal
By **PT**

Disapproved

4 Approve Plumbing Proposal
By **WSD**

Tender Stage

5 Prepare Building Tender Drawings and Specification
By **PT**

6 Arrange Tender Out→ Tender Return → Tender Assessment (Two-Envelope System with Technical and Price Proposals) → Contract Award

Post-Contract

Construction Stage

Notify Appointment of RC & Commencement of Works
By **AP**

7 Employ a Domestic Plumbing Sub-contractor who appoints a LP for Execution of Plumbing Installation
By **RC**

8 Notify WSD of the Commencement Date and Scope of Plumbing Works to be carried out
● WWO 46 Part I by **AP** & **LP**

9 Submit Plumbing Material to AP (including copper pipe & fittings, sink & shower & basin mixers, valves, water pump etc.)

Disapproved

Approved

10 Note Commencement Date/Permit to proceed with the plumbing installation
● WWO 46 Part III by **WSD** to **LP** for commencement of works

11 Construct and Install on site
By **RC**

12 Give Continuous Supervision
By **RC** and **TCPs**

13 Give Periodic Supervision
By **AP** and **TCPs**

Q2
On top of compliance with the statutory requirements, HD conducts quarterly PASS assessments.

Completion Stage

14 Cleanse & Disinfect Fresh Water Inside Service
By Plumbing Sub-contractor of **RC**

15 Apply for Connection of Water Supply & Confirm Compliance with Waterworks Requirements
● WWO 132 Part II by **AP**

16 Notify Completion & Request for Inspection & Approval by WSD
● WWO 46 Part IV by **AP** & **LP**

17 Inspect and Test Water Samples
By **WSD**

Satisfactory

Unsatisfactory

18 Issue Certificate Regarding Water Supply Connection
By **WSD**

Q2
On top of compliance with the statutory requirements, HD conducts PASS assessment at completion stage.

Conduct flat to flat final inspection/Testing & Commissioning
By **RC** then **PT**

Report Completion to AP
By **RC**

Certify Completion and Apply for Occupation Permit
By **AP**

Issue Occupation Permit
By **ICU**

Q3
On top of compliance with the statutory requirements, to address the risk of Legionnaires' disease, since 2012, HD has also required the water supply system of newly completed public rental estates to be disinfected with chlorinated water.

1) HA has been specifying the use of lead-free solder materials for jointing of copper pipes. (BS EN 1254-1:1998)

2) HA has checked submission of lead-free solder materials and approved for use on site.

3) HA has identified the major cause of the incident is the use of non-conforming solder materials for the jointing of copper pipes, which has escaped unnoticed, at the project stages highlighted with a "star" ★ .

4) HA has been / will be implementing improvement measures to address this problem -

   a) the latest additional water sample testing requirements, published under WSD's Circular Letter No. 1/2015 on 13 July 2015, to be incorporated in HA specifications and implemented to all on-going HA contracts with immediate effect. The four new test parameters and acceptance criteria required under this Circular Letter are: lead (≤10μg/L), cadmium (≤3μg/L), chromium (≤50μg/L) and nickel (≤70μg/L);

   b) ask contractors to declare the application of solder materials on site is lead free;

   c) include solder materials in on-site delivery verification; and

   d) strengthen inspection on soldering materials, ensuring compliance with contract requirements, i.e., explore the use of hand-held equipment in speedy on-site checks for lead content in soldering materials.

Legend

No. Key steps from Design to Completion Stage of Fresh Water Supply System

Q Current HD's practice on top of compliance with statutory requirements

Processes related to Buildings Ordinance (Chapter 123 & 123a) (BO) **under exemption** (enforced by ICU to exercise independent administrative building control over HA buildings in line with the BO and related requirements)

Processes related to Waterworks Ordinance (Chapter 102 & 102a) **without exemption** (enforced by Water Supplies Department)

HA's Practice on top of statutory requirements

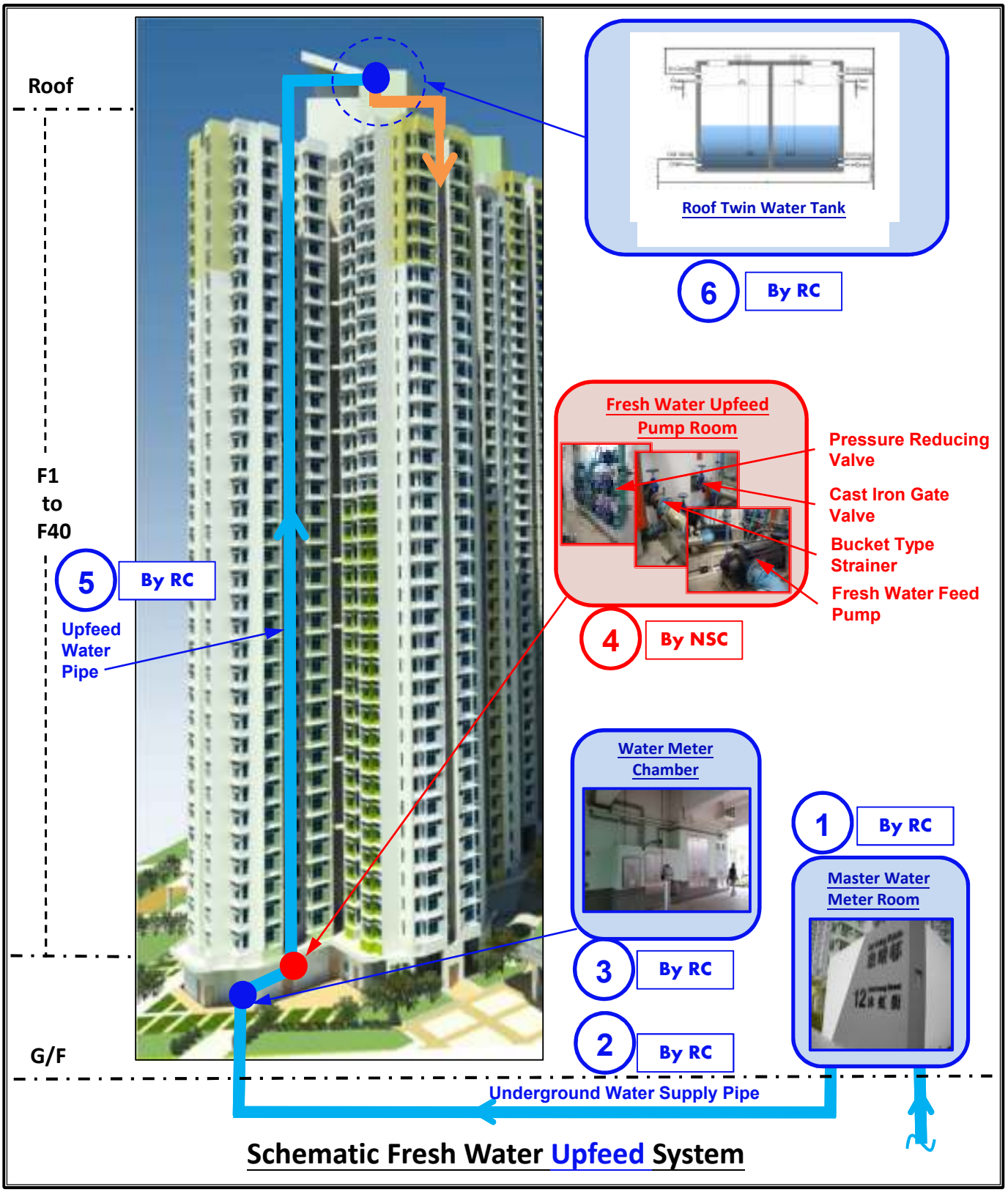
Colour Legend of Activities

- By HA
- By AP
- By PT
- By RC
- By LP
- By WSD
- By ICU

Abbreviations

AP	Authorized Person
ICU	Independent Checking Unit
GBP	General Building Plans
LP	Licensed Plumber
PT	Project Team
RC	Registered Contractor
TCP	Technically Competent Person
WSD	Water Supplies Department

Annex 2



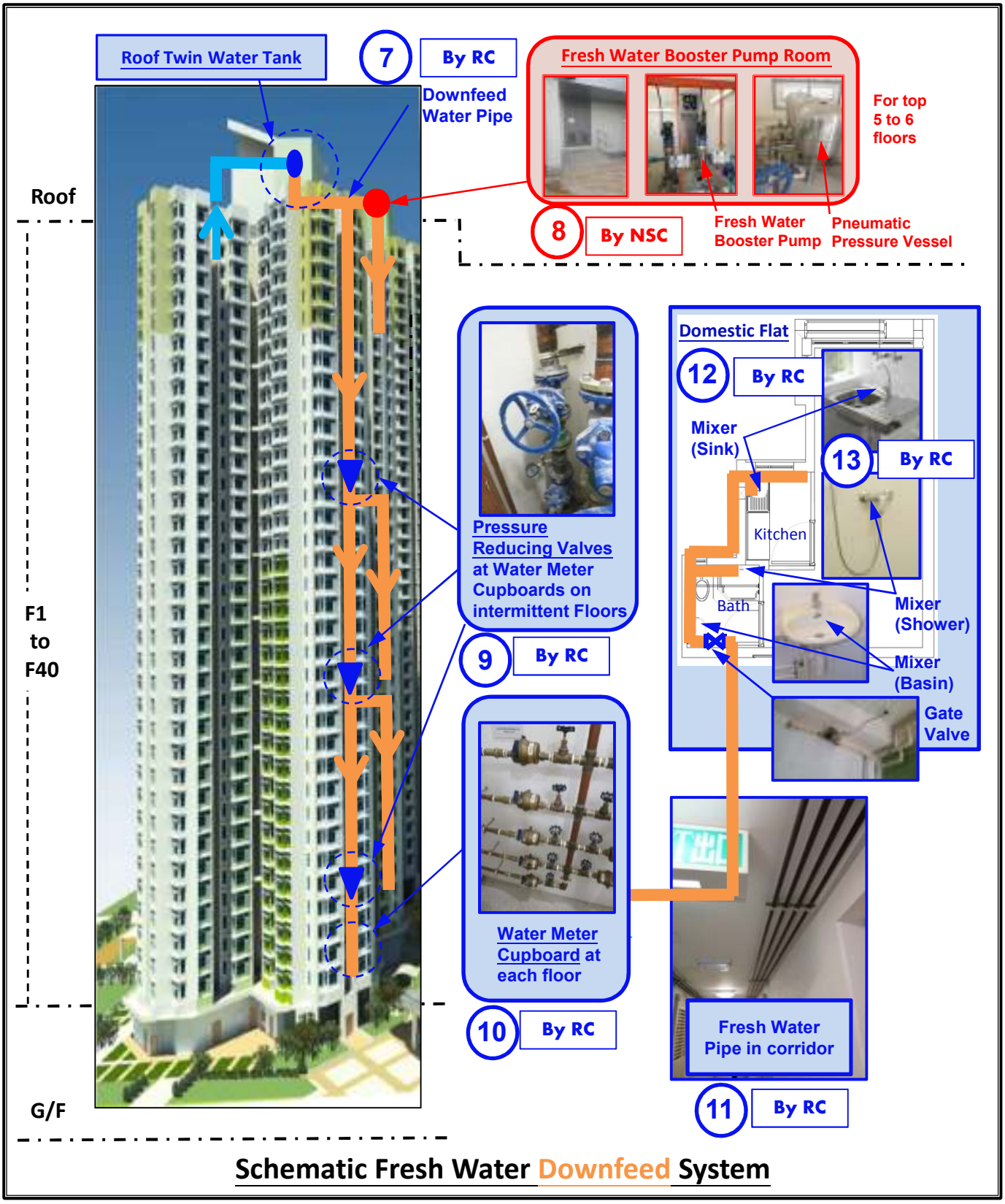
Schematic Fresh Water Upfeed System

Fresh Water Pipe (Ductile Iron) by RC

Fresh Water Pipe (Copper) by RC
[For 2012 or later versions of specifications, copper pipe for up to 76.1mm, ductile iron for larger pipe size]

By NSC — By Nominated Sub-contractor

By RC — By Registered Contractor



Schematic Fresh Water Downfeed System

Fresh Water Pipe (Ductile Iron) by RC

Fresh Water Pipe (Copper) by RC
[For 2012 or later versions of specifications, copper pipe for up to 76.1mm, ductile iron for larger pipe size]

By NSC — By Nominated Sub-contractor

By RC — By Registered Contractor

Annex B

Test results of water samples taken from public rental housing estates

The Housing Department (HD) and the Water Supplies Department (WSD) are systematically taking water samples from public rental housing (PRH) developments in which the fresh water supply systems were installed by the Hong Kong Housing Authority's main contractors, to determine whether the lead content in drinking water exceeds the World Health Organisation (WHO)'s provisional guideline value of not more than 10 micrograms per litre. In general, HD and WSD are taking water samples for testing by batches in accordance with the completion year of the PRH developments, starting with newly completed developments and working back to the older ones. Some estates involve more than one development, and the sampling tests for each development may be completed at different times. Once a batch of water sample tests are completed, HD will immediately announce the testing results.

（Results announced for 46 PRH estates involving 83 PRH developments up to 24 September 2015）

PRH developments with lead in water samples exceeding WHO's provisional guideline value

	Name of PRH development	Year of completion	No. of flats	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	115	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	130	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
8	Yan On Estate (Yan Hei House, Yan Yuet House, Yan Chung House)	2011	2,587	Yau Lee Construction Company Limited	69	5
9	Choi Fook Estate (Choi Lok House, Choi Sin House, Choi Hay House)	2010	2,524	Yau Lee Construction Company Limited	90	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

PRH developments with lead in water samples complying with WHO's provisional guideline value

	Name of PRH development	Year of completion	No. of flats	Main contractor	No. of samples taken	No. of samples with excess lead
1	Cheung Lung Wai Estate, Cheung Lung Lane and Cheung Lung Wai Estate Ancillary Facilities Block	2015	1,358	Yau Lee Construction Company Limited	45	0
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	150	0
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)	2015	3,039	China State Construction Engineering (Hong Kong) Limited	53	0 (Note)
5	Mei Tung Estate (Mei Tak House)	2014	990	Able Engineering Company Limited	24	0
6	Yee Ming Estate	2014	2,059	Hanison Construction Company Limited	102	0
7	Tak Long Estate, carpark block and kindergarten	2014	8,164	Yau Lee - Hsin Chong Joint Venture	198	0
8	Fung Wo Estate	2013	1,607	Hsin Chong Construction Company Limited	50	0
9	Cheung Sha Wan Estate and Cheung Sha Wan Estate Ancillary Facilities Block	2013	1,390	China State Construction Engineering (Hong Kong) Limited	47	0
10	Lung Yat Estate and Lung Yat Community Hall	2013	990	Shui On Building Contractors Limited	35	0
11	Mei Tin Estate (Mei Chuen House) and free standing block	2013	1,216	Hsin Chong Construction Company Limited	35	0

12	Shek Lei (II) Estate (Shek Foon House)	2013	839	Hip Hing Construction Company Limited	26	0
13	Ching Long Shopping Mall	2013	-	Zone A: China State Construction Engineering (Hong Kong) Limited Zone B: Yau Lee - Hsin Chong Joint Venture	20	0
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	73	0
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	56	0
16	Domain and Yau Tong Community Hall	2012	-	China State Construction Engineering (Hong Kong) Limited	8	0
17	Choi Fook Estate (Choi Foon House)	2011	915	Hsin Chong Construction Company Limited	27	0
18	Choi Tak Estate (Choi Yan House, Choi Yee House)	2011	1,586	Hsin Chong Construction Company Limited	40	0
19	Kwai Luen Estate Phase 1 (Luen Yan House, Luen Hei House)	2011	1,470	Shui On Building Contractors Limited	41	0
20	Mei Tung Estate (Mei Yan House)	2010	799	China State Construction Engineering (Hong Kong) Limited	27	0
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	82	0
22	Shatin Pass Estate (Wo Tin House, Shun Tin House)	2011	1,278	Chevalier (Construction) Company Limited	53	0
23	Yau Lai Estate Phase 5 (Cheuk Lai House, Yung Lai House) and carpark block	2011	2,002	Shui On Building Contractors Limited	36	0
24	Yau Lai Estate Phase 6 (i.e. Yau Lai Shopping Centre)	2011	-	Shui On Building Contractors Limited	4	0
25	Shin Ming Estate (Shin Chi House, Shin Lai House)	2011	1,974	Shui On Building Contractors Limited	49	0
26	Tin Ching Estate Tin Ching Amenity and Community Building	2011	-	Paul Y. General Contractors Limited	24	0
27	Chai Wan Estate (Wan Poon House, Wan Ying House)	2010	1,600	Nishimatsu Construction Co., Limited	46	0
28	Choi Tak Estate (Choi Shing House, Choi Shun House)	2010	1,462	Hanison Construction Company Limited	69	0
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	0
30	Tin Ching Estate Phase 3 (Ching Moon House, Ching Hei House, Ching Yuet House)	2009	2,365	Paul Y. General Contractors Limited	65	0
31	Shek Kip Mei Estate Phase 1 (Mei Yue House, Mei Ying House)	2006	2,033	Paul Y. General Contractors Limited	55	0
32	Sau Mau Ping (South) Estate (Sau Ho House, Sau Wong House)	2009	1,598	Chatwin Engineering Limited	130	0
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	0
35	Yau Lai Estate Phase 4 (Tsui Lai House, Hong Lai House, Yan Lai House)	2009	2,369	Shui On Building Contractors Limited	121	0
36	Yau Lai Estate Phase 3 (Ying Lai House, Fung Lai House)	2008	1,598	China State Construction Engineering (Hong Kong) Limited		
37	Shek Mun Estate Phase 1 (Kin Shek House, Mei Shek House) and supermarket	2009	1,958	Paul Y. General Contractors Limited	45	0
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	0
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	0
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	0
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		0
42	Choi Ying Estate Phase 1 (Ying Fu House, Ying On House)	2008	1,598	China State Construction Engineering (Hong Kong) Limited	137	0
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		0
44	Choi Ying Estate Phase 3 (i.e. Choi Ying Place)	2008	-	Shui On Building Contractors Limited		0
45	Ching Ho Estate Phase 1 Ching Ho Shopping Centre	2008	-	Yau Lee Construction Company Limited	3	0
46	Ching Ho Estate Phase 2 (Ching Ping House, Ching Yun House)	2008	1,598	China State Construction Engineering (Hong Kong) Limited	54	0
47	Tung Wui Estate Tung Tau Community Centre	2012	-	Paul Y. General Contractors Limited	1	0

48	Shek Kip Mei Estate Phase 2 Ancillary Facilities Block	2012	-	Yau Lee Construction Company Limited	6	0
49	Lower Ngau Tau Kok Estate Phase 1 Lower Ngau Tau Kok Estate Plaza	2012	-	Yau Lee Construction Company Limited	3	0
50	Yan On Estate Yan On Shopping Centre	2011	-	Yau Lee Construction Company Limited	2	0
51	Oi Tung Estate (Oi Yat House)	2008	716	Nishimatsu Construction Co., Limited	23	0
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	0
53	Lei Yue Mun Estate Phase 2 (Lei Lung House)	2007	799	Paul Y. General Contractors Limited	27	0
54	Shek Lei (II) Estate (Shek Wai House, Shek Yi House)	2007	1,598	Nishimatsu Construction Co., Limited	48	0
55	Ching Ho Estate Phase 3 (Ching Chak House, Ching Long House, Ching Chiu House)	2006	2,397	Shui On Building Contractors Limited	81	0
56	Kwai Chung Estate (Pak Kwai House, Hop Kwai House)	2008	1,983	Yau Lee Construction Company Limited	81	0
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	0
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	0
59	Kwai Chung Estate Phase 3 (Chui Kwai House, Pik Kwai House, Luk Kwai House)	2005	2,742	Yau Lee Construction Company Limited	84	0
60	Hin Yiu Estate (Hin Yiu House)	2005	799	Shui On Building Contractors Limited	26	0
61	Shek Yam Estate Phase 5 (Lai Shek House)	2005	340	Hanison Construction Company Limited	9	0
62	Kwai Shing (East) Estate (Shing Wo House)	2003	362	Hsin Chong Construction Company Limited	59	0
63	Tsz Lok Estate (Lok Foon House)	2003	265	China State Construction Engineering (Hong Kong) Limited	23	0
64	Lok Fu Estate (Lok Tsui House)	1994	360	Hung Wan Construction Co Ltd	16	0
65	Yat Tung (II) Estate (Mei Yat House, Mun Yat House, Kui Yat House)	2005	2,782	Yau Lee Construction Company Limited	108	0
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	0
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	0
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	0
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	0
70	Kwai Chung Estate Phase 3 Kwai Chung Shopping Centre	2005	-	Yau Lee Construction Company Limited	6	0
71	Kwai Chung Estate Phase 4 (Chin Kwai House, Tsz Kwai House)	2005	1,983	China State Construction Engineering (Hong Kong) Limited	70	0
72	Kwai Chung Estate Phase 5 (Hiu Kwai House, Ying Kwai House, Yuk Kwai House, Nga Kwai House, Yat Kwai House)	2005	4,515	Hip Hing Construction Company Limited	152	0

(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 provisional guideline value. 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 C

Press Releases

Task force announces preliminary findings of investigation into cause of excessive lead content in drinking water (with video)

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The task force set up by the Government on July 15 to investigate the cause of excessive lead in drinking water in public rental housing estates announced its preliminary findings today (September 25).

The preliminary findings revealed that leaded solder joints installed in the inside service were the cause of excessive lead in drinking water in Kai Ching Estate and Kwai Luen Estate Phase 2. Copper alloy fittings also leached lead but did not result in excessive lead in water.

Speaking at a press conference today, the Chairman of the task force, Mr Wong Chung-leung, said, "In the past two months, the task force held seven meetings and visited Kai Ching Estate and Kwai Luen Estate Phase 2 where excessive lead in drinking water was found. It dismantled more than 100 components (44 copper pipes, 28 valves, three meters, 12 taps and 47 solder joints) from the water supply chains. For control purposes, 22 components were also taken from a supply chain at Hung Hei House at Hung Fuk Estate in Yuen Long, where lead content in the water samples collected was found to be well below the World Health Organization (WHO) Provisional Guideline Valve (PGV), i.e. 10 micrograms per litre, for similar testing."

Also attending the media briefing, member of the task force Dr Chan Hon-fai explained the methodology of testing. He said that the task force had conducted leaching tests, elemental analyses of various components, mathematic modelling and lead isotopic analysis. The test results indicated that copper alloy valves, taps and solder joints of copper pipes with diameters below 76 millimetres dismantled from the water supply chain of Hong Ching House at Kai Ching Estate leached lead, with solder joints found to be leaching the highest amount of lead. Elemental analysis of solder joints showed that their lead content reached 41 per cent, 585 times the British Standard (BS) of 0.07 per cent lead.

The task force calculated the amount of lead leaching and the contribution from all pipe components by using the 24-hour leaching test results as the base. The analysis of the materials in copper pipes showed that they contained a very small amount of lead, meeting the BS. The level of lead leaching was even lower than the detectable level. As for copper alloy fittings, including valves, meters and taps, the BS specifies the lead content for different types of copper alloy, including the ratio of lead content. On the assumption that only copper alloy fittings leached lead, the leaching rate was calculated at 2.7 mcg per litre under mathematic modelling, well below the WHO PGV of 10 mcg per litre. The result was supported by the situation in Hung Fuk Estate, where stainless steel pipes, copper pipes with lead-free solder and copper alloy fittings were used and the lead content in the water samples collected complied with the WHO PGV. The task force, therefore, considered that excessive lead content in Kai Ching Estate and Kwai Luen Estate Phase 2 was not caused by the copper alloy fittings but the leaded solder joints.

The task force also made use of lead isotopic analysis to identify the source of lead. While the lead isotopic ratios of leaded solder and copper alloy fittings were found in two distinctive clusters, the mean value of the water samples with excessive lead closely agreed with the mean value of leaded solder. In other words, lead in water came from leaded solder.

Apart from investigating the leaching of lead, the task force examined the leaching rate of three other heavy metals - chromium, cadmium and nickel - in all the components dismantled from the water supply chains. Nickel was found in the leaching test of kitchen taps and washing machine taps at the units of Hong Ching House at Kai Ching Estate. As the taps contained a very small amount of water, however, nickel could be flushed away within one to two seconds after turning on the taps. The amounts of chromium and cadmium leached from all the components were undetectable (below 1 mcg per litre).

Separately, the task force found that some valves and taps installed were not those submitted to the Water Authority (WA) before the commencement of plumbing works, although they were on the WA's directory list of pipes and fittings. Some valves and taps installed did not comply with the BS requirements in respect of lead content. However, leaching test results revealed that the non-conforming valves and taps did not contribute to excessive lead in water.

The task force made the following recommendations:

1. Prevent use of leaded solder and non-conforming pipes and fittings:
(a) An enhanced system for site inspection and testing during construction of plumbing works
* Qualified persons (e.g. a building services engineer or a building services inspector) to carry out adequate and regular field inspection;
*Conduct systematic non-destructive tests of soldering joints during construction (e.g. conducting a quick lead test or using an x-ray forensic spectrometer);
* Arrange random sampling and testing of soldering materials delivered to the site;
(b) Stipulate the testing of four additional heavy metals (lead, chromium, cadmium and nickel) for water samples and testing the lead content of solder joints in newly completed inside service by Licensed Plumber and Authorised Person;

2. The WA to explore the use of pipe materials free from the risk of misuse of leaded joints in plumbing works, e.g. using silver brazing or compression joints for copper pipes or stainless steel pipes;

3. The Housing Authority to consider requiring the adoption of central procurement for solder materials; and

4. The WA to consider reviewing relevant legislation.

The task force reminded the public to take note of the following:

1. If water has been standing in pipes for a long time (for instance, after several hours of non-use, overnight, over a weekend or after a holiday), run water at the tap for about two minutes before using it for drinking or food preparation;

2. As hot water increases the amount of lead that may leach from pipe materials, use only water from a cold-water tap for cooking and drinking;

3. Use other pipe materials with very low risk of excessive lead in drinking water, such as stainless steel pipes, galvanised iron pipes or copper pipes with compression joints or soldered by silver brazing; and

4. For details, please refer to the brochure titled "Hong Kong's Water Supply - Reducing Lead in Drinking Water" which can be obtained in the Public Enquiry Service Centres in all Home Affairs Department District Offices and all estate management offices of the Housing Department or downloaded from the Information Services Department's designated website: www.isd.gov.hk/drinkingwater .

The task force aims to issue the final report in October.

Ends/Friday, September 25, 2015
Issued at HKT 17:39

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Task Force on Excessive Lead in Drinking Water

25 September 2015

Preliminary report

1. Preliminary findings
2. Testing
3. Recommendations

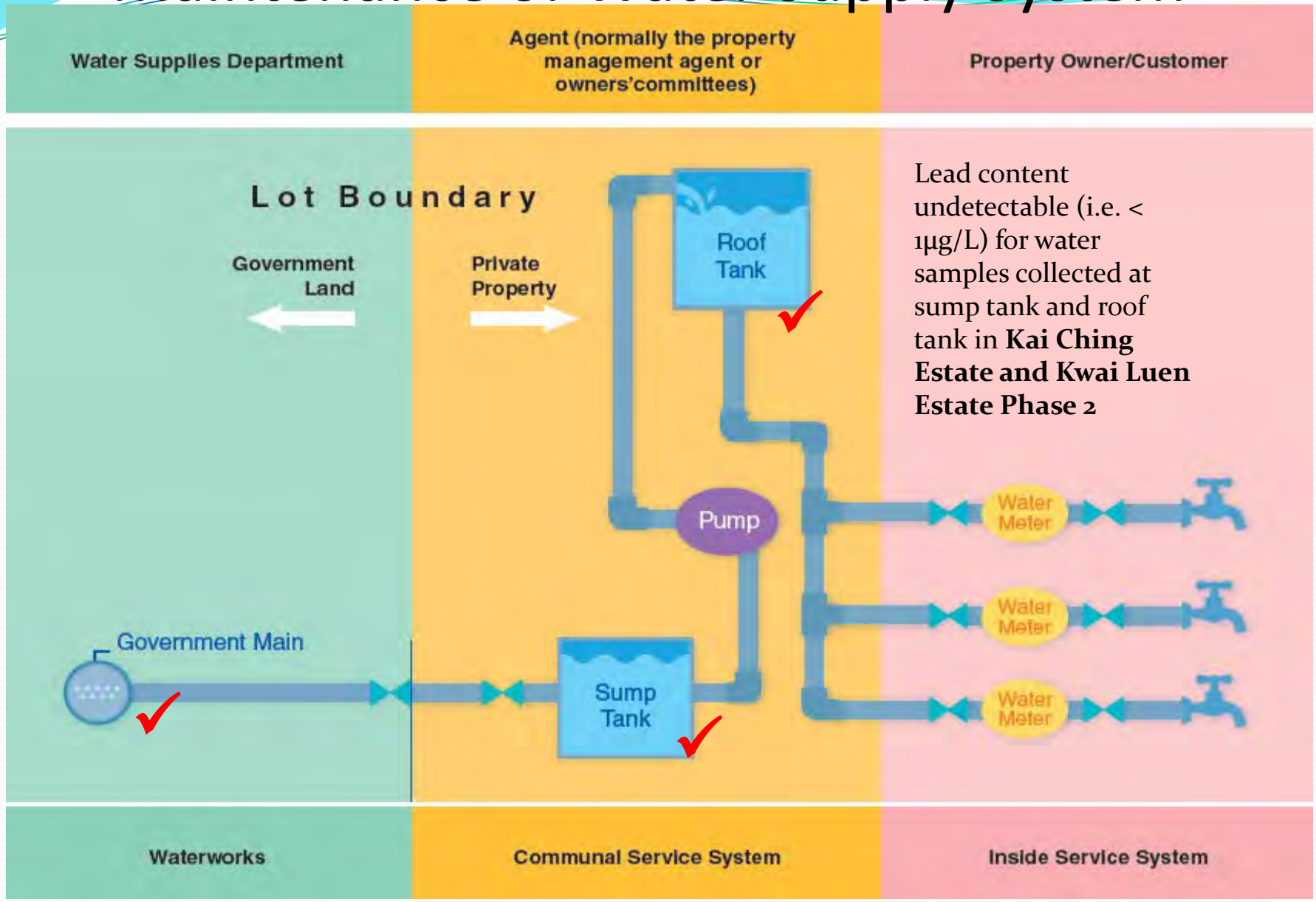
Preliminary findings
1. Excessive lead in water

- Leaded-solder joints are the source of excessive lead in drinking water in Kai Ching Estate and Kwai Luen Estate Phase II

- Copper alloy fittings also leach lead but do not result in excessive lead in drinking water

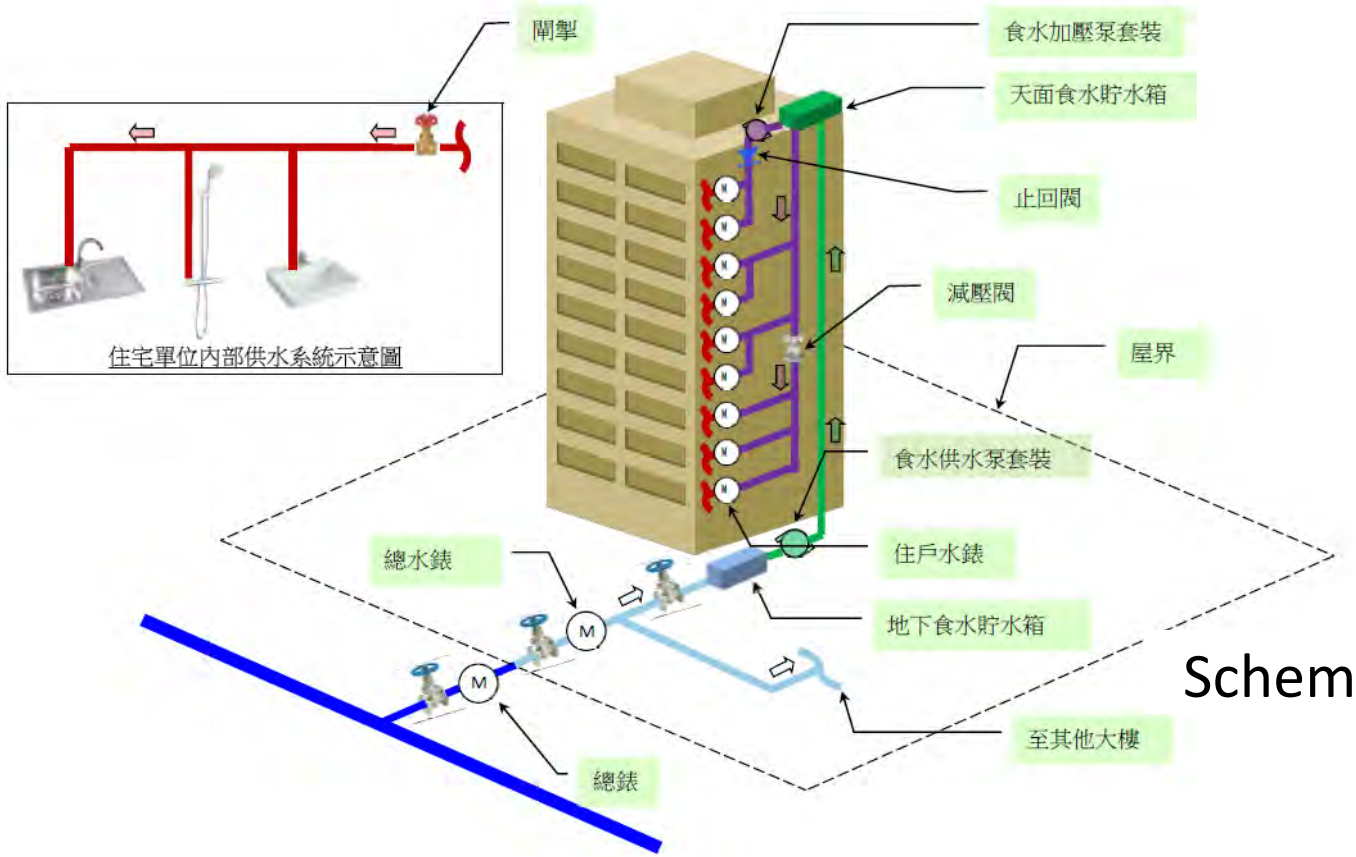
Testing

Maintenance of Water Supply System



Lead content undetectable (i.e. < 1μg/L) for water samples collected at sump tank and roof tank in **Kai Ching Estate and Kwai Luen Estate Phase 2**

As Constructed Inside Service in Kai Ching Estate and Kwai Luen Estate Phase II



Schematic Diagram

- Ductile Iron for risers (pipe in green)
- Copper for downpipes and branch pipes (pipes in purple and red)

Number of components from three water chains dismantled for examination/testing

Pipes, joints and fittings	Copper Pipes	Valves	Water Meter	Taps	Copper pipe Joints
Sample photos		 		 	 
Kai Ching Estate: Hong Ching Hse	15	8	1	4	17
Kai Ching Estate: Yuet Ching Hse	13	8	1	4	13
Kwai Luen Estate Phase II: Luen Yat Hse	16	12	1	4	17
Total	44	28	3	12	47
Hung Fuk Estate: Hung Hei Hse as 'control'	**3**	**11**	**1**	**4**	**3**

Leaching Test

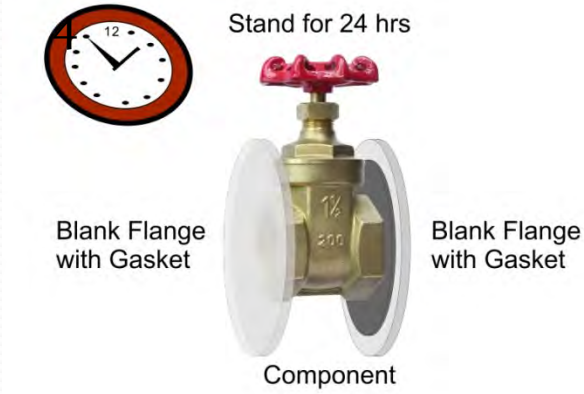
- Provide information on leaching of lead and other heavy metals from various components under 24-hr stagnant condition

1

2

3

4



5

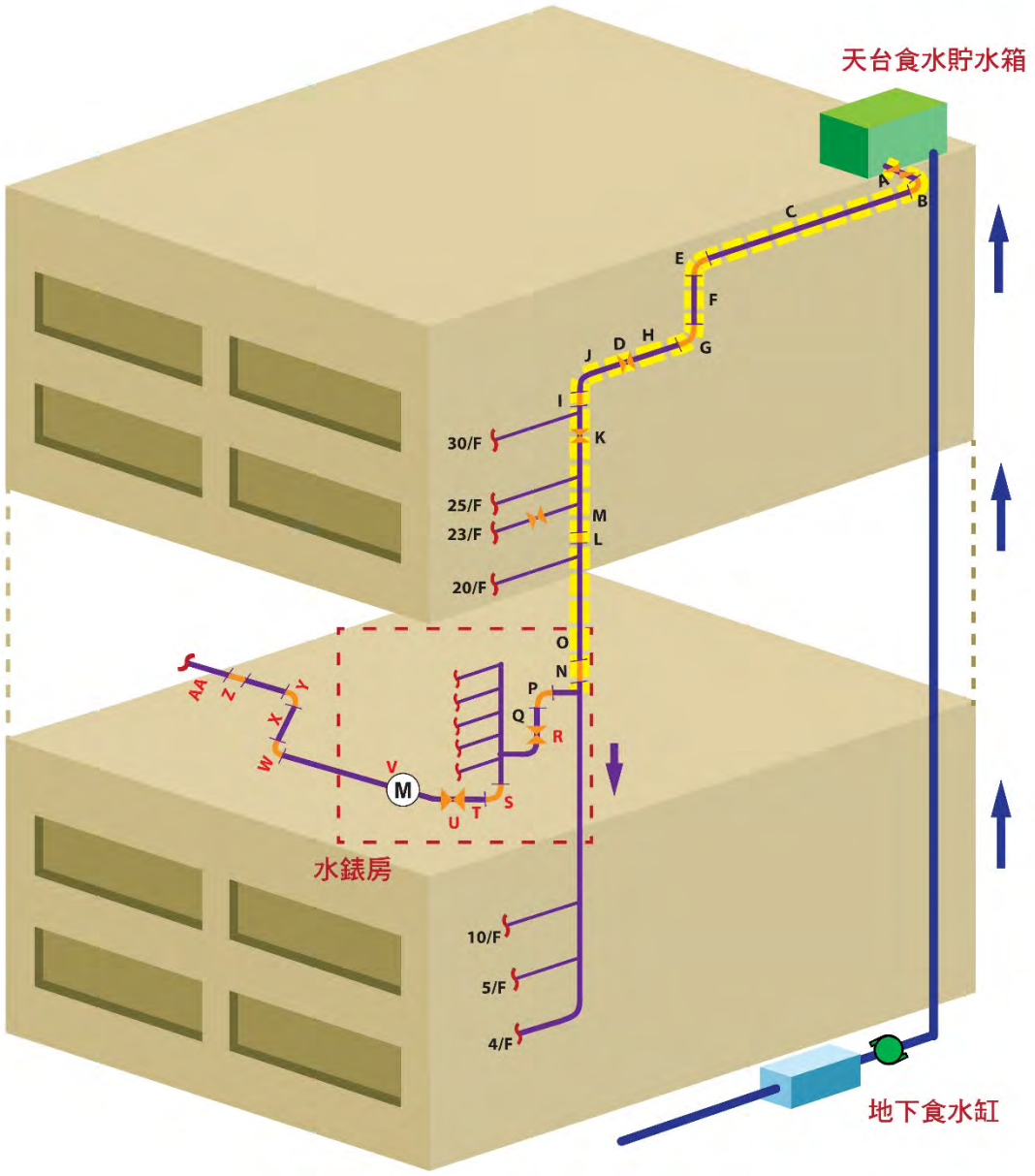
Check water samples for lead, chromium, cadmium and nickel by Inductively Coupled Plasma Mass Spectrometer (ICP – MS)

Lead Leaching Result for Kai Ching Estate (Hong Ching House) Downpipe from Roof to 14th Floor

Lead leaching from Cast Iron gate valves and copper downpipes / silver brazing joints with dia > 76mm **undetectable** or very minor*.

Item No.	Pipe / fittings	Test Result Pb* (μg)
A	150 mm dia. C.I. gate valve	0
B	150 mm dia. elbow	0
C	150 mm dia. copper pipe	0
D	150 mm dia. C.I. gate valve	0
E	150 mm dia. elbow	0
F	150 mm dia. copper pipe	0
G	150 mm dia. elbow	0
H	150 mm dia. copper pipe	0
I	100 mm dia. socket	0
J	100 mm dia. copper pipe	0
K	100 mm dia. C.I. gate valve	4.5
L	100 mm dia. socket	0
M	100 mm dia. copper pipe	0
N	80 mm dia. socket	0
O	80 mm dia. copper pipe	0

Note : *@24 hr

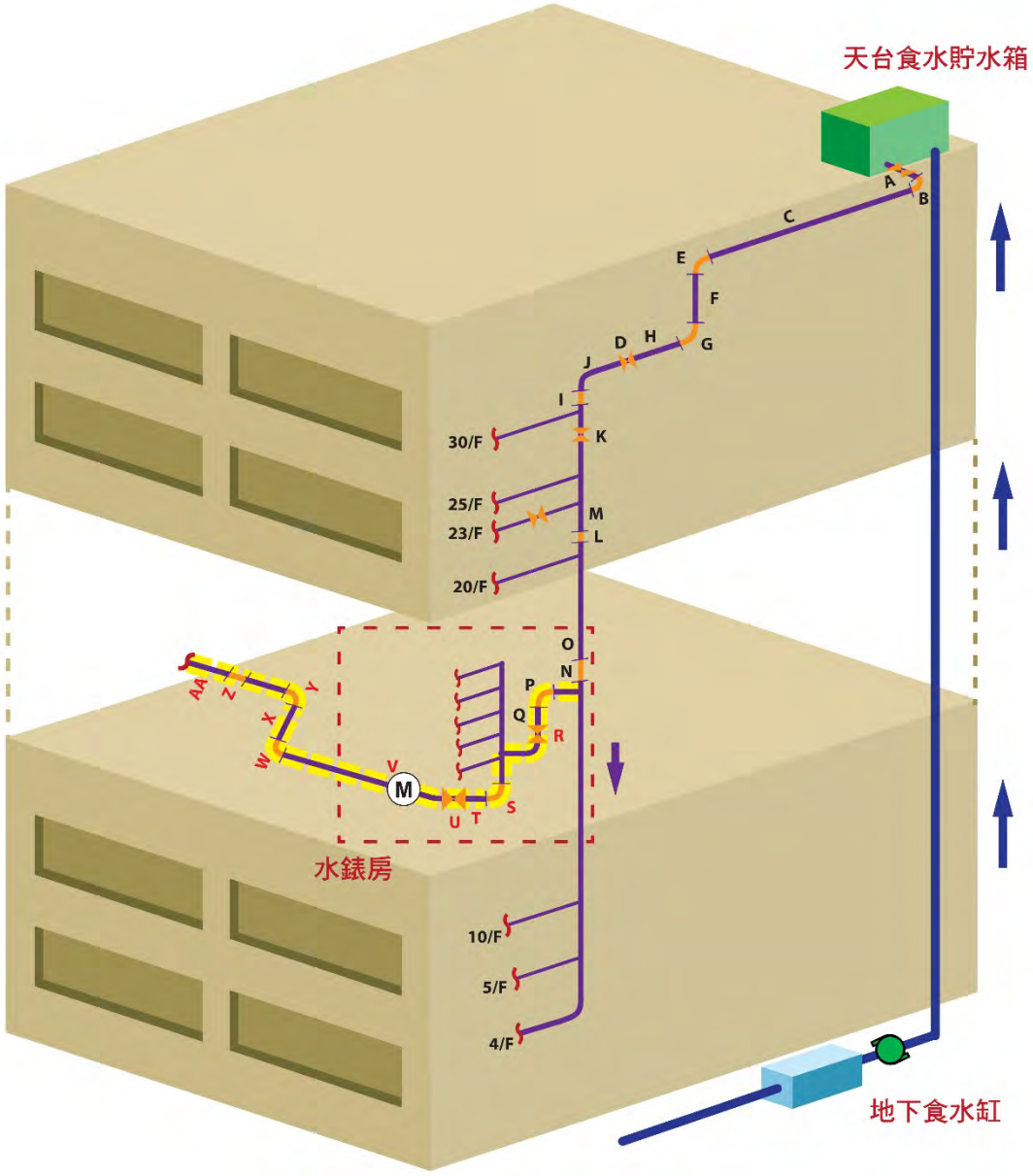


Lead Leaching Result for Kai Ching Estate (Hong Ching House)
Branch pipe leading to residential flat

Lead leaching from copper alloy valves , meters and copper pipes / solder joints with dia <= 76mm **detectable**.

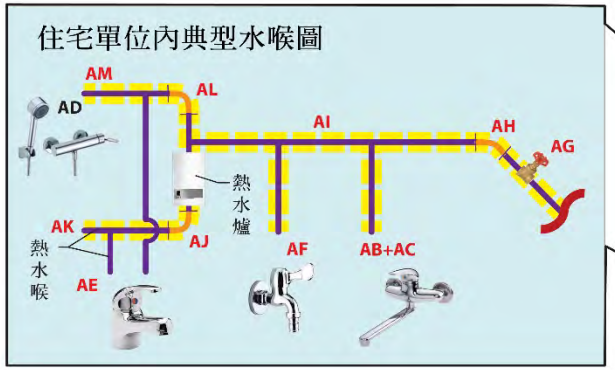
Item No.	Pipe / fittings	Test Result Pb* (µg)
P	40 mm dia. elbow	0.8
Q	40 mm dia. copper pipe	0
R	40 mm dia. copper alloy gate valve	10.3
S	20 mm dia. elbow	0.8
T	20 mm dia. copper pipe	2.5
U	20 mm dia. stop cock	13.8
V	15 mm dia. meter no. 12232841	3.7
W	20 mm dia. elbow	4.3
X	20 mm dia. copper pipe	1.3
Y	20 mm dia. elbow	17.3
Z	20 mm dia. socket	7.1
AA	20 mm dia. copper pipe	1.7

Note : *@24 hr



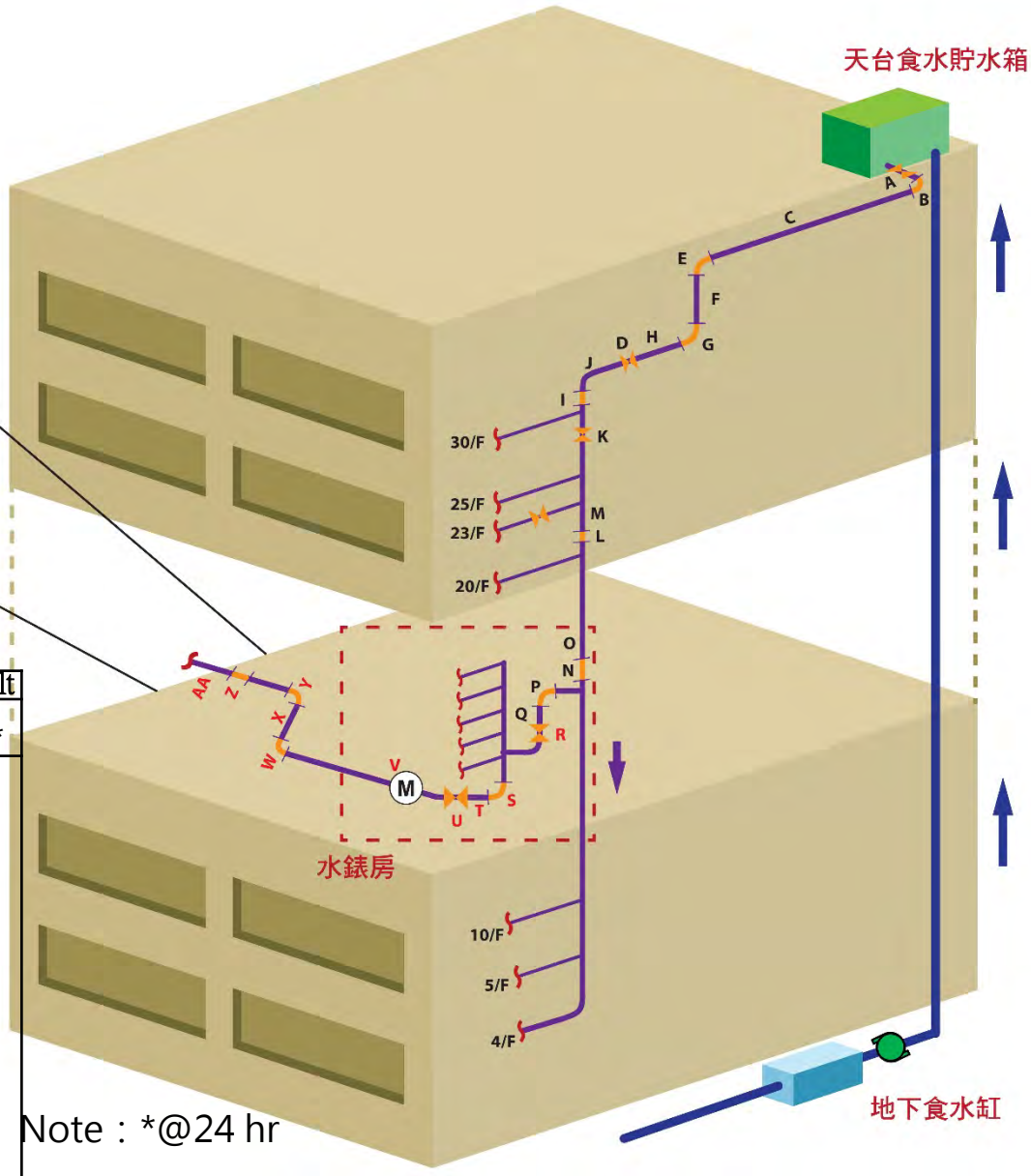
Lead Leaching Result for Kai Ching Estate (Hong Ching House)
Branch pipe within residential flat

Lead leaching from copper alloy valves, taps, and copper pipes / solder joints with dia <= 76mm **detectable**.



Item No.	Pipe / fittings	Test Result Pb (μg)*
AB	Tap at kitchen	4.1
AC	Tap at kitchen_part 2	2.1
AD	Shower tap at toilet	0
AE	Basin tap at toilet	4.6
AF	Tap for washing machine	13.7
AG	20 mm dia. gate valve	14.9
AH	20 mm dia. elbow at kitchen	14.9
AI	20 mm dia. copper pipe at kitchen	16
AJ	20 mm dia. elbow (hot water pipe) at toilet	639.8
AK	20 mm dia. copper pipe (hot water pipe) at toilet	7.7
AL	20 mm dia. elbow (cold water pipe) at toilet	3.5
AM	20 mm dia. copper pipe (cold water pipe) at toilet	5.5

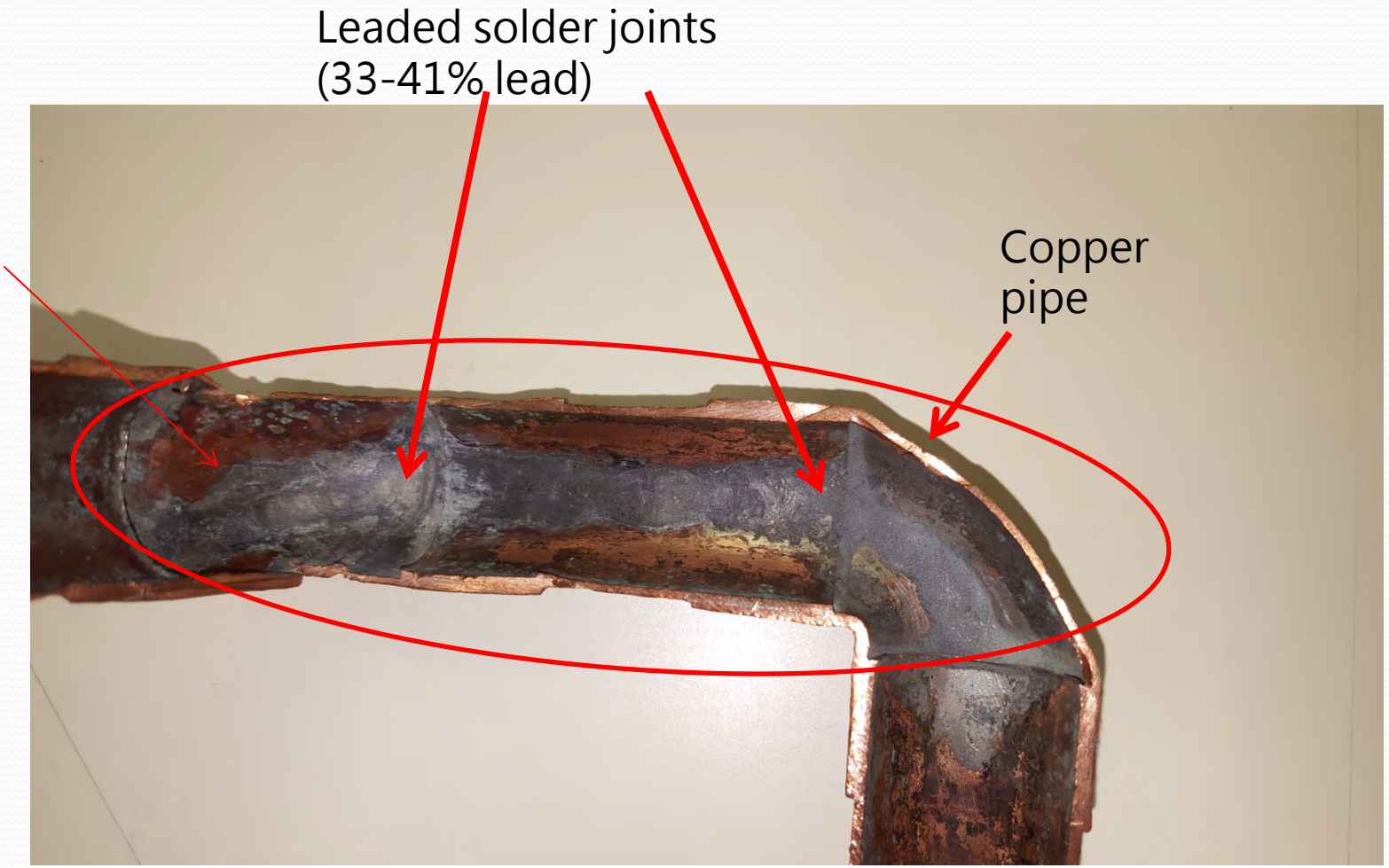
Note : *@24 hr



Summary of lead leaching test

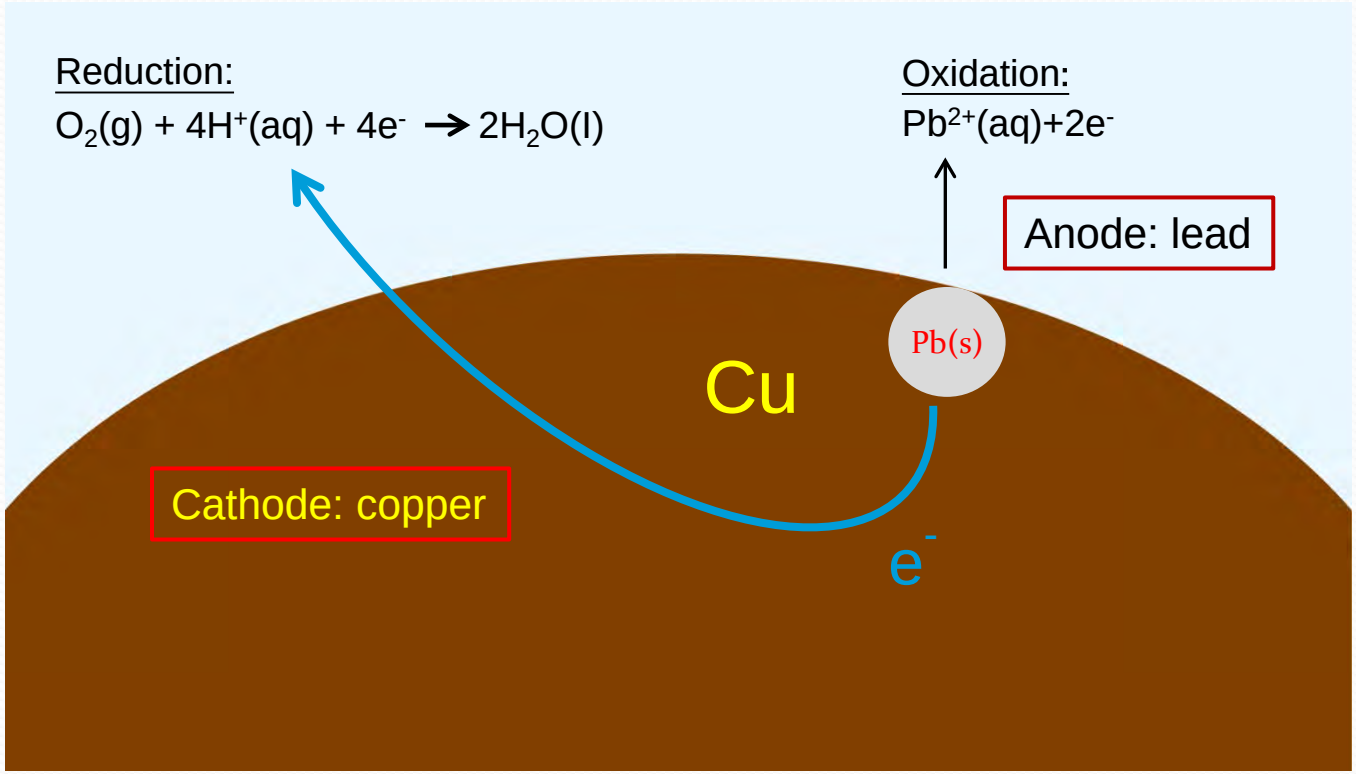
Pipes, joints and fittings		Copper Pipes	Valves	Water Meter	Taps	Copper pipe Joints
Sample photos			 		 	 
Total no. of components installed in Hong Ching House		**Numerous**	**8**	**1**	**4**	**194**
Lead Leaching (µg)*	Dia > 76mm	0	Cast iron 0– 4.5			Brazing joints 0
	Dia <=76mm	0 – 16	Copper alloy 10.3 – 14.9	3.7	0 – 13.7	Solder joints 1.4 – 639.8
Note: *@24 hr						

Leaded solder joints



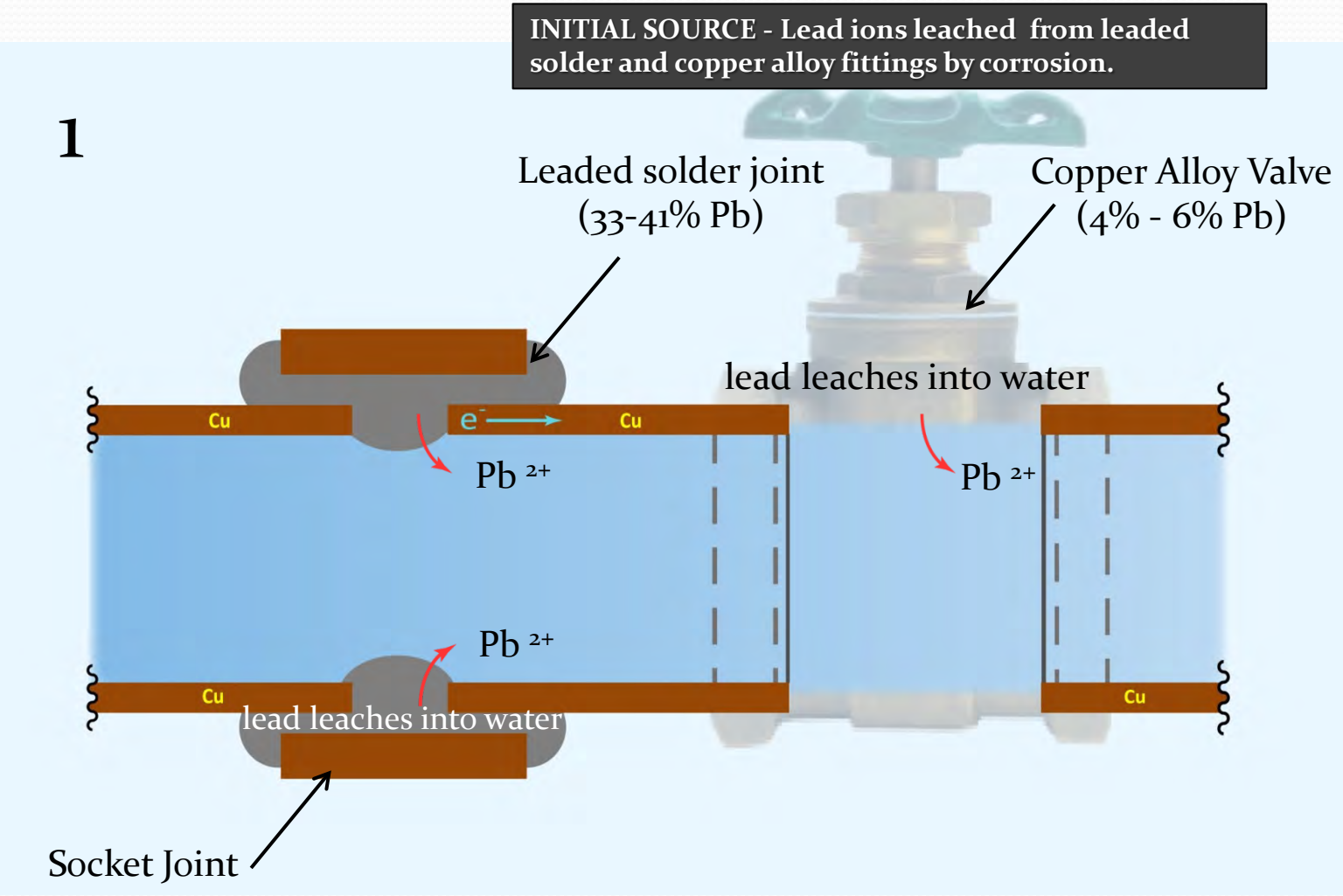
Lead solder seeped into the internal water surface due to unsatisfactory welding in some solder joints causing lead leaching.

Galvanic Corrosion



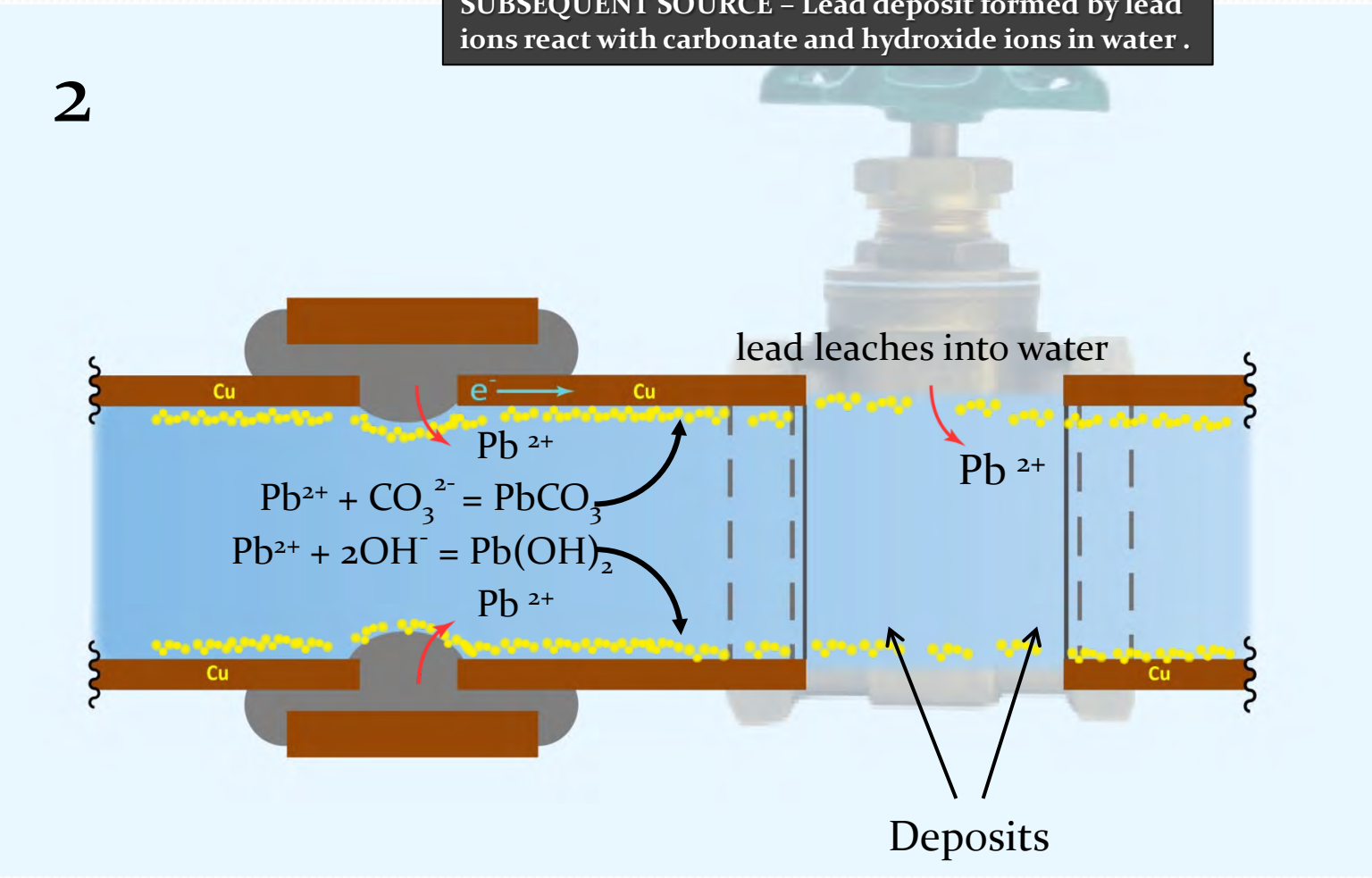
Cu: Copper alloy and copper pipe
Pb(s): From copper alloy and solder material (if leaded)

Lead leaching in water and formation of lead deposits



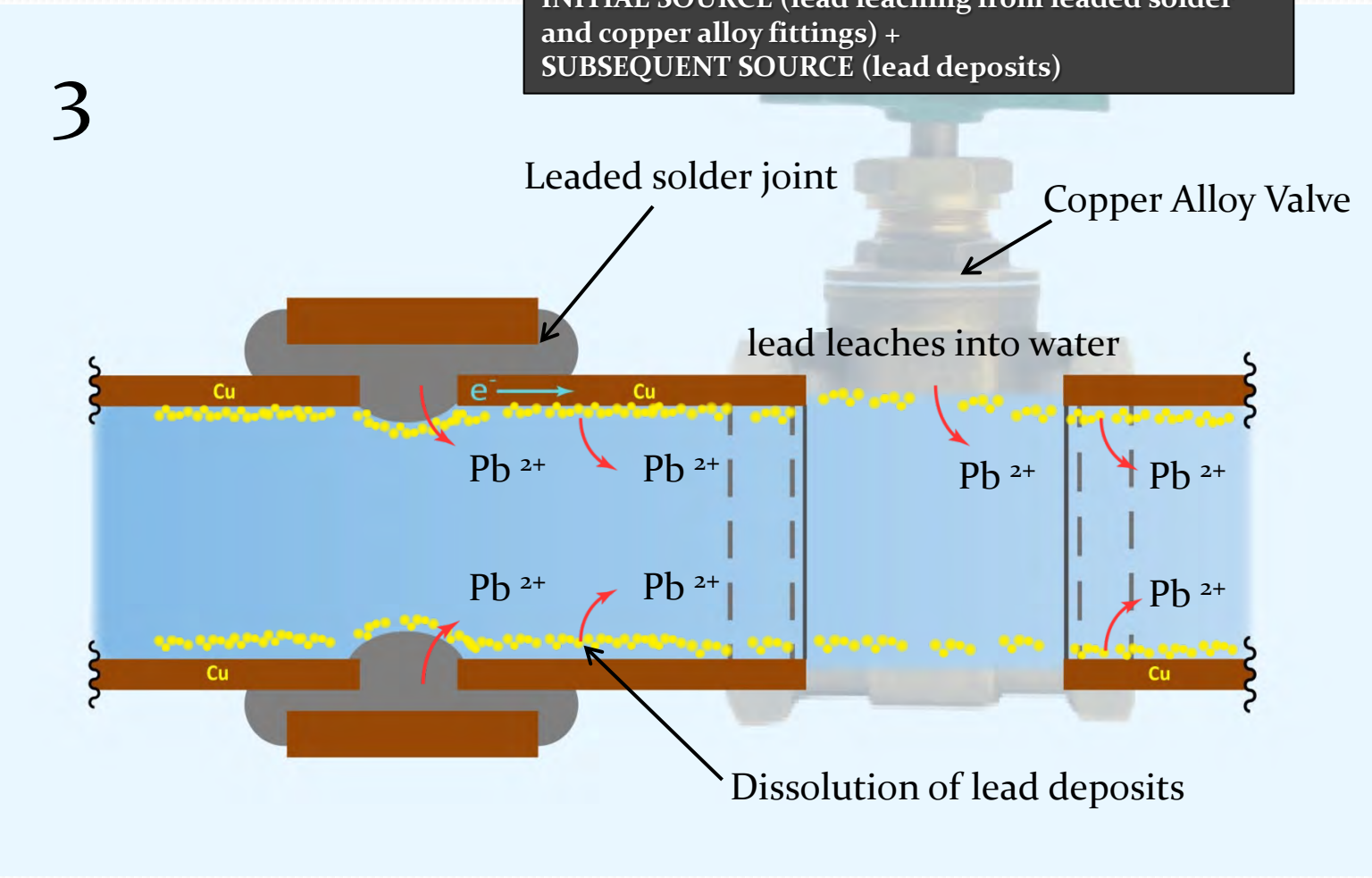
Lead leaching in water and formation of lead deposits

SUBSEQUENT SOURCE – Lead deposit formed by lead ions react with carbonate and hydroxide ions in water .



Lead leaching in water and formation of lead deposits

Source of Lead in water =
INITIAL SOURCE (lead leaching from leaded solder and copper alloy fittings) +
SUBSEQUENT SOURCE (lead deposits)



Lead deposits in branch pipes and pipe fittings

Copper Alloy Gate Valve

Copper pipe elbow

Copper pipe elbow

deposits

Lead leaching result after cleansing of lead deposits

Pipes, joints and fittings	Copper Pipes	Valves	Water Meter	Taps	Copper pipe Joints
Sample photos		 		 	 

	Lead Leaching?				
Before Cleansing	Yes	Yes	Yes	Yes	YES
After Cleansing	NO	Yes	Yes	Yes	YES

0.003 – 0.007 % impurities Comply with BS of less than 0.1% impurities

Observation

Copper pipes do not leach lead

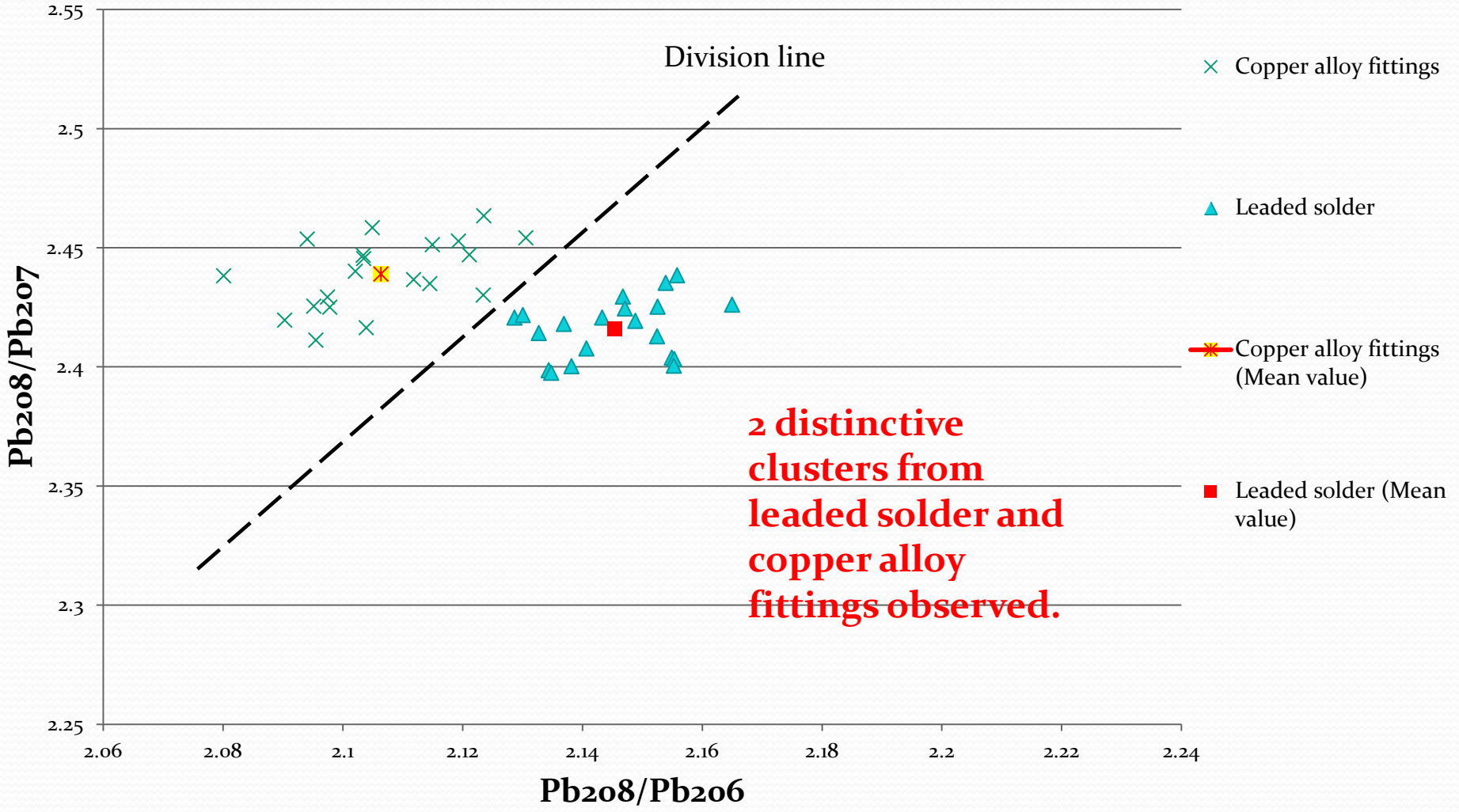
33 – 41 % lead in solder

NOT comply with BS of 'lead free' solder i.e. less than 0.07 % lead

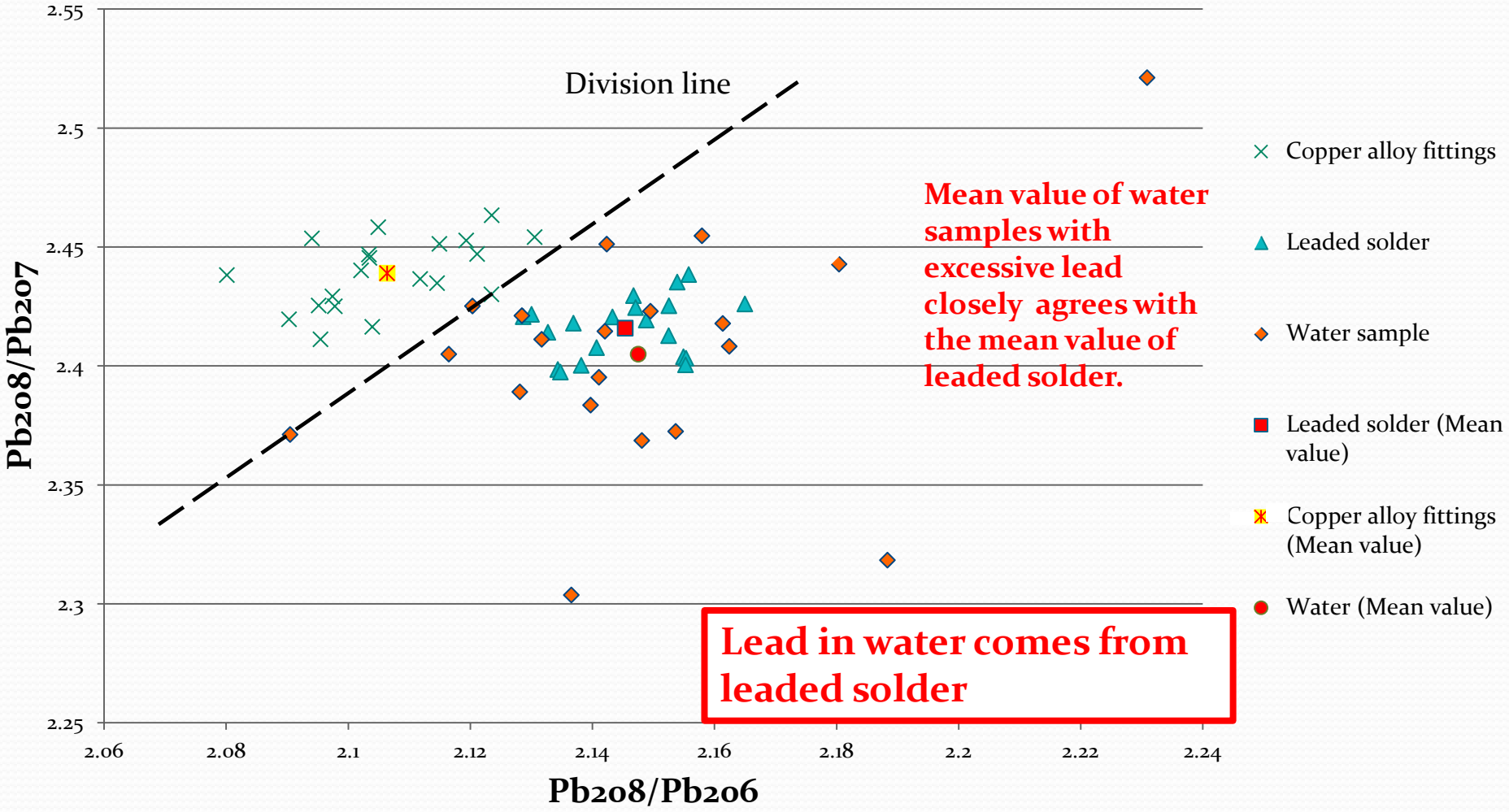
Lead isotopic analysis

- Lead contains three main isotopes – 206Pb: 207Pb: 208Pb.
- Lead from different origins has different isotopic ratios (like fingerprint)
- Precision instrument can measure the distribution of different isotopic ratios, thus locating the source of lead in water
- By working out the ratios of lead isotopes in leaded solder, copper alloy fittings and water samples with excessive lead content (fingerprints), we can find out the main source of lead in water

Isotopic analysis of leaded solder and copper alloy fittings

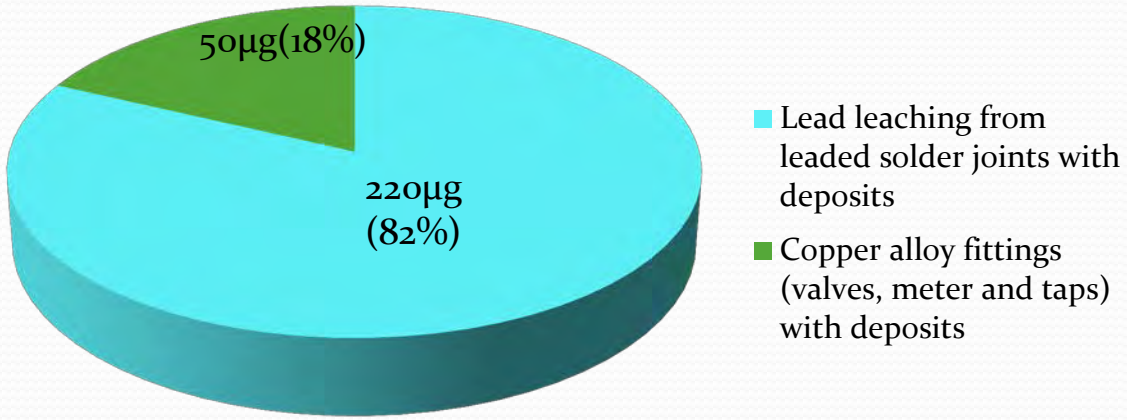


Isotopic analysis of leaded solder, copper alloy fittings and water samples with excessive lead

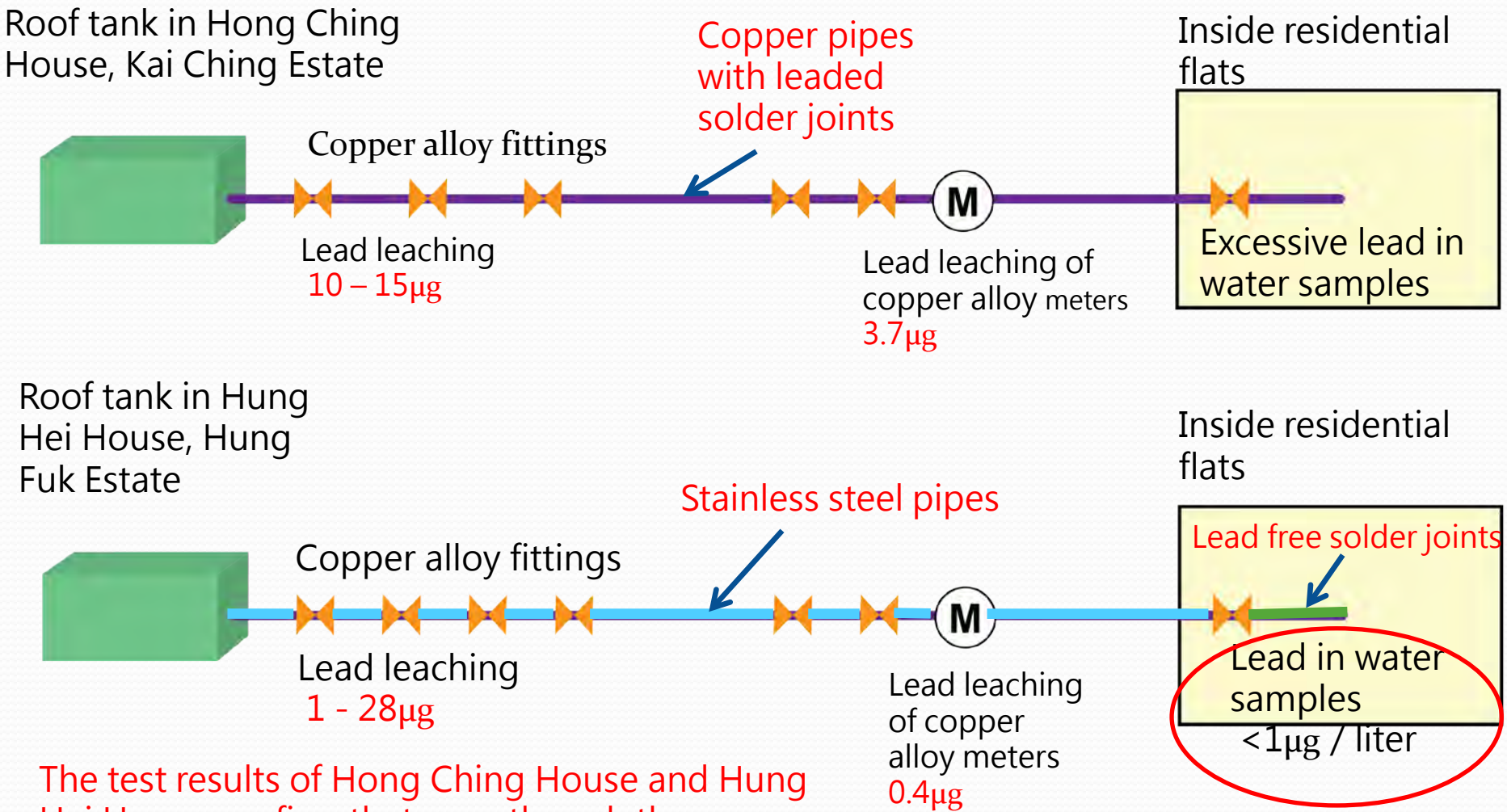


Mathematic modeling

- Calculate the total lead amount leached and the contribution from all pipe components by using the 24-hour leaching test results (see diagram below).
- Assuming only copper alloy fittings leach lead, calculated lead leaching: 2.7 µg/L, below WHO standard of 10 µg/L. Lead leached from copper alloy fittings does not result in excessive lead in drinking water.
- Mathematic modeling confirms that excessive lead in drinking water in Kai Ching Estate and Kwai Luen Estate Phase II is caused by leaded solder joints.



Can lead leaching from copper alloy fittings contribute to excessive lead in water?



The test results of Hong Ching House and Hung Hei House confirm that even though the copper alloy fittings leach lead, they do not result in excessive lead in water

- Similar findings were observed in Kai Ching Estate: Yuet Ching House, and Kwai Luen Estate Phase II: Luen Yat House

Conclusion

- Leaded solder joints are the source of excessive lead in drinking water in Kai Ching Estate and Kwai Luen Estate Phase II
- Copper alloy fittings also leach lead but do not result in excessive lead in drinking water
  - Confirmed by isotopic analysis
  - Mathematic modeling
  - Comparison between the findings in Hong Ching House and Hung Hei House

Preliminary findings
2. Leaching of other heavy metals

- Kitchen taps and washing machine taps in Kai Ching Estate leach **nickel** (under 24-hour stagnation condition)
- Taps contain very few amount of water (less than 150 ml), water with nickel can be flushed away in 1 to 2 seconds after turning on the tap
- Elemental analysis on the cross section of the taps show that nickel was seeped into internal surface of taps during electroplating
- Leaching test results for **chromium** and **cadmium** contents are undetectable, i.e. lower than 1 ug/L

Preliminary findings

3. Fittings non-complying with British Standard

Elemental analysis of fittings installed on site in Kai Ching Estate

Components		Installed on Site	Lead Content (%)	Submitted to WSD in WWO 46	On the directory list accepted by the WA
		Brand		Brand	
Copper alloy valve	65 mm dia Gate Valve	Victory	7.1 X , 5.9✓, 7.2 X	Waterfront	✓
	35 mm Gate Valve	Victory	7.5 X , 8.7 X	Ring	✓
	20 mm Gate Valve	Victory	7.8 X	Wealthmark	✓
	20 mm dia Stopcock	Victory	6.8 X, 5.9✓	Wealthmark	✓
Copper alloy tap	Shower mixer at toilet	Anspron	1.3✓, 1.5✓	Anspron	✓
	Basin mixer at toilet	Anspron	2.0✓ , 2.9 X	Anspron	✓
	Tap at washing machine	Daimler	1.4✓ , 1.8✓	A.T.A/Shing Shun	✓
	Single level Sink Mixer at kitchen	Anspron	2.0✓ , 2.1✓	Ansporn	✓

- **Some valves and taps installed were not those submitted to the Water Authority (WA), but they are on the directory list accepted by the WA and some valves and taps installed do not comply with BS requirement in respect of lead content. (According to BS EN 1982, the lead content of copper alloy valve and tap is 4%-6% and 0.5-2.5% respectively)**
- **Despite non-compliance with BS requirement, leaching test results of valves and taps not complying with BS requirement are similar to those complying with BS requirement. That is, they do not contribute to excessive lead in water.**

Review the existing control mechanism on inside service at the time of construction

Under Water Authority (WA)

- All pipes and fittings should comply with British Standards+
- Authorised Person^ (AP) and the Licensed Plumber (LP) need to submit a plumbing proposal and a list of pipes and major components of fittings
- The AP and LP have to confirm that all pipes and fittings are in compliance with the waterworks standards and requirements upon completion
- Inside service is inspected and approved by the WA
- Require LP to arrange water samples tested to be in compliance with specified standards before issue of the certificate regarding water supply connection by the WA (Testing for four heavy metals: lead, chromium, cadmium and nickel was not required before July 2015) #

  - + All pipes and fittings with certificates issued under Water Regulations Advisory Scheme or passed the laboratory test that in compliance with required standard are included in the directory list accepted by the WA
  - ^ AP as defined under Buildings Ordinance (Cap 123)
  - # The tests parameters include turbidity, colour, pH at 25°C, free residual chlorine, conductivity at 25°C, total coliforms, E. coli, heterotrophoc plate count. The above four heavy metals were not included. WSD Circular Letter 1/2015 dated 13.7.2015 specifies the requirement of testing for four heavy metals: lead, chromium, cadmium and nickel.

Review the existing control mechanism on inside service at the time of construction

Under Housing Authority (HA) contract

- **material specification** – (i) the use of lead-free solder materials for jointing of copper pipes; and (ii) the use of pipes and fittings complying with BS requirements
- a **material approval system** – requiring the Contractor's submission of documents/samples, and an undertaking by the Contractor that the materials are in full compliance with requirements. (For Kai Ching Estate, the Contractor's submission of lead-free solder checked and approved for use on site.)
- a **surveillance and control system** during the construction in which

  (i) Site staff checks materials upon delivery to site

  (ii) "Component and Materials Team" conducts laboratory tests of sink mixers and shower mixers to ensure compliance with the specified performance standards

  (iii) According to Building (Administration) Regulations, the Registered Contractor is to carry out continuous supervision, HA's Contract Manager serving as AP role and Technically Competent Persons (TCP) exercise periodic supervision by carrying out surveillance checks and test.

(The above control mechanism is being reviewed by the Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates of HA)

Reasons for not knowing the existence of lead in water in advance

- Did not check whether the solder joints contain lead
- Testing of water samples did not include the four heavy metals

→ Inadequate knowledge about the consequences of leaded solder material

Measures needed to formulate to prevent recurrence of similar incidents in the future

Recommendations

Prevent recurrence of similar incidents in future

1. **Prevent use of leaded solder material**

An enhanced system for site inspection and testing during construction of plumbing works

- Qualified persons (e.g. BSE/BSI) to carry out adequate field inspection on the plumbing works
- Conduct systematic non-destructive test to soldering joints during construction (e.g. quick lead test or x-ray forensic spectrometer)
- Arrange random sampling and testing of soldering materials delivered to site
- Stipulate the testing of four additional heavy metals (lead, chromium, cadmium and nickel) for water samples and testing of solder joints samples in newly completed inside service by AP and LP (WSD Circular Letters 1/2015 & 5/2015 already issued)

Prevent recurrence of similar incidents in future

2. The WA to explore the use of pipe materials free from the risk of misuse of leaded joints in the plumbing works, e.g.:
   - use of silver brazing or compression joint for copper pipes
   - use of stainless steel pipes

3. The HA to consider requiring the adoption of central procurement for soldering materials

4. The WA to consider reviewing relevant legislations

Points to note

- If water has been standing in the pipes, for instance, after several hours of non-use, overnight, over a weekend or after a holiday, run water at a tap, usually for about two minutes, prior to using it for drinking or food preparation.

- As hot water increases the amount of lead that may leach from the pipe materials, use only water from the cold-water tap for cooking and drinking.

- For other pipe materials, such as stainless steel pipes, galvanized iron pipes or copper pipes with compression joints are used, the risk of excessive lead in drinking water will be low.

- For details, please refer to the brochure titled “Hong Kong’s Water Supply – Reducing Lead in Drinking Water” which can be obtained in the Public Enquiry Service Centres of all Home Affairs Department District Offices and all estate management offices of the Housing Department or downloaded from ISD designated website: www.isd.gov.hk/drinkingwater.

Thank you