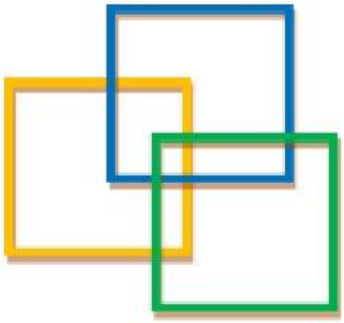
Hong Kong Institute of Utility Specialists
Non – profit Making Organization

Particular Specification For Buried Water Carrying Services Affecting Slopes



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Foreword

It's been more than ten years now since the disastrous landslip that occurred in Kwun Lung Lau on Hong Kong Island on 23 July, 1994. Since 1995, the Government of HKSAR has awarded tens of millions of dollars in contracts related to detection of leakage from buried water carrying services (BWCS) both on slopes and on the roads throughout the territory. As expected, this sequence of events generated an increasingly large pool of "Utility Specialists (US)", with most working almost independently, devoid of any standardized surveying methods, quality requirements (on survey results) and the "registration" of operation personnel in the market before the establishment of HKIUS in 2002.

In view of the availability of the multitude of method statements, specifications, training manuals, and the contracts documents produced for the vast number of underground utility survey contracts (by government and private projects), the following sections try to provide a comprehensive set of method statement, by addressing the following topics in general and where the abbreviation can be found in the Appendix:

(1) Utility Services Information to be Investigated
(2) Level of Accuracies
(3) Types of Deliverables and Schedules
(4) Requirements for Deliverables

You are welcome to take reference to this particular specification for your contract and in case you need further information, please send an e-mail to info@hkius.org.hk or call Ir Dr. King Wong.

Mr, Zico Kai Yip KWOK
(郭啟業先生)
President, HKIUS (2010-11)
April, 2011

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E1. Description

Buried Water Carrying Services (BWCS) refers to conduits used for carrying water buried underground. These include sewers, stormwater drains and water mains. Leakage from water carrying services may cause structural failures to slopes and retaining walls even at some distance away. It is difficult to notice leakage from conduits especially the buried ones. The Kwun Lung Lau Landslide in 1994 was a fatal disaster that caused by the leakage of the conduits on the crest of the slope.

Monitoring and repair of the buried water carrying services shall be carried out properly and periodically to ensure the structural integrity of the conduits and thus the stability of slopes. Moreover, Hong Kong is a hilly region with plenty of slopes and retaining walls, many structures are built on hilly areas, it would be important to carry out high quality survey to detect for any leakage of the BWCS to prevent the possibility of the recurrence of the Kwun Lung Lau incident.

E2. Survey Equipment

E2.1 Equipment

For monitoring and maintenance of water-carrying services affecting slopes, diverse types of specific equipment from several aspects is required. It includes equipment from utility survey, CCTV survey, manhole survey and water leakage detection.

E2.2 Locating buried water carrying services (Utility services)

Pipe-cable-locator (PCL) and Ground Probing Radar (GPR) are the equipment used for underground utility survey. PCL is electromagnetic type detection equipment and GPR is radar scan type detection equipment.

Hand-held receiver, signal generator (transmitter) and signal clip are three main components of PCL. Suggested by COP on Monitoring and Maintenance of water-carrying services affecting slopes, for metallic pipes, cables or non-metallic pipes with tracing tapes or wires, the output signal from the signal generator is either directly connected to the buried services using suitable connectors, or induced onto the services by placing the generator on the ground surface directly above the services. The hand-held detector then picks up the signal and the position at which it is the strongest will indicate the position of the buried utilities. If the pipe is non-metallic, the output signal can be radiated by ID marker (small transmitter) inserted into and pushed along the pipe from which the signal can be picked up by the detector.

Structures and features buried underground can also be mapped and located by GPR through adopting radio waves. Compare with PCL, GPR requires a large area for survey in order to distinguish different and congested utilities

E2.3 Closed Circuit Television Survey (CCTV survey)

Monitor, camera, video/DV recorder, text input device and control unit are the major components for CCTV survey. Suggested by COP on Monitoring and Maintenance of water-carrying services affecting slopes, CCTV cameras with pan and rotate head shall be used to enable the internal conditions of junctions and connections to the sewers and drains to be inspected closely.

Also, CCTV equipment shall be capable of surveying a length of sewers or drains up to 350m where entry to the sewers or drains may be obtained at each end and up to 30m by rodding or up to 150m where a self-propelled unit is used where entry is at one end only. The equipment shall be maintained in full working order and shall be fully calibrated in accordance with the manufacture's recommendation. (COP on Monitoring and Maintenance of water-carrying services affecting slopes, 2006)

CCTV camera is towed by winch and bond through the drain, all winches shall be stable with either lockable or ratcheted drums. All bonds shall be steel or of an equally non elastic material to ensure the smooth and steady progress of the CCTV camera. All winches shall be inherently stable under loaded conditions
Each unit shall carry sufficient numbers of guides and rollers such that, when surveying, all bonds are supported away from the drain and manhole structures and all CCTV cables and/or lines used to measure the camera's location within the drain are maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.

E2.4 Manhole survey

For manhole survey, the COP suggests the contractor shall equip the team undertaking the manhole survey work with equipment for easing and lifting manhole covers, confined space safety equipment, road safety equipment, personnel protective equipment (PPE), spirit level, bent rod and measuring tape.

E2.5 Water Leakage Detection

The major equipment to be used for slope leakage detection Contract includes the following items:

(1) Leak Noise Correlators

(2) Mechanical Leak Detectors

(3) Electronic Leak Detectors

(4) Noise Loggers

According to the COP, leak noise correlator is one of the most sophisticated leak locating instruments. It consists of the least two accelerometer sensors, two hydrophones, and a correlator. The accelerometer sensors are attached to the hydrants along the water main to be surveyed. The correlator analyses the leak noises collected by the two accelerometer sensors or the two hydrophones for locating the leak position. A correlation peak shows that a leak noise is present.
According to the COP, mechanical leak detector is a leak locating instrument which uses mechanical means to amplify the sound of a leak. It transmits the sound to the sound to the operator's ears through a hand held detector, which is in direct contact with the pipe, valves or fittings, ground/road surface or other contact points. Examples of such detectors include the listening stick and the geophone.

According to the COP, electronic leak detector is a leak locating instrument which uses electronic means to amplify the sound of a leak. It consists of a ground microphone, a noise amplifier, headphones and frequency filters. The leak noise is amplified and transmitted to either headphones, a loudspeaker or an indicating meter electronically. Background noises can be removed by electronic frequency filters. By listening at the regular intervals (above ground) along the line of the water main being surveyed, the user is able to identify both audibly (via the headphones) and visibly (from the indicating meter) where the strongest leak noise activity is located.

According to the COP, noise logger is a leak location instrument, which is installed at valves or fittings along a section of water mains being surveyed. It detects and records the constant source of noise generated by a leak, usually over a 2-hour period. The results are analyzed to identify whether there is a suspected leak in the section of a water main.

E3. Survey procedure

E3.1 General Survey

Calibration, Planning and Preparation

(1) Checking past record

(2) For private services, collect all information available regarding the assets from the client (asset owner).

(3) For public services, information can be obtained from various relevant Government Departments.

(4) Reconnaissance survey

(5) The full extent of assets (manholes, pipes, catch-pits and other ancillaries) located within the survey extents.

(6) Any other manholes and additional features not shown on the base mapping or layout plans, and/or revisions to match existing conditions on site

(7) Safety precautions include Permit-to-work (PTW), Temporary Traffic Arrangement (TTA), Personal Protective Equipment (PPE), etc

Operation

Utility survey:

(1) Locating buried water-carrying services

(2) Observe surface installations.

(3) Carry out utility survey.

(4) Electromagnetic method (PCL) for metallic pipes

(5) GPR for non-metallic pipes

Investigation

(1) Visual inspection to find out clues of leakage like water spots and seepage

(2) Inspection of drains

Checking

(1) Checking field data on site

(2) Final checked by RPUS

E3.2 CCTV and manhole survey

(1) High pressure water jetting if found suitable.

(2) CCTV survey / Man-entry survey if necessary.

(3) Manhole internal condition survey

(4) Inspection for water mains.

E3.3 Water Leakage Detection

(1) Leak Noise Correlation Survey.

(2) Mechanical Leak Detection/ Electronic Leak Detection.

E4. Submission of Survey Results

E4.1 General

Report shall consist each of the followings:

(1) Introduction
   a. Project name and Location
   b. Site appreciation

(2) Details of Investigation
   a. Date of Investigation
   b. Detailed description of the investigation procedure adopted
   c. All equipment used for the investigation
   d. Identification of supervisor and equipment operators carrying out the investigation

(3) Investigation results
   a. Summary of results
   b. Report on examination, analysis and interpretation of the investigation results;
   c. Identification of utilities, chambers (including all manholes) and sub-surface anomalies (if possible by GPR survey);
   d. Records of on-site verification of data handled by the qualified person (MHKIUS (BWCS)) responsible for the Report;
   e. Report on difficulties encountered

(4) Appendix
   a. Floppy diskettes or CDR for the digital data files of qualitative and numeric data about the underground assets found;
   b. Engineering Drawings (updated) showing the types and location of various underground assets;
   c. Survey Photographs - 3R coloured photographs (prints and negatives/digital copy in JPEG format)

E4.2 Utility Survey

For the part of Utility survey, following specific items shall be included:

(1) Survey report – name and certificate number of competent person, mandatory information, survey result, recommendation.

(2) Site photographs.

(3) Information of equipment used.

(4) Utility survey drawing – alignment, depth, diameter, direction (drainage services), type of the services, location of manholes and other related surface installations.

E4.3 CCTV Survey

For the part of CCTV survey, following specific items shall be included:

(1) Operator's report – background information, summary of pipes, summary of defects, recommendations

(2) Layout plan

(3) Video record – video record of the entire inspection

(4) Survey result

(5) Photographs – general photographs at 5m interval (if no defect is found) defect photographs capturing defects and defects shall be clearly seen

E4.4 Manhole Internal Condition Survey

For the part of manhole internal condition survey, following specific items shall be included:

(1) Location plan with all the manholes plotted within the survey extent.

(2) Manhole record card.

(3) At least 2 photographs (location photo and internal photo).

(4) Condition photos for any other circumstances.

E4.5 Water Leakage Detection

For the part of water leakage detection, following specific items shall be included:

(1) Name of Operator(s), (A/O/M/FHKIUS)

(2) Location of Survey,

(3) Date and Time of Survey,

(4) Total length of survey,

(5) Number of survey setups,

(6) Results (LNC print outs),

(7) Analysis of Results,

(8) Suspected or confirmed leak location with plan,

(9) Any difficulties encountered,

(10) Recommendations

E5. Quality Control and Quality assurance

E5.1 Training and Experience Requirements for Personnel

Monitoring of water-carrying services often requires the use of special equipment and demand judgment based on information available. Personnel taking part in the monitoring should be suitably experienced and trained. Table1 gives indicative guidelines.

A trial test may be required to demonstrate the ability of the proposed teams and the suitability of the equipment and methods before commencement of the inspection and leak detection.

E5.2 Quality Control of Manhole and CCTV Survey

Since the recommendations for the subsequent repair works are based on the findings of the surveys, quality check should be performed on the results of the inspection. The following quality check practices are recommended for surveys including a large number of manholes and drains:

(1) Validate data collected at surveys; and/or

(2) Re-survey a number of randomly selected manholes and sections of drains that have been inspected.

Data validation and inconsistency checks for manhole surveys should include items such as missing data, inconsistent pipe sizes, inconsistent invert levels, connectivity, etc.

E5.3 Quality Control of Leak Detection for Water Mains

The quality of leak detection in locating leaks in a water main may be checked by exposing the section of water main at the suspected leak location for verification. In addition, the following quality check methods may be adopted for leak detection works carried out, depending on the scale of works.

(1) Install identification tags randomly inside the valve chambers along the sections of water mains to be surveyed and request the contractor to report immediately on the findings of the tags during the course of the leak detection works; and/or

(2) Re-survey a number of randomly selected sections of the water mains that have been surveyed either by an independent qualified leak detection specialist or by using alternative instrument such as noise loggers if appropriate

E5.4 Interpretation of Results

Should a report of any survey length fail to achieve the specified standard, it should be recoded and the report of that length resubmitted.

In addition the coding of the five lengths completed immediately before and after the failed length should also be subjected to rechecking as part of an additional quality control check.

If there are any failed reports in this additional check, these should be recoded and resubmitted. Should any failure occur in the increased sample the selection should be increased by a further five lengths before and after, as above, until the required accuracy is achieved.

The ongoing accuracy of the specialist (the confidence level) should be calculated by taking the mean of each 5 percentage results (each 5 representing one control unit).

Both the individual survey percentages and the mean results should be entered on to the Specialist's Accuracy Graph. This graph should have three boundaries:

(1) Header - Record Accuracy

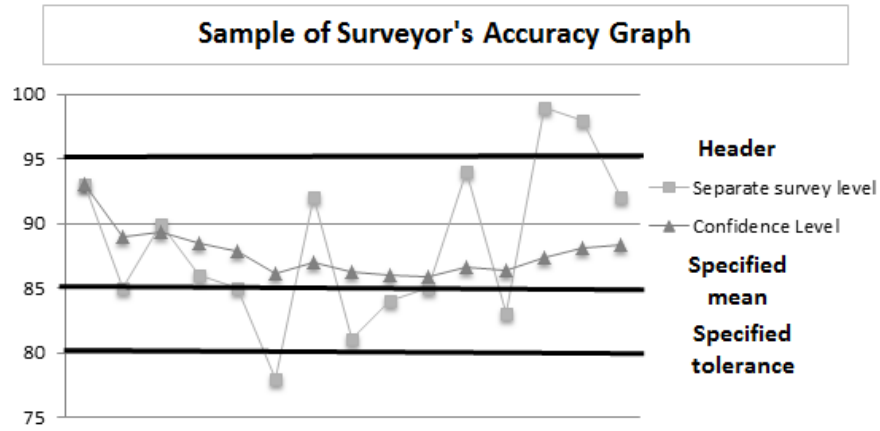
(2) Specified mean – Average surveyor's accuracy for each survey or inspection

(3) Specified tolerance – The minimum surveyor's accuracy for each survey or inspection

Any Specialist whose particular report is scored below the tolerance, the report has to be reviewed and re-submitted until achieving the HKIUS requirement.

For the separate survey level which means the particular surveyor's accuracy for his each survey or inspection. It should be recorded and submitted by particular surveyor's supervisor who shall be RPUS
For the confidence level which means the mean of particular surveyor's accuracy for each year. It represents how much confidence the utility specialist can provide to client.

Sample of Surveyor's Accuracy Graph



E6. Deliverable

E6.1 Preliminary Stage

(1) One set of preliminary digital data.

(2) One set of paper copy of drawings.

(3) Control results, including simple description of permanent ground markers.

(4) One copy of brief technical report drafted by MHKIUS and checked by RPUS.

(5) One set of photographs.

E6.2 Interim Stage (where necessary)

(1) One set of interim digital data.

(2) One set of paper drawings in 1:100 scale

(3) One copy of interim technical report drafted by MHKIUS and checked by RPUS

E6.3 Final Stage

2 copies of Final Report drafted by MHKIUS (BWCS) and checked by RPUS which is a compilation of all deliverables required under interim stage to incorporate all comments provided by the Engineer.

E7. Deliverable Schedule

Utility Specialists shall supply for the Site preliminary digital data and paper check plots including a draft technical report with control results within one week after the programmed completion of the works for the site. The Engineer may direct the Contractor to submit preliminary reports of the Site during the execution of investigation. The Contractor shall submit the reports within 1 week after the Engineer has given such written instruction at no additional costs.

Engineers shall return a copy of preliminary data with comments and correction progressively within one week data. The Utility Specialist shall incorporate the Engineer's comments on the preliminary data within the preparation of his Final Survey report.

The Utility Specialist shall submit a Final Report for the investigation within 4 weeks after the completion date of the Works.

E8. Presentation and Drawing

The investigation results (layout plan only) shall be plotted in 1:100 scale or other scale to be confirmed in A1 drawings on the specified grid and datum approved by the Engineer. The layout, border and title block shall be approved by the Engineer.

The drawings shall show building lines, roads with road names and traffic lane road markings, pavement and kerbs, and other significant physical features within the investigated area.

E9. Preliminary and Final Report

E9.1 Preliminary and Final Report

The Utility Specialist shall examine, analyse, process and interpret the investigation results and incorporate findings in a report. The report shall include the following essential information:

(1) Introduction
   a. Project name and Location
   b. Site appreciation

(2) Details of Investigation
   a. Date of Investigation
   b. Detailed description of the investigation procedure adopted
   c. All equipment used for the investigation
   d. Identification of supervisor and equipment operators carrying out the investigation

(3) Investigation results
   a. Summary of results
   b. Report on examination, analysis and interpretation of the investigation results;
   c. Identification of utilities, chambers (including all manholes) and sub-surface anomalies (if possible by GPR survey);
   d. Records of on-site verification of data handled by the qualified person (MHKIUS) responsible for the Report;
   e. Report on difficulties encountered

(4) Appendix
   a. Floppy diskettes or CDR for the digital data files of qualitative and numeric data about the underground assets found;
   b. Engineering Drawings (updated) showing the types and location of various underground assets;
   c. Survey Photographs - 3R colored photographs (prints and negatives/digital copy in JPEG format)

The drawings and textual report will be certified and stamped by the approved qualified person responsible for the preparation of the Report.

E9.2 Preparation of Survey Report

The Utility Specialist shall supply the Survey Report as described fully as in the above. This report shall include all results with a detailed discussion and accompanying plans. It shall be prepared and signed by an qualified person who shall hold one of the following qualifications:

(1) MHKIUS (BWCS) plus 2 years local experiences or RPUS; or the following

(2) MICE, or MHKIE or MHKIS with relevant training and 10 years post-training experiences.

E10. Personnel Requirement

In order to maintain the Utility Profession's requirements for the consistency, reliability and accuracy of reports, inspection shall be performed by a properly trained and accredited personnel, for example, OMHKIUS or MHKIUS.

Personnel responsible for surveying and report preparation shall hold a certified qualification issued by a Registered Training Organization (RTO), such as Utility Training Institute (UTI) or The Hong Kong Polytechnic University or equivalent approved by HKIUS.

A certified qualification shall be:

Either Degree, Professional Diploma, Professional Certificate or equivalent approved by HKIUS in Utility Surveying and Management or related subject awarded by a RTO such as Utility Training Institute or The Hong Kong Polytechnic University.

Further information can be referred to the Appendix A2 in this PS.

References

(1) 16/WSD/97, Leakage Detection of Buried Watermains Affecting Slopes - Stage I, Water Supplies Department

(2) 3M Cable Locator User Manual

(3) Code of Practice (COP) on Monitoring and Maintenance of Water-Carrying Services Affecting Slopes. (2006). Hong Kong: Environment, Transport and Works Bureau, HKSAR.

(4) Course Note, Advanced Water Leakage Detection/Survey for Operators, Engineer/ Specialists and managers, UTI, 2005

(5) DC96/19, Investigation of Sewers and Drains Behind and Adjacent Fill Slopes and Retaining Walls, Drainage Services Department.

(6) HKHA161/95, Detection of Leakage from buried water carrying services in the vicinity of slopes 'and retaining walls within the lands 'maintained by Housing Authority.

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(8) King Wong (2000), The design of Water Leakage Detection Methods for Hong Kong. An unpublished Master Degree Thesis at The University of Hong Kong.

(9) Method Statement for Conduit Condition Evaluation. (June, 2011). Hong Kong, China: HKIUS.

(10) Method Statement for Manhole Internal Condition Survey. (June, 2011). Hong Kong, China: HKIUS.

(11) Method Statement for Utility Mapping By Non-Destructive Methods. (June, 2011). Hong Kong, China, HKIUS

(12) Method Statement for Water Leakage Detection Survey. (June, 2011). Hong Kong, China: HKIUS.

(13) W. Lai, S. Tsang & K. Wong, Applications of Ground Penetrating Radar in Civil Engineering Works, 2004

(14) Work Procedure for Conduit Condition Evaluation (CCTV and Man Entry Survey). (June, 2011). Hong Kong, China: HKIUS.

(15) Work Procedure for Manhole Internal Condition Survey (MHICS). (June, 2011). Hong Kong, China: HKIUS.

(16) Work Procedure for Utility Mapping By Non-Destructive Methods. (June, 2011). Hong Kong, China: HKIUS.

(17) Work Procedure for Water Leakage Detection Survey. (June, 2011). Hong Kong, China: HKIUS.

(18) King Wong(2009), Hong Kong Conduit Condition Evaluation Codes(HKCCEC) The Code of Practice on Conduit Condition Evaluation using CCTV in Hong Kong, 4th Edition,UTI.

Appendix

A1 Abbreviations

Company/ Organization	
Code	Description
BD	Buildings Department, HKSARG
CEDD	Civil Engineering and Development, HKSARG
DSD	Drainage Services Department, HKSARG
EMSD	Electrical and Mechanical Services Department, HKSARG
EPD	Environmental Protection Department, HKSARG
HA	Hong Kong Housing Authority, HKSARG
HKIUS	Hong Kong Institute of Utility Specialists, HKSARG
HKURC	Hong Kong Utility Research Centre
HyD	Highways Department, HKSARG
LandsD	Lands Department, HKSARG
LD	Labour Department, HKSARG
PolyU	The Hong Kong Polytechnic University
UTI	Utility Training Institute
WRc	Water Research Centre
WSAA	Water Services Association Australia
WSD	Water Supplies Department, HKSARG
WTI	Water Training Institute
Others	
Code	Description
%	Percentage
BMP	Bitmap (Picture Format)
BWCS	Buried Water Carrying Service
CCE	Conduit Condition Evaluation

Company/ Organization	
CCE(CCTV & ME)	Conduit Condition Evaluation(Closed Circuit Television & Man- Entry)
CCES	Conduit Condition Evaluation Specialists
CCTV	Closed Circuit Television
CD	Compact Disc
CL	Cover Level
COP	Code of practice
CP	Competent Person
DN	Nominal Diameter
DP	Design Pressure
DVD	Digital Versatile Disc
e.g.	Exempli Gratia
GIS	Geo-Information System
EPR	Environmental Protection Requirements
etc.	et cetera
GL	Ground Level
H	Height
HKCCEC	Hong Kong Conduit Condition Evaluation Codes
HPWJ	High Pressure Water Jetting
hr	Hour
Hz	Hertz
ICG	Internal Condition Grade
ID	Internal Diameter
IDMS	Integrated Data Management System
IL	Invert Level
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group (Picture Format)

Company/ Organization	
kHz	Kilo- Hertz
kPa	Kilopascal
m	Meter(s)
ME	Man Entry
MHICS	Manhole Internal Condition Survey
mm	Millimetre(s)
Mpa	Megapascal
MPEG	Motion Picture Experts Group (Video Format)
MS	Method Statement
MSCC	Manual of Sewer Condition Classification, UK
OHSAS	Occupational Health and Safety Assessment Series
PPE	Personal Protective Equipment
ppm	Parts per million
PS	Particular Specification
PSI	Pound Per Square Inch
QA/ QC	Quality Assurance/ Quality Control
Ref.	Reference
RMSE	Root Mean Square Error
RPUS	Recognized Professional Utility Specialist
RTO	Recognized Training Organization
SCG	Service Condition Grades
SOPs	Safe Operator Procedures
SPF	Sun Protection Factor
SPG	Structural Performance Grade
SRM	Sewer Rehabilitation Manual
STP	System Test Pressure
TTA	Temporary Traffic Arrangement

Company/ Organization	
US	Utility Specialist
VHS	Video High Speed
W	Width
WLD	Water Leakage Detection
WO	Works Order
WP	Work Procedure

A2 Requirements for Personnel Carrying Out Inspection

Training and Experience Requirements for Personnel Carrying Out Inspection (HKIUS standard, 2011)

Title	Role	Minimum Training Requirement	Minimum Years of Practical Experience	Qualification
Project Leader	Responsible for contract administration and preparation, checking and certifying of reports for compliance with the technical specification.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	10 years in contract administration, preferably in works related to the inspection, survey and in data management.	Either: M/FHKIUS, RPUS plus CP, CW or MHKIE/ R.P.E. plus CP, CW and relevant training in RTO (e.g. PolyU, UTI) for surveys and data management
Deputy Project Leader	Responsible for assisting project leader and acting the post of project leader when project leader temporary not with the team	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	10 years in contract administration, preferably in works related to the inspection, survey and in data management.	Either: M/FHKIUS, RPUS plus CP, CW or MHKIE/ R.P.E. plus CP, CW and relevant training in RTO (e.g. PolyU, UTI) for surveys and data management
Team Leader	Responsible for works arrangement and data processing including checking of raw data for quality and consistency.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	5 years in works related to the inspection, survey and in data management.	M/FHKIUS, RPUS, CP, CW
Crew Leader	Responsible for supervising the field works and site safety.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	3 years in works related to the inspection, survey and in data collection	O/MHKIUS, CP, CW
Operators	Responsible for operating equipment and carrying out inspection and survey.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	2 years in works related to the inspection, survey and in data collection.	AMHKIUS, CP, CW