

TECHNICAL SPECIFICATIONS FOR THE INSPECTION AND
EVALUATION OF GRAVITY PIPELINES

1.00 PART 1 -- GENERAL

1.01 SCOPE

- A. It is the intent of this contract to assess the internal structural and service condition of sewer systems, including manholes, lift stations, and sewer lines prior to preconditioning or rehabilitation. Assessment will be performed using visual inspection and pan and tilt color camera-CCTV.
- B. Qualifications of contractor:
 - 1. If requested by the Engineer, the proposed contractor shall submit a verifiable reference list documenting the successful completion of a minimum of 500,000 linear feet of internal sewer condition assessment on projects of similar size and scope to this project. The reference list along with a list of available equipment & resumes of key personnel shall be submitted to the engineer a minimum of two weeks prior to bid.
- C. It is also the intent of this contract to survey individual sewer lines that have been preconditioned to further assess condition and record findings.
- D. It is the responsibility of the Contractor to comply with applicable OSHA regulations. The Contractor shall provide written documentation that all workers have received the training required under these regulations and guidelines.
- E. Two forms of internal condition assessment are addressed by this specifications:
 - 1. Sewer survey – Detailed viewing of the sewer (“survey”) ,with the aid of CCTV equipment, to assess internal structural condition, service condition, and identify and locate miscellaneous construction features as well as assess the structural and service condition of laterals.
 - 2. Sewer inspection – Viewing the sewer system pursuant to investigative work following other operational activity including:
 - a. Locating manhole(s) and/or lateral(s) with or without radio-sonde
 - b. Sewer preconditioning and cleaning activities
 - c. Sewer rehabilitation, including point repairs
 - d. Such other similar purposes as may be required by the Owner.

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3. Sewer inspection shall be carried out manually or with the aid of CCTV equipment, to assess overall condition.

1.02 SUBMITTALS

- A. As requested by the Engineer, the Contractor shall provide to the Engineer the following information in writing prior to the set deadline, or at the indicated frequency, whichever is applicable.

1. Project Schedule (At Pre-Construction Conference)
2. Listing of Cleaning Equipment & Procedures (At Commencement)
3. Listing of Flow Diversion Procedures (At Commencement)
4. Listing of Preconditioning Procedures (At Commencement)
5. Listing of Safety Precautions and Traffic Control Measures (At Commencement)
6. Listing of CCTV Equipment (At Commencement)
7. Listing of Backup and Standby Equipment (At Commencement)
8. Manufacturers Details of CCTV Equipment (At Commencement)
9. Location where Debris from Cleaning will be Disposed (At Commencement)
10. Updated Schedule of Planned Inspections/Cleaning of Sewer Reaches (Post Commencement, Weekly)
11. Two (2) Copies of CCTV Video Tapes, Two (2) Copies of CCTV DVD's, Two (2) Copies of Inspection Report incorporating a summary statistical breakdown of defects and main findings (As per Schedule in Exhibit "C")
12. Daily Logs and Progress Reports (Daily)
13. Confined Space Entry Logs (Daily)

- B. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the contract. The Contractor shall include in his daily record, reference to:

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1. Delays: e.g. dense traffic, lack of information, sickness, labor or equipment shortage.
 2. Weather: conditions, e.g. rain, etc.
 3. Equipment: on site, e.g. specialist cleaning, by-pass equipment, etc.
 4. Submittals: to the designated representative
 5. Personnel: on site by name, e.g., all labor, Specialist Services, etc.
 6. Accident: report, e.g. all injuries, vehicles, etc.
 7. Incident: report, e.g. damage to property, property owner complaint, etc.
 8. Major defects encountered, including collapsed pipe, if any: e.g. cave-ins, sink holes, etc.
 9. Visitors: on site
- C. The Engineer's designated representative on site shall certify receipt of the daily record noting any items and adding any observations with reference to claims for payment to the Contractor. The Owner may at his discretion, for which the Contractor must receive direction in writing, make an exception to this requirement for weekly submission of progress rather than for daily submission.

1.03 REQUIREMENTS AND EXTENT OF SURVEY/INSPECTION

- A. The Contractor shall survey and/or inspect sewer systems with digital cameras or color pan and tilt CCTV imagery as specified in order to record all relevant features and confirm their structural and service condition. Surveys/Inspections of sewer systems shall be carried out in compliance with the NASSCO PACP reporting format and coding standards.
- B. All CCTV operator(s) responsible for direct reporting of sewer condition shall have a minimum of 3 years previous experience in surveying, processing, and interpretation of data associated with CCTV surveys/inspections. If requested by the Engineer, the Contractor shall provide the designated representative with written documentation that all CCTV survey operators meet these experience requirements which shall include a list of projects undertaken as well as client name and telephone number for reference.
- C. Approved Contractors will be required to provide evidence acceptable to the Engineer that all CCTV technicians performing work under this contract have satisfactorily completed NASSCO Pipeline Assessment Certification Program

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(PACP) training and possess valid PACP Certification documents. All defect coding, as well as material, shape and lining coding used throughout the project will conform to NASSCO's Pipeline Assessment Certification Program, PACP. Required training to meet these requirements will be carried out at the Contractor's expense.

- D. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the contract as previously described in Item 1.03.

1.04 SURVEY/INSPECTION UNITS

- A. The Contractor shall provide sufficient survey/inspection units and all relevant ancillary equipment, including standby units in the event of breakdown, in order to complete all sewer and manhole surveys/inspections as specified.

1.05 SURVEY/INSPECTION VEHICLE

- A. The survey/inspection vehicle shall comprise of two totally separate areas. One of these, designated as the viewing area, shall be insulated against noise and extremes in temperature, include the provision for air conditioning, and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the specification. Seating accommodation shall be provided by the Contractor to enable two people, in addition to the operator, to view clearly the on-site monitor, which shall display the survey/inspection as it proceeds.
- B. The working area shall be reserved for equipment, both operational and stored, and no equipment utilized within the sewer shall be allowed to be stored in the viewing area.

1.06 CCTV SURVEY/INSPECTION AND OPERATIONAL EQUIPMENT REQUIREMENTS

- A. The surveying/inspecting equipment shall be capable of surveying/inspecting equipment shall be capable of surveying/inspecting a length of sewer up to at least 1000 ft. when entry onto the sewer may be obtained at each end and up to 750 ft. where a self propelled unit is used, where entry is possible at one end only. The Contractor shall maintain this equipment in full working order and shall satisfy the designated representative at the commencement of each working shift that all items of equipment have been provided and are in full working order.
- B. Each survey/inspection unit shall contain a means to transport the CCTV camera in a stable condition through the sewer under survey and/or inspection.

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Such equipment shall ensure the maintained location of the CCTV camera when used independently on or near to the central axis of a circular shaped sewer when required in the prime position.

- C. Where the CCTV camera is towed by winch and drum through the sewer, all winches shall be stable with either lockable or ratcheted drums. All drums shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera equipment. All winches shall be inherently stable under loaded conditions.
- D. Each unit shall carry sufficient numbers of guides and rollers such that, when surveying or inspecting, all bonds are supported away from pipe and manhole structures and all CCTV cables and/or lines used to measure the CCTV camera's location within the sewer are maintained in a taut manner and set at right angles where possible, to run through or over the measuring equipment.
- E. Each unit shall carry a range of flow control plugs or diaphragms for use in controlling the flow during the survey/inspection. A minimum of one item of each size of plug or diaphragm – within the range of pipe sizes set out in the contract - shall be carried
- F. Each survey/inspection unit shall have on call equipment available to carry out the flushing, rodding and jetting of sewers as and when such procedures are deemed to be necessary.

1.07 FIELD SUPERVISION BY CONTRACTOR

- A. The Contractor shall maintain on site at all times a competent field supervisor in charge of the survey/inspection. The field supervisor shall be approved in writing by the designated Engineer prior to commencement of work. Any change of supervision must also be approved in writing by the designated Engineer prior to the change. The field supervisor shall be responsible for the safety of all site workers and site conditions as well as ensuring that all work is conducted in conformance with these specifications and to the level of quality specified.

1.08 APPLICATION OF INSPECTION TYPE

- A. The following guidelines concerning the use of CCTV shall be followed, subject to the review and approval of the designated Engineer:
 - 1. Generally CCTV alone shall be used for internal condition assessment where the depth of flow of sewage is less than 25% of overall sewer diameter at the start of the survey. The Contractor will make an informed decision to continue should the depth of flow increase

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beyond the 25% level but no greater than 40% of overall sewer diameter at any time throughout the length.

2. Generally CCTV combined with plugging and/or bypassing shall be used for internal condition assessment where depth of flow of sewage varies from 25% to 75% of overall sewer diameter for sewers greater than 24-inches in diameter. Where depth of flow of sewage exceeds 25% and is less than 75% of overall sewer diameter the designated Engineer shall instruct Contractor to either:
 - a. Continue using CCTV (where depth of flow is only marginally greater than 25% of overall diameter) or
 - b. Use plugging/bypass pumping to reduce flow levels below 25%.

1.09 RESPONSIBILITY FOR OVERFLOWS OR SPILLS

- A. It shall be the responsibility of the Contractor to schedule and perform his work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the sewer system.
- B. In the event that the Contractor work activities contribute to overflows or spills, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the designated representative in a timely manner.
- C. Contractor will indemnify and hold harmless the Owner for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering and administrative expenses of the Owner in defending such fines and claims.

2.00 PART 2 – PRODUCTS (NOT USED)

3.00 PART 3 – EXECUTION

3.01 CLEANING PRIOR TO INTERNAL CONDITION INSPECTION

- A. Where required by the contract and instructed in writing or by written Order to Proceed, the Contractor shall clean the sewer prior to internal condition inspection.

3.02 SEWER CLEANING UNITS AND EQUIPMENT

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- A. The Contractor shall provide sufficient sewer cleaning units and equipment, including standby units in the event of breakdown, in order to complete cleaning operations as specified.

3.03 REASONS FOR CLEANING OF SEWERS

- A. Normal sewer cleaning is defined as removal of minor quantities of silt and debris preventing observation of sewer condition and defects.
- B. Heavy sewer cleaning is defined as removal and extraction of silt, debris, and obstructions from the sewer which actually prevent entry and use of CCTV equipment, or the completion of the sewer run and/or manned-entry inspection of sewers.
- C. Mechanical cleaning is defined as the removal of hard or semi-hard deposits, tuberculation, or other materials requiring the use of mechanically operated equipment which actually prevent entry and use of CCTV equipment, or the completion of the sewer run and/or manned-entry inspection of sewers.

3.04 EXTENT OF NORMAL CLEANING

- A. Normal Cleaning is considered to be cleaning of the sewer prior to CCTV or manned-entry inspection and does not necessarily require removal and extraction of the silt and debris from the wastewater flow and will only be required should the level of silt be deemed to prohibit the accurate assessment of the pipeline under inspection. It normally includes up to three (3) complete cleaner passes of the entire sewer line segment.

3.05 EXTENT OF HEAVY OR MECHANICAL CLEANING

- A. Heavy or mechanical cleaning is not required as part of the internal condition inspection service unless specifically designated in the bid schedule. Where such designation exists, heavy or mechanical cleaning shall be performed as necessary. Heavy cleaning is defined as the removal of loose debris that requires more than three (3) complete cleaner passes the entire sewer line segment. Mechanical cleaning is defined as the removal of hardened deposits, tuberculation, etc. and generally requires specialized cutting and cleaning equipment.
- B. In the event that heavy or mechanical cleaning is required, the Contractor shall:
 - 1. Provide and/or manage the equipment necessary for proper jetting, rodding, bucketing, brushing, root cutting, flushing and vacuum uplift or any other approved removal and extraction system necessary to

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remove and extract silt, debris and obstructions from the sewer which would otherwise preclude use of CCTV equipment and/or manned-entry inspection of the sewers.

2. Demonstrate the performance capabilities of the cleaning equipment and method for use when requested by the designated Engineer. If results obtained by the demonstration are not satisfactory, select other methods or equipment that will clean the sewer line and repeat demonstration.
 3. Install a gauge to monitor working pressure on the discharge of high-pressure pumps for jetting equipment.
 4. Provide more than one type of equipment or attachments on a single reach or at a single location as required.
- C. The Contractor shall exert all reasonable care to avoid damage to the sewer or manhole during the cleaning operation. Mechanical equipment used for heavy cleaning shall be equipped with an overload clutch to limit the risk of damage to the pipe.

3.06 REMOVAL OF DEBRIS WITH CLEANING

- A. The Contractor shall provide all equipment and personnel necessary to safely remove and extract silt and debris from the sewer through existing manhole access, load it onto trucks for disposal, and dispose of the silt and debris at approved sites.

3.07 CCTV – GENERAL

- A. CCTV Camera Prime Position: The CCTV camera shall be positioned to reduce the risk of picture distortion. In circular sewers the CCTV camera lens head shall be positioned centrally (i.e. in prime position) within the sewer. In non-circular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. In all instances the camera lens head shall be positioned looking along the axis of the sewer when in prime position. A positioning tolerance of $\pm 10\%$ of the vertical sewer dimension shall be allowed when the camera is in prime position.
- B. CCTV Camera Speed: The speed of the CCTV camera in the sewer shall be limited to 30 LF per minute for surveys to enable all details to be extracted from the ultimate CD-ROM recording. Similar or slightly higher speed as agreed by the designated Engineer shall be provided for inspections.
- C. CCTV Color Camera: The Contractor shall provide a color pan and tilt camera(s) to facilitate the survey and inspection of all laterals, including

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defects such as hydrogen sulfide corrosion in the soffit of sewers and benching or walls of manholes over and above the standard defects that require reporting, where required by the designated Engineer. These will be carried out as part of the normal CCTV assessment as the survey or inspection proceeds when instructed by the designated representative.

D. Linear Measurement:

1. The CCTV monitor display shall incorporate an automatically updated record in feet and tenths of a foot of the footage of the camera or center point of the transducer, whichever unit is being metered, from the cable calibration point. The relative positions of the two center points should also be noted.
2. The Contractor shall use a suitable metering device, which enables the cable length to be accurately measured; this shall be accurate to $\pm 1\%$ or 3 inches whichever is the greater.
3. The Contractor shall demonstrate compliance with the tolerance listed above, using one or both of the following methods in conjunction with a linear measurement audit form which shall be completed each day during the survey:
 - a. Use of a cable calibration device
 - b. Tape measurement of the surface between manholes
4. A quality control form will be completed and submitted by the contractor depicting the level of accuracy achieved.
5. If the Contractor fails to meet the required standard of accuracy, the designated representative shall instruct the Contractor to provide a new device to measure the footage. The designated Engineer retains the right to instruct the Contractor in writing, to re-survey those lengths of sewer first inspected with the original measuring device using the new measuring device.

E. Data Display, Recording and Start of Survey/Inspection:

1. At the start of each sewer length being surveyed or inspected and each reverse set-up, the length of pipeline from zero footage, the entrance to the pipe, up to the cable calibration point shall be recorded and reported in order to obtain a full record of the sewer length. Only one survey shall be indicated in the final report. All reverse set-ups, blind manholes, and buried manholes shall be logged on a separate log. Video digits shall be recorded so that every recorded feature has a

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correct tape elapsed time stamp. Each log shall make reference to a start and finish manhole unless abandonment took place because of blockage. Manhole number shall be indicated in the remark's column of the detail report. Surveys must not extend over 2 tapes.

2. The footage reading entered on to the data display at the cable calibration point must allow for the distance from the start of the survey/inspection to the cable calibration point such that the footage at the start of the survey is zero.
3. In the case of surveying through a manhole where a new header sheet must be completed, the footage shall be set at zero with the camera focused on the outgoing pipe entrance.
4. At the start of each manhole length a data generator shall electronically generate and clearly display on the viewing monitor and subsequently on the CD-ROM recording a record of data in alpha-numeric form containing all fields required by the PACP information standard:
5. The size and position of the data display shall be such as not to interfere with the main subject of the picture.
6. Once the survey of the pipeline is under way, the following minimum Information shall be continually displayed:
 - a. Automatic update of the camera's footage position in the sewer line from adjusted zero
 - b. Sewer dimensions in inches
 - c. Manhole or pipe length reference number (PLR). General convention allows upstream manhole number to be designated PLR.
 - d. Direction of survey, i.e., downstream or upstream
7. Correct adjustment of the recording apparatus and monitor shall be demonstrated by use of the test tape or other device approved by the Contractor. Satisfactory performance of the camera shall be demonstrated by the recording of the appropriate test device at the commencement of each day for a minimum period of 30 seconds.
8. Footage and corresponding time elapsed video digit shall be given throughout survey/inspection for all relevant defects and construction features encountered unless otherwise agreed.

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9. Where silt encountered is greater than 10 percent of the diameter of the pipe, the depth of silt shall be recorded at approximately 50-foot intervals.
 10. CD-ROM capacity shall be adequate to record two hours of video inspection. Recording of a single segment shall not extend over more than one video tape. No unrecorded gaps shall be left in the recording of a segment between surveys/inspections.
 11. Only segments between manholes on the same sewer reach or basin shall be included on one CD-ROM. There shall be no “split surveys” or “split basins” between CD-ROMs.
 12. All continuous defects shall incorporate a start and finish abbreviation in the log report
- F. Coding: Defect Coding, as well as Material, Shape, and Lining Coding, and conventions used throughout the project will be PACP-compliant. The CCTV Contractor must ensure that all surveyors conform to the detailed requirements of the reporting procedure concerning feature description and feature definition as well as the computer file format.

3.08 MAN ENTRY SURVEY – GENERAL

- A. Photographic Camera Position – General Illustration of Sewer Interior:
1. The CCTV camera shall be positioned to reduce the risk of picture distortion. In circular sewers the camera will be centered and oriented to look along the axis of the sewer. In non-circular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally.
 2. The CCTV camera shall be positioned so that the long side of the photograph or CD-ROM frame is horizontal.
- B. Camera Position – Laterals/Specific Defect:
1. A means of accurately locating the photographic or camera’s footage and any recorded lateral or defect, along the sewer shall be provided, to an accuracy of $\pm 1\%$ or 6 inches whichever is the greater.
 2. When requested by the designated representative in writing at any time during a survey or inspection, the Contractor shall demonstrate compliance with the above tolerance in subparagraph 3.2.B.1. The

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device used by the Contractor to measure the footage along the sewer will be compared with a standard tape measure. The results will be noted. If the Contractor fails to meet the required standard of accuracy, the designated Engineer shall instruct the Contractor to provide a new device to measure the footage. The designated representative retains the right to instruct the Contractor in writing to re-survey those lengths of sewer inspected with the original measuring device at no extra cost.

- C. Photographic Quality: The CCTV system and suitable illumination shall be capable of providing an accurate, uniform and clear record of the sewer's internal condition. In-sewer lighting standards shall meet the requirements of the PACP and applicable codes regarding safety and power.

3.09 PHYSICAL INSPECTION OF MANHOLES AND LIFT STATIONS

A. General

1. Manholes and lift stations shall be inspected to assess general physical condition and to locate leaks which are causing or could cause soil erosion and degradation to the sanitary systems, and/or other underground utilities or surface structures, and which are allowing leaks into, or out of, the sewer system.

B. Documentation of Inspection

1. Observations shall be recorded on a manhole and lift station physical inspection report form. Information recorded on these forms shall include but not be limited to location of the structure, relationship of a structure's incoming and outgoing lines, size of lines, depth of structure, condition of cover, ring, wall, bench and invert, type of material, and any other pertinent information which would allow sources of Infiltration/Inflow.
2. If requested by the Engineer, horizontal GPS coordinates, to an accuracy of 1 meter, shall be obtained for each manhole and wet well, geo-referenced and recorded as per these technical specifications.
3. Owner to provide manhole and lift station I.D. Residential addresses will I.D. private property.
4. Color photographs shall be taken of the interior and exposed exterior of all manholes and lift stations, and shall portray any defects as best as possible. The main purpose of the photographs is to assist management in decisions for future testing or rehabilitation purposes. The "Manhole and Lift Station Inspection Report" form will be used to

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record the inspection results. The Engineer shall approve the form to be used.

5. Besides any hard copy in the reports, photographs shall be provided to the Owner in a digital electronic version on computer discs (CD's) in the JPEG format. Each digital photo file and photograph, shall have a unique I.D. applied to it that will indicate which manhole or Lift station is pictured, and will correspond to that features I.D. in the data.
- C. Contractor shall furnish all data and photographs gathered in the field investigation, and it shall be incorporated into a report listing all findings and recommendations for future inspection or rehabilitation.

3.10 CCTV AND MAN ENTRY SURVEY DATA SPECIFICATION

A. Survey Reporting:

1. The Contractor shall submit to the Engineer two printed "Full English" reports including summary statistical breakdown of all defects encountered and two CD-ROM/DVD's with copies of all descriptive data in digital format. All video and survey information shall be provided in electronic form utilizing a Microsoft Access compatible database. The supplied data and information shall remain the property of the Engineer.
2. The report shall be computer validated using PACP-compatible software approved by the designated representative.
3. When requested, the Contractor shall provide hard copy output or manually completed site coding sheets at the time of the survey and shall forward copies of these sheets to the designated representative, preferably each day, but at least every other day, together with a daily report on progress.

- B. Site Coding Sheets: Each sewer length, i.e. the length of sewer between two consecutive manholes, shall be entered on a separate coding sheet or entered separately electronically. Thus where a Contractor elects to "pull through" a manhole during a CCTV Survey or "walk through" during a Man Entry survey a new coding sheet shall be started at the manhole "pulled or walked through" and the footage re-set to zero on the coding sheet. Where a length of sewer between consecutive manholes is surveyed from each end (due to an obstruction) two coding sheets should be used. Where a length of sewer between two consecutive manholes cannot be surveyed or attempted for practical reasons a (complete header) coded sheet shall be made out defining the reason for abandonment. At uncharted manholes a new coding sheet must be started and the footage re-set to zero.

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- C. Measurement Units: All dimensions shall be in feet and tenths of a foot. Measurement of sewers shall be to the nearest tenth of a foot.
- D. CCTV And Man Entry Photographs:
1. Still photographs (JPEG format) shall be taken of all defective laterals and pipeline defects. Where a defect is continuous or repeated the photographs shall be taken at the beginning and end of the defect.
 2. CCTV Photographs must clearly and accurately show what is displayed on the monitor, which shall be in proper adjustment.
 3. Still photographs shall be durable and clearly identified in relation to the photograph number (cross referenced to the site survey sheet) street location, sewer dimensions, manhole start and finish numbers, survey direction, footage and date when the photograph was taken.
 4. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 14 point, and be type printed in upper case.
 5. The annotation shall be positioned so as not to interfere with the subject of the photograph.
- E. Control Sample Photographs and/or CD-ROMs: The designated representative may issue a written instruction to the Contractor to provide a sample of the photographs and/or CCTV tapes taken during the contract period which the Contractor shall provide within 5 working days of receiving the written instruction.

3.11 CCTV PERFORMANCE

- A. Color CCTV: All CCTV work shall use color CCTV reproduction.
- B. CCTV Picture Quality:
1. An approved test device shall be provided and be available on site throughout the Contract, enabling the test specified in this clause to be checked.
 2. The test card shall be Marconi Regulation Chart No.1 or its approved derivatives with a color bar, clearly differentiating between colors, with no tinting, to show the following: White, Yellow, Cyan, Green, Magenta, Red, Blue, and Black.

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3. At the start of each and every working shift, the camera shall be positioned centrally and at right angles to the test card at a distance where the full test card just fills the monitor screen. The Contractor shall ensure that the edges of the test card castellations coincide with the edges of the horizontal and vertical scan (raster). The card shall be illuminated evenly and uniformly without any reflection. The illumination shall be to the same color temperature as the color temperature of the lighting that recorded for subsequent use by the designated Engineer, the recording time to be at least 30 seconds. The type of camera used is to be identified on the test recording. The recording must show the camera being introduced into the test device and reaching its stop position. Other test devices may be used subject to approval by the designated Engineer.
4. The electronic systems, television camera and monitor shall be of such quality as to enable the following to be achieved:
 - C. Shades of Gray: The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five clearly recognizable stages.
 - D. Color: With monitor adjusted for correct saturation, the six colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no tint.
 - E. Linearity: The background grid shall show squares of equal size, without convergence/divergence over the whole of picture. The center circle shall appear round and have the correct height/width relationship ($\pm 5\%$)
 - F. Resolution: The live picture must be clearly visible with no interference and capable of registering a minimum number of TV lines/pictures height lines. The resolution shall be checked with the monitor color turned down. In the case of tube cameras this shall be 600 lines.
 - G. Color Constancy: To ensure the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color constancy, no variation in illumination shall normally take place during the survey.
 - H. The Contractor shall note that the designated Engineer may periodically check both the live and picture color consistency against the color bar. Any differences will require re-survey of the new length or lengths affected, at the Contractor's expense.
 - I. Playback and CD-ROM Labeling:

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1. Playback video shall be capable of a resolution of a minimum of 400 lines recorded at standard (SP setting) VHS speed. CD-ROM playback imaging shall be linked to electronic out put of alpha-numeric data so that if necessary direct interrogation of database can take place with simultaneous viewing of CCTV images.
 2. Each CD-ROM disc shall be labeled by reference to the header record for the survey section completed together with the following information:
 - a. Sequential (unique) CD-ROM number
 - b. Basin/ catchment worked in
 - c. Survey company name and logo
 - d. Survey date
- J. CCTV Focus/Iris/Illumination: The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operated. The adjustment of focus and iris shall provide a minimum focal range from 6 inches in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer. The illumination must allow an even distribution of the light around the sewer perimeter without the loss of contract picture, flare out or shadowing.
- K. Contractor's Data Quality Control Procedure:
1. The Contractor shall operate a quality control system, to be approved by the designated Engineer, which will effectively gauge the accuracy of all survey reports produced by the operator.
 2. The system shall be such that the accuracy of reporting is a function particularly of:
 - a. The number of faults not recorded (omissions)
 - b. The correctness of the coding and classification of each fault recorded.
 3. The minimum levels of accuracy to be attained under the various survey headings are as follows:

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- a. Header Accuracy 95%
- b. Detail Accuracy 85%

3.12 COLLAPSED SEWERS/DEFECTIVE MANHOLES

- A. Any sewer found with greater than 10% deformation (i.e. collapsed or near to collapse) must be reported to the designated representative immediately for remedial action.
- B. Any manhole found broken, cracked, with missing covers or surcharged, must be reported to the designated representative immediately for remedial action
- C. Any sewer found with existing conditions that pose a threat of personal injury to the public, such as a collapsed sewer with attendant depression roadway, must be protected by the Contractor until the designated representative arrives at the job site
- D. Any manhole found where the existing conditions pose a threat of personal injury to the public, such as broken, cracked or missing covers or covers found in traveled portions of any sidewalk or roadway must be protected by the Contractor until the designated representative arrives at the job site.

4.00 PART 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. Mobilization, when listed on the Proposal, will be measured as a lump sum item.
- B. Normal Cleaning, when listed on the Proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthestmost extent of the cleaning performed. Measurements shall be made to the nearest foot.
- C. Heavy Cleaning, when listed on the Proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthestmost extent of the heavy cleaning performed. Measurements shall be made to the nearest foot.
- D. Mechanical Cleaning, when listed on the Proposal, shall be measured by the hour. Measurement shall be made to the nearest half hour.
- E. Grease/Root Removal, when listed on the Proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthestmost

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extent of the grease or roots removed. Measurements shall be made to the nearest foot.

- F. Removal of Protruding Taps, when listed on the Proposal, shall be measured for each tap removed.
- G. CCTV Inspection, when listed on the proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthestmost extent of the inspection performed. Measurements shall be made to the nearest foot.
- H. Additional CCTV Setup, when listed on the Proposal, shall be for each setup made.
- I. Physical Inspection of Manhole or Lift Station, when listed on the proposal, shall be for each inspection made.

4.02 PAYMENT

- A. Payment for Mobilization shall be 50% with first pay request, 40% with second pay request, and 10% with final pay request.
- B. Payment for Normal Cleaning shall be made per LF.
- C. Payment for Heavy Cleaning shall be made per LF.
- D. Payment for Mechanical Cleaning shall be made per HR.
- E. Payment for Grease/Root Removal shall be made per LF
- F. Payment for Removal of Protruding Taps shall be per EA.
- G. Payment for CCTV Inspection shall be made per LF.
- H. Payment for Additional CCTV Setup shall be per EA.
- I. Payment for Physical Inspection of Manhole or Lift Station shall be per EA.