



**Request for Proposal  
SSES Phase 7 Project Addendum No. 2 to  
RFP No. 405146.78.0119  
April 30, 2020**



The following information encompasses Addendum No. 2 for the above referenced RFP. Bidders shall fully consider and acknowledge this Addendum in the preparation and submittal of its formal Proposal. Failure to do so may result in the rejection of the Proposal.

Section 1 – Additional Bidder Questions

Section 2 – Technical Specifications 01501, 02541, 02542, 02544, 02546

All other conditions and requirements remain unchanged.

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**Section 1  
Additional Bidder Questions**

**Q1:** Can data deliverables for CCTV, SONAR, MACP or Smoke be uploaded to an FTP site instead of submitting them weekly in a hard drive?

**SARP10:** No, all deliverables will be delivered to the Program on hard drives/ thumb drives weekly.

**Q2:** Are hard copies of completed inspection log photographs required to be submitted to the Program Manager with invoicing?

**SARP10:** No, hard copies of completed inspection log photographs are not required to be submitted with invoicing. Section 02541-3 1.03(3)(A) has been updated to clarify this question.

**Q3:** Are hard copies and digital inspection log reports for field activities required to be submitted?

**SARP10:** Only digital reports for field activities are required to be submitted. Hard copies are not required to be submitted. Section 02541-3 1.03(4)(a) has been updated to clarify this question.

**Q4:** Are draft reports for CCTV, Sonar or MACP required to be delivered to the program manager within fifteen working days of oldest inspections?

**SARP10:** No. Draft reports are not required to be submitted to the Program Manager. CCTV Section 02541-3 1.03(4)(b), Sonar section 02542-3 1.03(3)(a)-(b), MACP section 02544-2 1.03(A)(4)(a) and (b), and Smoke-Test section 02546-3 1.03(A)(1)(e), (f) and (g) have been updated to clarify data deliverables and reports.

**Q5:** Can hydraulic cleaning have a different rate from mechanical cleaning?

**SARP10:** No, refer to Section 02541-6 (D)(3) and (5) have been updated to clarify the use of hydraulic cleaning and to specify the use of mechanical cleaning.

**Q6:** What is the process for the approval of heavy cleaning?

**SARP10:** The subcontractor shall use both Teamworx and send an email to the Program Team. The Program Team will have a designated person for the approval of heavy cleaning. The designated person will reply to subcontractor's email to notifying them of the approval. Heavy cleaning must be approved prior to completing work. The Program will provide back-up individuals to approve heavy cleaning.

**Q7:** Where would the measurement for the approximate depth of the undocumented manhole need to be documented?

**SARP10:** The information shall be documented in the header of the NASSCO PACP inspection form.

**Q8:** Are dashes or periods appropriate for new manhole asset IDs?

**SARP10:** New manhole asset IDs shall use periods. The use of dashes is not acceptable. Section 02544-6 3.01 (A)(2) describes the procedure to name new asset IDs and it has been updated to reflect this revision in this addendum.



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**Q9:** Are we supposed to redundantly report buried/UTC/UTL assets in Teamworx as well as submit their respective forms weekly with each data deliverable?

**SARP10:** Yes, buried manhole, unable to locate, and unable to complete forms must be reported both daily in Teamworx for field coordination purposes, and weekly included with the data submittals for data acceptance purposes.

**Q10:** Does MACP 02544-1 section 1.01(A)(1) refers to “map” edits or “geodatabases”?

**SARP10:** MACP 02544-1 section 1.01(A)(1) refers to the data that needs to be included in the MACP submittal. Map edits must be used for geometry changes, e.i. unmapped new manholes, CCTV verified buried manholes, etc.

**Q11:** Are ESRI ArcPad .axf files required for GPS data delivery?

**SARP10:** No. GPS point data deliveries will be in an ESRI Shape file. The program has discontinued the use of the ArPad .axf file. Sections 02554 1.02(K) and 1.03(A)(1)(a) have been updated to clarify this question.

**Q12:** Does MACP section 02544-3 1.03(A)(1)(a) infer map edits or geodatabases?

**SARP10:** Section 02544-3 1.03(A)(1)(a) has been updated to clarify this question.

**Q13:** Can we use newer equipment other than the equipment described in MACP section 02544-4 2.01(C)(1), and Smoke section 02546-4 2.01(F)(1) for GPS point data collection?

**SARP10:** Both sections have been updated to clarify the minimum required equipment needed for acceptable GPS data collection.

**Q14:** Can the tolerable sway for 3D manhole inspection in Section 02544-5 2.01(C)(2)(c) be revised to 0.1 inches?

**SARP10:** Yes, Section 02544-3 2.01(C)(2)(c) has been updated to clarify this question.

**Q15:** What is the meaning of “original GIS map data” in in MACP section 02544-3 2.01(A)(1)(a)

**SARP10:** The program does not want the Original GIS Map data back. Any changes to the original database provided by the program are made by Map Edit forms and providing weekly deliverables. The Program does not want an updated GIS geodatabase.

**Q16:** Are sketches of work performed for smoke-testing and dye-testing required to be submitted with data deliverable?

**SARP10:** No. Sketches are not required to be submitted. Any geometry changes found with smoke-testing or dye-testing work require a Map Edit form to be submitted with data deliverable. Smoke-Testing Sections 02546-3 1.03(A)(1)-(3) have been updated to clarify this question.

**Q17:** If we are using 2 blowers capable of 3,750 CFM can we smoke test 1,000 l.f. max at a time if reasonable?

**SARP10:** No. Please continue to follow the specifications for field operations as described in Smoke-Testing section 02546-6 3.02(A)(3).

**Q18:** With offices closed due to the current stay at home order, can we submit forms with a digital signature if a printer/scanner is not available? Also, is it ok if no signatures are “wet” signatures?

**SARP10:** Yes, digital signatures are acceptable.

**Q19:** Can tap cutting be moved to an hourly rate also, and considered part of heavy cleaning?

**SARP10:** No, tap cutting will not be changed to hourly rate or considered part of heavy cleaning.

**Q20:** Can a line item be added for 24-inch lines and greater for CCTV with no sonar?

**SARP10:** No line item will be added for lines 24-inch or greater for CCTV inspection with no sonar.



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**Q21:** In the Commercial Proposal, Page 11 of 13 Titled Schedule of Submittals and Applicable Liquidated Damages, there is an item “C09 LCM Subcontractor Documentation” that needs to be submitted with the proposal. Could you please clarify what other documents need to be submitted with the proposal under this item?

**SARP10:** The following items need to be included with C09 LCM Subcontractor Documentation:

- Complete the required contractor approval sheet
- Provide Experience Modification Rate for the past 3 years on insurance company letterhead 2017,2018,2019
- Provide OSHA 300 and 300A logs for the last 3 years
- Provide OSHA citations in the last 5 years
- Any fatalities in the last 5 years
- Provide Company safety policy/program (Electronic)

**Q22:** Are point clouds required to be submitted for 3D manhole scans?

**SARP10:** No, point cloud data is not required to be submitted for 3D manhole scans. The only requirements for 3D manhole scans are specified in MACP section 02544-3 1.03(A)(3)(a)(i)-(iii).

**Q23:** Section 02541-14 E. talks about traffic control being paid for on lump sum basis, could you please explain, since I thought traffic control was to be included in unit cost for CCTV pricing.

**SARP10:** Traffic Control from Section 02541-14 will be exclusively negotiated on a lump sum basis when a special setup is required at a busy or complicated intersection or a given condition when either flaggers or arrow boards are required. Some traffic control setups along busy two-lane roads with either horizontal or vertical blind spots can also qualify. All other regular traffic control should be included in the unit pricing for PACP and MACP.



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**Section 2  
Technical Specifications 01501, 02541, 02542, 02544, 02546**

**SECTION 01501  
SPECIAL CONDITIONS**

**PART 1 GENERAL**

**1.01 SUBMITTALS**

- A. Site Contractor emergency phone numbers.
- B. Schedules of work on a weekly basis that will be delivered no later than 2:00 PM on Thursday for the week following, and daily AM email updates of approximate crew locations each day.
  - 1. Weekly schedule format shall contain the following elements:
    - a. Map format.
    - b. Sufficient streets labeled and identified at a scale to provide clarity.
    - c. Nature and type of crew location by map area.
  - 2. **The Contractor shall fax or email its smoke test locations to local Memphis Fire Department station by 7:00 AM on each day of smoke testing. It is the Contractor's responsibility to do its due diligence on communicating with local Memphis Fire Department in the Contractor's daily smoke test work area, as well as establishing the best method of communicating daily smoke test locations with such local Fire Department(s).**

**1.02 MEETINGS**

- A. The Program Team will arrange ~~bi-weekly~~ **monthly** meetings ~~(every other week)~~ with the Subcontractor to discuss data management and field issues.

**1.03 WASTE DISPOSAL**

- A. All debris removed from sanitary sewer lines shall be disposed of in a lawful manner at a landfill. The Subcontractor shall not dispose of debris at a City of Memphis Wastewater Treatment Plant. ~~The Program Manager has a consultant under contract to coordinate with a SSES subcontractor the acquisition of a solid and a liquid sample of sewer cleaning debris removed from the WCTS, including laboratory analysis, and completion of the permit paperwork. The entity responsible for disposing of the debris must have a permit for disposal at the landfill. The Program Manager will hire a consultant to facilitate the acquisition of the landfill disposal permit including taking samples of debris, laboratory analysis, and completion of the permit paperwork.~~ The Subcontractor shall coordinate with the consultant to provide a full truckload of debris from which the sample will be pulled ~~and will work with the Program Manager's consultant to acquire the permit.~~ The Subcontractor shall be responsible for providing a location and legal means of storage for the truckload of debris to be stored until the analytical results are processed.

**1.04 ACCESS ROADS**

- A. For interceptor assessment, the Program Manager will **assess and consider** constructing access roads in accordance with the dates specified on the maps. Road building will not be covered by this contract.

**PART 2 PRODUCTS**

- 2.01** This part not used.

**PART 3 EXECUTION**

- 3.01** This part not used.

**END OF SECTION 01501**

**SECTION 02541**  
**CLOSED CIRCUIT TELEVISION INSPECTION OF SEWER MAINS & CONNECTIONS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Work will consist of cleaning and Pipeline Assessment Certification Program (PACP) internal closed-circuit television (CCTV) surveys to digitally inspect and record conditions of existing sanitary sewer mains and connections. Sewer pipes and connections to be inspected are located in both improved streets, arterial and primary roads, backyards and unimproved easements.
- B. The Work covered by this section includes furnishing all labor, competent PACP certified technicians, equipment, tools, accessories, and materials required to clean and inspect the designated sanitary sewer lines.

**1.02 SUBMITTALS**

A. PACP Requirements

- 1. PACP compliant inspections, logs, data, and photos shall be delivered to the Program Manager (from hereon Program Manager shall be interpreted as “Program Manager or his designee”) on external hard drive(s) which will become property of the Program Manager. Data files shall be formatted to facilitate upload into a PACP compliant Exchange database or internet uploads formats to an FTP site approved only when requested by the Program Manager.
- B. Unless otherwise specified all sample data submittals shall be delivered to the Program Manager within two weeks of the NTP.
- C. For rehabilitation work, only Post-Rehabilitation PACP submittals will be required by the Purchaser. All CCTV done prior to rehabilitation shall be at the expense of the Subcontractor to ensure conformance with the Specifications.

D. Traffic Control

- 1. Traffic Control Plan shall be submitted to the Program Manager, including the following items:
  - a. Outline of permit acquisition procedure for lane closures.
  - b. Methods for proper signing and barricades, which comply with City of Memphis requirements.
  - c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN P.E. The City requires two-week lead time for permit processing.
    - i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.
    - ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be required to modify the sample Traffic Control Plan to obtain a permit from the City.

- d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a traffic control plan for all mobile operations in accordance with standard MUTCD specifications.

E. Permits

1. ~~The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits as required to perform this work. The City of Memphis has secured a Special Waste Recertification from the Division of Solid Waste Management of the Tennessee Department of Environment and Conservation for continued disposal at North and South Shelby landfills as well as separate solid and liquid waste profiles with Republic Services. The Subcontractor will be responsible for using a manifest form provided by the Program Manager and pre-signed by the Subcontractor's authorized representative for every disposal event. The Subcontractor is also responsible of providing a copy of the manifest and invoice from Republic Services after each disposal event.~~
  2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within the 25 feet railroad easement as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way the Subcontractor shall contact the Program Manager 48 hours in advance who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.
  3. Permit required confined space entry plans in compliance with the Loss Control Manual.
- F. Copies of National Association of Sewer Service Companies (NASSCO) certification for all field staff conducting PACP inspections.
- G. Sample of PACP compliant television survey log in MS Access format.
- H. Sample of PACP compliant video inspection in MP-4 (Web optimized) format.
- I. Cleaning and CCTV vehicle, equipment, and cleaning supplies list.
- J. Disposal site(s) and **written e-mail notification to the Program Manager that the provided numbered manifest forms have been received.** ~~appropriate landfill permits for appropriate disposal of all waste materials removed from the sewer during the light and heavy cleaning operations.~~

**1.03 DELIVERABLES**

A. Records

1. Pipe Cleaning Record
  - a. The Subcontractor shall provide a dated manifest of the volume or weight of the dewatered sewer cleaning loads taken and dumped at the permitted landfill. **The Subcontractor shall use the numbered manifest forms provided by the Program Manager. Each waste load manifest shall include a scanned copy of the landfill invoice be associated with a list of corresponding sewer segments from where the waste originated. The copy of both the numbered manifest and invoice shall be sent to the Program Manager the same day that dumping occurs.**
2. Digital Inspection Record



- a. In the digital PACP V.6.0.1 compliant format, the Subcontractor shall provide the following information:
  - i. Digital CCTV survey inspection which shall be recorded and shall be continuous as the inspection proceeds through the manholes and sewer pipes. Inspection videos should be delivered in an MP-4 (Web optimized) format.
  - ii. Digital Recordings: The digital recording shall document the visual and audio record of the manhole and sewer pipe inspection and shall be the basis of measurement and payment. Digital recording playback shall be at the same speed that it was recorded. Original digital recordings for the Project shall be forwarded to the Program Manager on clearly labeled external hard drive(s) in PACP ACCESS format with final report submittals and shall become the property of the Program Manager. Data for a single facility asset will not be split across multiple hard drives. Digital recordings shall be available to the Program Manager by the close of business on the Monday following a week after data acquisition. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.
    - (1) Picture Quality: The sewer inspection digital record shall be free of steam, fog, vapor, or other headspace distortion that degrades the quality of the picture from the intended purpose of evaluating the sewer for structural and watertight integrity. If necessary, the Subcontractor shall provide positive ventilation or other means through the sewer pipe to draw out steam, fog, and vapor that will degrade the recorded image of the pipe.
3. Inspection Documentation Logs
  - a. Observations made during television inspection shall be documented in an unmodified PACP compliant manner within an electronic inspection log form, supported by accompanying audio, digital photographs and MP-4 (Web optimized) format recording written to an external hard drive and submitted to the Program Manager. ~~Hard copies of completed inspection log photographs shall be furnished to the Program Manager with invoicing.~~
4. Electronic & ~~Hard Copy~~ **Data Deliverable** Records
  - a. **Daily Production** Reports:
    - i. The Subcontractor shall prepare **printed daily** inspection log reports for each associated sewer pipes inspected during the actual field inspection activities. These field logs shall then be **sent to the Program Manager inspectors in digital format after each day of work**, ~~reviewed by the Subcontractor's technical staff, along with reviewing the associated digital video record, as a means of ensuring that no defects or entries are omitted or incorrect. Edited field logs shall then be used in the final project reports and submitted in pdf format.~~
  - b. ~~Draft Report and Final Report~~ **Data Deliverables and Reports:**
    - i. ~~The Draft Final Report will contain electronic and hard copies of each of the PACP CCTV log pipe segment inspection logs.~~ Digital recordings of the inspections written to an external hard drive and the PACP compliant database of the inspections in ACCESS format shall **also** be submitted in electronic and pdf format.
    - ii. ~~Draft Report~~ **The PACP data for the Subcontractor's working week** shall be delivered to the Program Manager **by the close of business on the Monday following a week after data acquisition**, ~~within fifteen working days the last of~~



~~final inspection.~~ The Program Manager will have ~~two work weeks~~ **one workweek period** to review and **accept or reject the PACP data.** ~~comment. Subcontractor shall address all comments provided and submit a Final Report within one work week upon receipt of comments. At the Program Manager's discretion, a meeting will be held so the Subcontractor can explain the processes used to address the comments.~~

5. Quality

- a. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7) calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

## PART 2 PRODUCTS

### 2.01 EQUIPMENT

#### A. General

1. All equipment used for PACP compliant CCTV sewer segment inspections of existing sanitary sewer mains and connections shall be specifically designed and manufactured for the purpose intended under this Contract. The software and hardware for the electronic capture of the inspection defects and recorded observations must be Version 6.0.1 NASSCO PACP compliant.
2. The Subcontractor shall submit an equipment list to the Program Manager for approval before the commencement of the Work and shall certify that back-up equipment is available and can be delivered to the worksite within 72 hours.
3. The Subcontractor shall provide equipment to perform inspections of sewer mains located in streets, street rights-of-way, backyards, easements and rights-of way that are off-road.
  - a. Including but not limited to portable CCTV equipment, vehicles capable of transporting TV equipment and accessing remote easements, and adequate cleaning equipment rights of way or easement applications.

#### B. PACP Compliant Software & Data Logger Requirements

1. Data logger
  - a. Internal inspection logs created and captured electronically during the television inspection through the use of commercially available electronic data loggers in the truck are required. NASSCO PACP protocols Version 6.0.1 shall be used for capturing and recording the observations. Audio commentary made during the inspection and captured on the digital video shall correspond with the PACP observations on the log.
  - b. The data logger equipment and software shall allow the Program Manager access directly to the captured electronic data and provide for a non-proprietary export of the data into MS ACCESS databases in accordance with PACP standards for standalone database review.
2. Software must be compliant with the NASSCO PACP V.6.0.1 standards. Follow PACP protocol for recording of observations and defects for sewer mains.

- a. All software shall be capable of providing complete survey reports in compliance with PACP, and the software shall be the V.6.0.1 of the PACP compliant software.
- b. The Program Manager has no intent to specify which software the Subcontractor shall use but requires the software and the submitted database to be fully compliant with PACP V.6.0.1 and capable of being exported to ACCESS databases. No payment will be rendered for improperly formatted data.
- c. Software and data logger must be capable of capturing sewer main and sewer lateral observations by PACP descriptions, record travel footage along pipeline, and video time stamp the recorded observations to support hyper linking from the digital record to the event point or location within the digital inspection record. The same requirements apply to still photo images (if provided) which shall follow PACP guidelines and be hyperlinked to the inspection log.

C. Sewer Main CCTV

1. Sewer Main Digital Color Video Camera

- a. All cameras used shall be digital format color CCTV units specifically designed and constructed for use in sewer pipe inspection work. The cameras shall be operable in 100 percent humidity conditions. The camera shall have a high-resolution, 360-degree pan and tilt or rotating head with a wide viewing angle lens and either automatic or remote focus and iris controls. Camera lighting shall be sufficient for use with digital color inspection cameras and for the manhole and pipe diameters identified in the contract.
  - i. Camera, Television Monitor, and Other Components shall be capable of producing a high-resolution color digital inspection record.
  - ii. Video file to be in MP-4 (Web optimized) format
- b. In all cases, the complete digital inspection system (camera, lens, lighting, cables, monitors, and recorders) shall be capable of providing a digital picture and digital video quality acceptable to the Program Manager. Inadequate lighting, image distortions, blurry or murky images, and dirty lenses will be a cause for rejection. No payment will be made for unsatisfactory inspections and the Subcontractor shall perform work until deliverable is of acceptable quality. Digital video cameras/digital recorders not specifically intended for use for internal television inspection of manholes and sewer lines shall not be permitted.
- c. Pan and tilt type camera, capable of turning at right angles to pipe's axis over an entire pipe wall perimeter shall be used.
  - i. The camera lens shall be capable of self-righting itself after a lateral view or connection view with a return view down the pipe with a "home" capability for the lens.
- d. Lighting shall be suitable to allow clear picture of entire inner pipe wall extending at least 10 feet in front, including black High Density Polyethylene (HDPE) pipe.
- e. Document header and observations shall be in accordance with PACP V.6.0.1 protocols.
- f. Subcontractor shall have equipment capable of cleaning and assessing 12" and smaller diameter siphons.

#### D. Cleaning Equipment

1. Hydraulic sewer pipe cleaners or combination hydraulic/vacuum cleaners shall be specifically designed and constructed for such cleaning.
2. Mechanical sewer pipe cleaners shall be specifically designed and constructed for such cleaning.
3. The Subcontractor shall possess equipment capable of hydraulically ~~or mechanically~~ cleaning a minimum of 1,000 linear feet of pipe from one direction and have a minimum 1,000 linear feet of hose or cable on-site during the cleaning execution.
4. Hydraulic sewer pipe cleaners shall be specifically designed and constructed for such cleaning. The sewer cleaner shall have a minimum usable water capacity of 600 gallons and a pump capable of delivering at least 30 gallons per minute at 1,500 psi at the nozzle.
  - a. The hydraulic cleaning equipment shall have multiple hydraulic cleaner hose nozzles for a variety of sewer cleaning conditions, including grease, roots, debris and granular materials.
  - b. Vacuum equipment shall be capable of lifting debris removed from the segment from the downstream manhole.
5. Mechanical sewer pipe cleaners (cable machines with buckets, brushes, swabs, root cutters, and power rodders with similar capability) shall only be use for cutting roots and protruding lateral service connections and be capable of controlled forward and reverse travel through the sewers without inflicting damage to the existing pipe in removing roots or cutting protruding lateral connections ~~rocks, grit and other heavy debris and roots.~~

### PART 3 EXECUTION

#### 3.01 INSPECTIONS

##### A. CCTV Inspection of Sewer Mains

1. Cleaning
  - a. Sewer pipe cleaners or combination hydraulic-vacuum cleaners must accompany CCTV units at all times. Ideally, sewers lines are to be cleaned and then followed immediately by CCTV inspection. All sewers must be cleaned in advance of CCTV during the same calendar day they are inspected.
  - b. Light Cleaning
    - i. Before CCTV work, the Subcontractor shall light clean the sewer line (three (3) cleaning attempts) from manhole to manhole, from upstream to downstream direction unless an obstruction is encountered, one sewer section at a time and performed as efficiently as possible at the Subcontractor's discretion.
    - ii. Materials shall not be passed from one sewer segment to another but must be trapped and removed from each sewer segment prior to CCTV inspection.
  - c. Heavy Cleaning

- i. If a camera is inserted and additional debris or impediments to inspection are observed following the required light cleaning, heavy cleaning shall be approved by the Program Manager. Sections of pipe containing significant roots, large areas of debris, and/or several inches of depth of sands and gravels that will require the use of additional hydraulic nozzles, cable/bucket machine, power rodders and root cutters is considered heavy cleaning.
- ii. Heavy cleaning will be proposed by the Subcontractor and approved by the Program Manager. The Subcontractor must obtain prior approval for heavy cleaning in each sewer segment in order to receive payment for heavy cleaning.
- d. Cleaning Execution
  - i. No roots, grease or debris from light or heavy cleaning shall be passed from sewer segment to sewer segment during the cleaning operation. All debris flushed from the sewer must be collected, captured, and removed from the sewer at the downstream manhole.
  - ii. Roots shall be removed in the sections where root intrusion is a problem. Special precautions shall be exercised during the cleaning operation to assure complete removal of visible roots from the joint area and so as not to incur further damage to the pipe. Any visible roots that may impact rehabilitation efforts shall be removed. Fine roots are allowed if the Subcontractor made a heavy cleaning attempt to remove roots with proper root removal means. Procedures may include the use of mechanical devices such as rodding machines, expanding root cutters and porcupines, and hydraulic procedures such as high-pressure jet cleaners.
  - iii. The Subcontractor is responsible for safe, responsible and legal handling of all material and debris removed from the sewers.
  - iv. Proper disposal arrangements are the exclusive responsibility of the Subcontractor. The Subcontractor shall provide a dated manifest of the volume and weight of the dewatered sewer cleaning loads taken and dumped at the permitted landfill. The Subcontractor shall not dispose of debris at a City of Memphis Wastewater Treatment Plant. Each waste load manifest shall be associated with a list of corresponding sewer segments from where the waste originated.
  - v. Siphons shall be cleaned to remove 95% of the debris from the pipe.
- 2. Sewer Flow Levels During Inspection Operations
  - a. Maintain low sewer flow during inspection by using sandbags or flow-through plugs or by inspecting during low flow times of day, evening, or early morning hours while camera is moving and recording observations in the sewer segment. Any items used to restrict flow shall be removed immediately after intended use.
    - i. Flow-through Plugs: If used, secure the plugs so as to remain in place during inspection. Use a fail-safe device at the downstream pipe connection to ensure the plug is not lost in the downstream sewer segment if it becomes dislodged from the upstream pipe connection.
    - ii. Conduct all cleaning and CCTV operations to prevent building backups and sewer overflows.

- iii. Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the cleaning and inspection operations.
  - b. Allowable Depth of Flow for Inspection Operations
    - i. For effective inspection, all flow shall be minimized in the segment being inspected. However, the depth of flow at the upstream manhole of the interceptor section being worked shall be within the specified limits provided herein.
  - c. Maximum Allowable Depth of Flow for CCTV Inspection
    - i. 6 - 10-inch diameter Pipe - 20% of pipe diameter
    - ii. 12 - 18-inch diameter Pipe - 25% of pipe diameter
    - iii. 24-inch diameter and Larger Pipe - 30% of pipe diameter
    - iv. Exceptions to these guidelines shall result in rejection, and non-payment, of the CCTV inspection unless approved in advance by the Program Manager.
- 3. Camera Operations
  - a. Using the pan/tilt feature, pan the interior of the manhole for record purposes in accordance with V.6.0.1 PACP protocols and begin and terminate the inspection in the starting and ending manholes.
    - i. Capture the inside of manhole walls, manhole channel, and pipe connection to wall at both upstream and downstream manhole and lateral connections using the digital mainline sewer camera and the pan/tilt feature.
  - b. Place the camera at center of manhole and commence video before entering pipe.
    - i. Start footage counter at manhole wall/pipe connection or at a short pre-measured distance down the pipe for the sewer segment inspection.
  - c. Connections: The digital camera shall be used to look at connections and up laterals from the connection in the main sewer pipe being inspected. The camera shall pause, pan, and record all connections. Conditions noted in these sidelines and laterals shall be noted on the inspection logs.
  - d. Mainline camera operations:
    - i. Move through line at speed no greater than 30 feet per minute stopping for minimum 10 seconds to record lateral connections, mainline connections, defects, and features and points of interest.
    - ii. Do not float camera.
    - iii. Maintain technical quality, sharp focus, and distortion free picture with the camera lens centered in the pipe for the different diameters inspected.
      - (1) Eliminate steam in line for duration of inspection.
      - (2) Utilize blower as needed to defog sewer line.

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS  
Modified by SARP10 Program

- iv. Digitally record a complete sewer segment in its entirety with no breaks, “blink-outs,” or interruptions from manhole to manhole according to PACP V.6.0.1 formats.
- v. Pan, tilt, and rotate as necessary to best view and evaluate lateral connections, pipe defects, features, obstructions, and points of interest.
- vi. Use power winches, powered rewinds, self-propelled tractors, or other devices that do not obstruct camera view or interfere with proper documentation of sewer conditions to move camera through sewer.
  - (1) Whenever non-remote powered and controlled winches are used, set up telephones or other suitable means of communication between manholes to insure good communication.
- vii. Use hydraulic jet nozzle pressure and flow to remove standing water from depressions or sags in the sewer, if necessary, for complete inspection of the sag portion of the sewer segment.
- viii. Measurement for location of defects and service laterals:
  - (1) At ground level by means of Program Manager-approved footage counter or metering device.
  - (2) Electronic display measurement meters: Accurate to PACP standards over length of section being televised.
  - (3) Do not pull unnecessary length of slack camera cable if it impacts the footage counter.
- ix. Stop camera at service connections and inspect lateral with pan and tilt camera.
  - (1) Identify building connection in PACP compliant terms as active, capped, or abandoned.
  - (2) If no wastewater flows are being discharged from building, consider steady, clear observed flow as infiltration/inflow.
- x. Identification of Defects
  - (1) If roots, sludge, or sediment material impedes inspection after the light cleaning, withdraw camera and perform heavy cleaning at the direction of the Program Manager.
  - (2) Upon completion of heavy cleaning operation, resume internal inspection.
  - (3) Furnish media confirmation for heavy cleaning (more than three passes with jet cleaner) to Program Manager.
  - (4) If protruding tap impedes inspection trim protruding tap to 1/2 inch.
- xi. If obstructions are not passable and cannot be removed by sewer cleaning, withdraw CCTV equipment and perform a reverse inspection from opposite end of the sewer segment in accordance with PACP protocols.
  - (1) Subcontractor shall be responsible for costs associated for reverse set-ups when an obstruction is encountered that cannot be passed.
  - (2) Subcontractor shall be responsible for all judgments and impacts as to whether an obstruction in the sewer main can be passed. Costs involved in extracting a stuck camera in the sewer main will be borne by the Subcontractor and at no additional cost to the Program Manager.

- (3) When additional obstructions are encountered after reversal of equipment and no means are available for passing a second obstruction in order to complete the sewer main inspection, remand the segment inspection to the Program Manager for resolution. The portion of the main inspected will be paid for as prescribed.

xii. Undocumented facilities

- (1) If undocumented manholes or sewer mains (facilities not on the field updated GIS sewer maps) are encountered during the inspection, the Subcontractor needs to complete the documentation requirements per PACP requirements and capture on the video the following:
  - (a) Approximate horizontal distance from the upstream or reference manhole.
  - (b) Approximate depth of the undocumented manhole by turning the pan/tilt camera vertically and estimating the height of the cover from the invert.
  - (c) A provisional manhole asset ID number shall be used by the Subcontractor by adding a dash and two-character number to the closest upstream manhole ID.

xiii. Retrieval of Stuck Equipment

- (1) The Subcontractor is responsible for hiring a licensed sub-Subcontractor to retrieve any equipment/foreign objects that get stuck in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor's own cost. Such retrieval by an appropriately licensed sub-Subcontractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor's equipment in the line shall be the responsibility of the Subcontractor. Subcontractor shall follow SARP10 sewer point repair specifications outlined in "Section 02540 Sanitary Sewer Point Repairs" and "Section 02950 Removal and Replacement of Pavements and Incidentals" during retrieval of equipment. Also, per "00585.2.2 Safety, Health, and Accident Prevention Program," Purchaser must approve sub-tier Subcontractors prior to mobilization to the jobsite.

4. Quality Assurance

- a. With each monthly invoice the Subcontractor shall provide a QA/QC memo documenting that 10% of the previous month's CCTV data has undergone a random, independent review by a PACP certified reviewer using NASSCO standards for Television Inspection of Main Sewer and PACP Quality control as the basis for the QA/QC procedures. The independent reviewer shall be a Tennessee P.E. or is a P.E. in another state and has a Tennessee P.E. license pending. Each line segment which has been randomly reviewed shall be identified in the QA/QC memo as well as any subsequent findings or recommendations. Internal independent QA/QC is acceptable, as long as the person is a Tennessee P.E. or is a P.E. in another state and has a Tennessee P.E. license pending. Failure to submit the QA/QC memo shall delay payment of the current month's invoice.
- b. For all new Subcontractors and Operators who begin PACP coding, an initial review of CCTV data will consist of reviewing, at a minimum, 20 of the first 100 PACP inspection records submitted. Subsequent reviews will be based on the results of the initial reviews as explained below.
- c. Auditing Procedures:



- i. Header Information: As explained in the NASSCO PACP Quality Control Standards each audited inspection record is given an accuracy level for the header information and the detailed observation records. It is expected that the accuracy of the header record exceed 90% because the majority of the contents are based upon facts and not subject to operator judgment. To assess the accuracy level of the header, record the number of errors as compared to the total number of header fields using the following formula:

(1)  **$100\% - (\text{error count}/\text{total header fields}) * 100\% = \text{Header Accuracy}$**

- ii. Detailed Observations: Determining the accuracy level for the detailed observation records is similar to the method for assessing the header record. The main difference being that a defect observation has multiple data entries that must also be counted towards the total number of entry fields. In the event that a defect is not coded all of the required entries for coding the missed defect are counted towards the total error count. The following formula is used to calculate the accuracy level of the detailed observation records:

(1)  **$100\% - (\text{error count}/\text{total entries}) * 100\% = \text{Detail Accuracy}$**

- iii. Review Scoring and Results

- (1) Satisfactory Review, no changes required. Accuracy Level of 90% or above for both the Header Record and Observation Detail with no major errors or omissions found.
- (2) Unsatisfactory Review (below levels of acceptance) will not be accepted by the Program Manager and will not be considered payable items in the Subcontractor's Request for Payment.

5. Deliverable Documentation

a. Mainline Sewer

- i. Submit V.6.0.1 PACP compliant records, logs, and electronic inspection data for sewer line inspection to Program Manager by the close of business on the Monday following a week after data acquisition.
- ii. Monthly QA/QC memo submittal listing which segments have been randomly reviewed, as well as any subsequent findings or recommendations.
- iii. Digital videos, data, and photos shall be delivered to the Program Manager on external hard drives which will become property of the Program Manager.
- iv. Data files shall be formatted to facilitate upload into a PACP Exchange Database with the approval of the Program Manager.
- v. Inspections displaying poor digital video/audio quality will be rejected. Quality refers to, but is not limited to, grease or debris on lens, camera under water, image too dark or light, image washed-out, distorted image, out of focus images, lines improperly cleaned, and poor/no audio.
- vi. Subcontractor will re-televisualize rejected inspections and resubmit inspections at no additional cost to the Program Manager.

b. Map changes/undocumented manholes:

- i. For map changes identifying undocumented manholes and network changes which were found as a result of field inspections or observations, a Map Edit Form shall also be prepared and supplied by the Subcontractor with a drawing or sketch

and shall indicate special details, field measurement or distances, or locations about an observed undocumented manhole or a change to the sewer network. The Map Edit Form should also identify buried manholes and siphons that have been encountered.

- ii. Subcontractor shall indicate all buried manholes identified in the field via CCTV using the provided Buried Manhole Form. Any additional manholes that have not been located or verified via CCTV but are impeding the completion of required CCTV work should be designated as unable to locate (UTL) and be included on the form.

c. Incident observation and data collection:

- i. The Subcontractor shall report all buried manholes, pipe collapses, large void, utility conflicts, Unable to Complete line segments, and heavy cleaning requests to the Program Manager through the program-defined reporting application (Teamworx) and shall fill out all required fields and attach picture documentation as necessary. At least one picture shall be included showing the incident or condition of the sewer line encountered that required it to be recorded. All reported incident observations will be monitored by the Program Manager and inadequate reporting will result in a meeting between the Program Manager and Subcontractor.

6. Easement or Turf Operation

- a. The Subcontractor will restore the work area to its original condition as quickly as possible after the inspection is complete. The Subcontractor will not be allowed to postpone restoration of the site until the end of the project.

**PART 4 MEASUREMENT & PAYMENT**

**4.01 MEASUREMENT**

A. Light Cleaning & CCTV Inspection

1. Light cleaning and mainline CCTV inspection shall be measured by linear foot by each diameter of mainline sewer inspected and documented in accordance with the specification.

B. Heavy Cleaning

1. Heavy cleaning shall be measured by crew hour for each diameter of heavy cleaning approved by the Program Manager and documented.

C. Remote Trimming of Protruding Service Lateral

1. Remote trimming of protruding service lateral that prevent a thorough inspection of the pipe will be measured per each.

D. Siphon Cleaning and CCTV Inspection

1. Siphon Cleaning and CCTV inspection shall be measured per linear foot of each diameter 12" and smaller of sewer inspected and documented in accordance with the specifications.

E. Traffic Control at Major Streets due to City Pavement Project

1. Traffic control and plans as required and approved by the City for Light Cleaning and Mainline CCTV due to a City pavement project of a major street shall be measured in a one-time basis.

#### 4.02 PAYMENT

##### A. Mainline CCTV Inspection

1. Light cleaning and mainline CCTV inspection shall be paid for at the unit price for each linear foot of each diameter inspected and documented in accordance with the specification.
2. The unit price for Light Cleaning and Mainline CCTV inspection shall cover the entire cost of the required light cleaning and CCTV inspection and reporting in accordance with PACP V 6.0.1 format, including but not limited to labor, mobilization and access, CCTV equipment, recording media, traffic control, light cleaning of mainline sewer, documenting results in PACP records and logs, digital format recordings, photo equipment, power supply for equipment, interim and final reports and all other appurtenant work.
3. No additional payment will be made for:
  - a. Re-inspection due to rejected inspection and/or records for any reason.
  - b. Reversals.
  - c. Performing excavation and associated sewer point repair to retrieve a stuck CCTV camera or hydraulic cleaning hose/nozzle.
  - d. Incomplete electronic logs.
  - e. Unapproved duplication of inspections: The Subcontractor is responsible to ensure duplications do not occur.
  - f. Traffic control at major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit unless Light cleaning and Mainline CCTV inspection is assigned at the direction of the Program Manager due to a City pavement project of a major street.

##### B. Heavy Cleaning

1. Heavy Cleaning shall be paid for at the unit price for each crew hour of each diameter of heavy cleaned sewers at the direction of the Program Manager and in accordance with the specification.
2. The unit price for Heavy Cleaning shall include the entire cost including but not limited to labor, mobilization and access, traffic control, appropriate disposal of sewer debris removed from sewer at permitted site and all other appurtenant work. Payment includes non-hydraulic jet efforts such as porcupines, cutters, power rodding, clam buckets, and other mechanical means, traffic control, and re-cleaning with hydraulic jet, labor, materials, and equipment necessary to clean mainline sufficiently to allow video reviewers a clear picture of pipe conditions.
3. No additional payment will be made for:
  - a. Additional passes of heavy cleaning if the inspection observation reveals roots, grease or other debris remaining in the sewer after the heavy cleaning passes.

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C. Remote Trimming of Protruding Service Lateral

1. Remote trimming of protruding service lateral that prevent a thorough inspection of the pipe will be measured per each.

D. Siphon Cleaning and CCTV Inspection

1. Siphon cleaning and CCTV inspection shall be paid for at the unit price for each linear foot of each diameter 12" and smaller inspected and documented in accordance with the specification.
2. The unit price for Light Cleaning and Mainline CCTV inspection shall cover the entire cost of the required light cleaning and CCTV inspection and reporting in accordance with PACP V 6.0.1 format, including but not limited to labor, mobilization and access, CCTV equipment, recording media, traffic control, light cleaning of mainline sewer, documenting results in PACP records and logs, digital format recordings, photo equipment, power supply for equipment, interim and final reports and all other appurtenant work.
3. No additional payment will be made for:
  - a. Re-inspection due to rejected inspection and/or records for any reason.
  - b. Reversals.
  - c. Performing excavation and associated sewer point repair to retrieve a stuck CCTV camera or hydraulic cleaning hose/nozzle.
  - d. Incomplete electronic logs.
  - e. Unapproved duplication of inspections: The Subcontractor is responsible to ensure duplications do not occur.

E. Traffic Control at Major Streets **or** due to City Pavement Project

1. Traffic control and plans as required and approved by the City for Light Cleaning and Mainline CCTV due to a City pavement project of a major street will be paid for on a lump sum basis.

**4.03** PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02541-4.01.A	LIGHT CLEANING & MAINLINE CCTV INSPECTION FOR EACH DIAMETER	LINEAR FEET
02541-4.01.B	HEAVY CLEANING FOR EACH DIAMETER	CREW HOUR
02541-4.01.C	REMOTE TRIMMING OF PROTRUDING LATERAL	EACH
02541-4.01.D	SIPHON CLEANING AND CCTV INSPECTION FOR EACH DIAMETER	LINEAR FEET
02541-4.01.E	TRAFFIC CONTROL	LUMP SUM

**END OF SECTION 02541**

**SECTION 02542**

**CLOSED CIRCUIT TELEVISION & SONAR INSPECTION OF LARGER DIAMETER SEWER MAINS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Work will consist of assessment, Pipeline Assessment Certification Program (PACP) internal closed-circuit television (CCTV), and Sonar surveys to digitally inspect and record conditions of existing sanitary sewer mains and connections in 24-inch and larger diameter sanitary sewer pipes. Larger diameter sewer pipes to be inspected are located in both improved streets, arterial and primary roads, backyards and unimproved easements. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work, in addition to any equipment necessary to access all elevated manholes while remaining in compliance with The Loss Control Manual. No cleaning of the sanitary sewer is required prior to CCTV and Sonar inspection unless otherwise specified by the Program Manager.
- B. The Work covered by this section includes furnishing all labor, competent PACP certified technicians, equipment, tools, accessories, and materials required to CCTV and Sonar inspect the designated 24-inch diameter and larger sanitary sewer lines.

**1.02 SUBMITTALS**

A. PACP Requirements

- 1. PACP compliant inspections, logs, data, and photos shall be delivered to the Program Manager (from hereon Program Manager shall be interpreted as “Program Manager or his designee”) on external hard drives which will become property of the Program Manager. Data files shall be formatted to facilitate upload into a PACP compliant exchange database or internet uploads formats to an FTP site **approved only when approved** by the Program Manager.

- B. Unless otherwise specified all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.

C. Traffic Control

- 1. Traffic Control Plan shall be submitted to the Program Manager, including the following items:
  - a. Outline of permit acquisition procedure for lane closures.
  - b. Methods for proper signing and barricades, which comply with City of Memphis requirements.
  - c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN P.E. The City requires two-week lead time for permit processing.
    - i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.
    - ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be required to modify the sample Traffic Control Plan to obtain a permit from the City.

- d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a traffic control plan for all mobile operations in accordance with standard MUTCD specifications.

D. Permits

1. The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits as required to perform this work.
  2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within the 25 feet of railroad easement as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way the Subcontractor shall contact the Program Manager 48 hours in advance who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.
  3. Permit required confined space entry plans in compliance with the Loss Control Manual.
- E. Copies of National Association of Sewer Service Companies (NASSCO) certification for all field staff conducting PACP inspections.
- F. Sample of PACP compliant television survey login MS Access format.
- G. Sample of PACP compliant video inspection in MP-4 (Web optimized) format.
- H. Cleaning, CCTV and Sonar inspection vehicle and equipment supplies list.
- I. Sample of combined CCTV & Sonar inspection report.
- J. Disposal site(s) and appropriate landfill permits for appropriate disposal of all waste materials removed from the sewer during the heavy cleaning operations.

**1.03 DELIVERABLES**

A. Records

1. Digital Inspection Record
  - a. In the digital PACP V.6.0.1 compliant format, the Subcontractor shall provide the following information:
    - i. Digital CCTV survey and Sonar inspection which shall be recorded and shall be continuous as the inspection proceeds through the manholes and sewer pipes.
    - ii. Digital Recordings:
      - (1) The digital recording shall document the visual and audio record of the sewer pipe inspection and shall be the basis of measurement and payment. Digital recording playback shall be at the same speed that it was recorded. Original digital recordings for the Project shall be forwarded to the Program Manager on clearly labeled external hard drive(s) in PACP ACCESS format with final report submittals and shall become the property of the Program Manager. Data for a single facility asset will not be split across multiple hard drives. Digital recordings shall be available to the Program Manager by the close of

business on the Monday following a week after data acquisition. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.

(a) Picture Quality:

- (i) The sewer inspection digital record shall be free of steam, fog, vapor, or other headspace distortion that degrades the quality of the picture from the intended purpose of evaluating the sewer for structural and watertight integrity. If necessary, the Subcontractor shall provide positive ventilation or other means through the sewer pipe to draw out steam, fog, and vapor that will degrade the recorded image of the pipe.

2. Inspection Documentation Logs:

a. CCTV Records:

- i. Observations made during television inspection shall be documented in an unmodified PACP compliant manner within an electronic inspection log form, supported by accompanying audio, digital photographs and MP-4(web optimized) format recording written to an external hard drive and submitted to the Program Manager. ~~Hard copies of completed inspection log photographs shall be furnished to the Program Manager with invoicing.~~

b. Sonar Records:

- i. Where combined CCTV and Sonar inspections are performed, the display in the viewing area shall show the combined CCTV and Sonar images of the sewer being inspected. The Sonar image shall be superimposed on the real CCTV image, and continuously recorded, as a combined operation at the time of the inspection resulting in a single combined video file in MP-4(Web optimized) format for each inspection.
- ii. The Sonar Inspection shall include a comprehensive final report on the findings concerning major defects including fractures, displaced joints, deformation, corrosion, lateral intrusions, dominant surface features, encrustation, and debris/silt depths.

3. Electronic ~~& Hard Copy~~ and Data Deliverable Records

a. Daily Production Reports:

- i. The Subcontractor shall prepare printed daily inspection log reports for each associated sewer pipe inspected during the actual field inspection activities. These field logs shall then be sent to the Program Manager inspectors in digital format after each day of work. ~~reviewed by the Subcontractor's technical staff, along with reviewing the associated digital video record, as a means of ensuring that no defects or entries are omitted or incorrect. Edited field logs shall then be used in the final project reports and submitted in pdf format.~~

b. ~~Draft Report and Final Report~~ Data Deliverable and Reports:

- i. ~~The Draft Final Report will contain electronic and hard copies of each of the PACPCCTV log pipe segment inspection logs.~~ Digital recordings of the inspections



written to an external hard drive and the PACP compliant database of the inspections in ACCESS format shall ~~also~~ be submitted in electronic and pdf format.

- ii. ~~Draft Report~~ **The PACP Sonar data for the Subcontractor's working week** shall be delivered to the Program Manager **by the close of business on the Monday following a week after data acquisition.** ~~within fifteen workin of oldest inspection.~~ The Program Manager will have ~~two~~ **one** workweeks **period** to review and **accept or reject the PACP Sonar data.** ~~comment. The Subcontractor shall address all comments provided and submit a Final Report within one workweek upon receipt of comments. At the Program Manager's discretion, a meeting will be held so the Subcontractor can explain the processes used to address the comments.~~

#### 4. Quality

- a. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7) calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

## PART 2 PRODUCTS

### 2.01 EQUIPMENT

#### A. General

1. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work. Expected terrain may require the use of four-wheel drive vehicles, ATVs, tracked vehicles, or other appropriate off-road vehicles.
2. All equipment used for PACP compliant CCTV sewer segment inspections of existing larger diameter sanitary sewer mains shall be specifically designed and manufactured for the purpose intended under this Contract. The software and hardware for the electronic capture of the inspection defects and recorded observations must be Version 6.0.1 NASSCO PACP compliant.
3. All CCTV equipment requirements contained in Section 02541 – Closed Circuit Television Inspection of Sewer Mains & Connections, Paragraph 2.01 are applicable, except 2.01.D. Cleaning Equipment since pre-cleaning of the larger diameter sewers is not required.

## PART 3 EXECUTION

### 3.01 CCTV & SONAR INSPECTIONS OF SEWER MAINS

#### A. Heavy Cleaning

1. Heavy cleaning shall be completed if segment has debris levels high enough to prevent the sonar equipment from passing through segment. Heavy cleaning shall be as contained

in Section 02541 - Closed Circuit Television Inspection of Sewer Mains & Connections,  
Paragraph 3.01.A.1. Cleaning.

B. Sewer Flow Levels During Inspection Operations

1. Maintain low sewer flow during inspection by using sandbags or flow-through plugs or by inspecting during low flow times of day, evening or early morning hours while camera is moving and recording observations in the sewer segment. Any items used to restrict flow shall be removed immediately after intended use.
  - a. Flow-through Plugs: If used, secure the plugs so as to remain in place during inspection. Use a fail-safe device at the downstream pipe connection to ensure the plug is not lost in the downstream sewer segment if it becomes dislodged from the upstream pipe connection.
  - b. Conduct all cleaning and CCTV operations to prevent building backups and sewer overflows.
  - c. Contractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the cleaning and inspection operations.
2. Allowable Depth of Flow for Inspection Operations:
  - a. For effective inspection, all flow shall be minimized in the segment being inspected. However, the depth of flow at the upstream manhole of the interceptor section being worked shall be within the specified limits provided herein.
3. Maximum Allowable Depth of Flow for CCTV Inspection
  - a. 24-inch diameter and Larger Pipe - 30% of pipe diameter. Flow in excess of the 30% depth of flow limitation shall include the provision for Sonar inspection for below the water surface level in addition to a raft mounted CCTV inspection for above the water level.
  - b. Exceptions to these guidelines shall result in rejection, and non-payment, of the CCTV inspection unless approved in advance by the Program Manager.

C. Camera Operations

1. When flow is in excess of the 30% depth of flow limitation, the Subcontractor shall include the provision for Sonar inspection for below the water surface level in addition to a raft/float mounted CCTV inspection for above the water level.
2. Raft/float supports shall be collapsible to fit through existing manhole frames associated with 24-inch diameter and larger sewers.
3. Camera Operations requirements shall be as contained in Section 02541 – Closed Circuit Television Inspection of Sewer Mains & Connections, Paragraph 3.01 are applicable for the execution of the CCTV operations with the camera mounted on a raft or float, except as modified below.
4. Contractor shall be responsible for all judgments and impacts as to whether an obstruction in the sewer main can be passed. Costs involved in extracting a stuck camera in the sewer main will be borne by the Subcontractor and at no additional cost to the Program Manager.

D. Camera & Sonar Combined Operations

1. The combination CCTV and Sonar equipment shall be capable of inspecting a length of sewer up to at least 1,000 linear feet when entry into the sewer may be obtained at each end and up to 750 feet where a self-propelled unit is used and where entry is possible from one end only.
2. Each inspection unit shall contain a means of transporting the CCTV camera or Sonar equipment in a stable condition through the sewer under inspection. Such equipment shall ensure the maintained location of the CCTV camera and Sonar equipment when used independently on or near to the central axis of a circular shaped sewer. The maximum allowable flow depth that is permissible for the combination Sonar/CCTV is equal to 75% of the pipe diameter. A Sonar only unit shall be used when flow is greater than 75% of the pipe diameter.
3. Where the CCTV camera or Sonar head are towed through the sewer, all winches shall be stable with either lockable or ratcheted drums. All connection shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera or Sonar equipment through the surcharged sewer. All winches shall be inherently stable under loaded conditions.
4. Each inspection unit shall carry sufficient numbers of guides and rollers such that, when inspecting, all connecting materials are supported away from pipe and manhole structures and all CCTV & Sonar lines used to measure the CCTV camera and the Sonar head location within the sewer are maintained in a taut manner and set a right angles where possible, to run through or over the measuring equipment.
5. The CCTV Camera and Sonar head shall be positioned to reduce the risk of picture distortion. In circular sewers the CCTV camera lens and/or Sonar head shall be positioned, when possible, centrally within the “dry” area for the CCTV and centrally within the “wet” area for the Sonar head. In non-circular sewers, picture/sonar image orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. In all instances the camera/sonar lens shall be positioned looking along the axis of the sewer. A positioning tolerance of + 10% of the vertical sewer dimension shall be allowed.
6. When the scanning Sonar is deployed, either stand alone or combined with CCTV, the speed or travel shall be limited to 4 inches per second or 20 feet per minute.
7. A General Condition 360° CCTV rotational scan must be implemented at every 50 feet interval (min) along sewers, and at all manholes and all salient, specified, defect features. More frequent scans must be made should the condition of the pipe differ from the previous scan. The tilt must not be less than 225°.
8. The color palette shall have a minimum of 16 colors with text. The Sonar image, inside the viewing area shall be in color.
9. The picture update speed shall not result in unsatisfactory picture resolution. The range of resolution shall be 1/10 inch.
10. The maximum beam width of Sonar energy pulse shall be no greater than two degrees from the center of the transducer.
11. The transducer shall be of the continuous scanning type, the speed of which shall be 1 second per 360° scan.

12. The Subcontractor is responsible for hiring a licensed sub-contractor to retrieve any equipment/foreign objects that get stuck in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor's own cost. Such retrieval by an appropriately licensed sub-contractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor's equipment in the line shall be the responsibility of the Subcontractor. Subcontractor shall follow SARP10 sewer point repair specifications outlined in "Section 02540 Sanitary Sewer Point Repairs" and "Section 02950 Removal and Replacement of Pavements and Incidentals" during retrieval of equipment. Also, per "00585.2.2 Safety, Health, and Accident Prevention Program", Purchaser must approve sub-tier Subcontractors prior to mobilization to the jobsite.

E. Coordination with Other Subcontractors

1. The Program Manager has an existing contract with a construction subcontractor to handle all clearing, grubbing, access road building, and easement coordination and acquisition. The SSES Subcontractor shall be responsible for notifying the Program Manager of access needs in a timely manner to allow the construction subcontractor to perform the work without impacting the SSES Subcontractor's schedule. SSES Subcontractor shall also coordinate directly with the construction subcontractor in instances where both entities must work on the same site simultaneously.

F. Quality Assurance

1. QA/QC shall be as contained in Section 02541 - Closed Circuit Television Inspection of Sewer Mains & Connections, Paragraph 3.01.A.4. Quality Assurance.

G. Deliverable Documentation

1. Mainline Sewer:
  - a. Submit V.6.0.1 PACP compliant records, logs, and electronic inspection data for sewer line inspection to Program Manager by the close of business on the Monday following a week after data acquisition.
  - b. Digital videos, data, and photos shall be delivered to the Program Manager on external hard drives which will become property of the Program Manager.
  - c. Data files shall be formatted to facilitate upload into a PACP Database with the approval of the Program Manager.
  - d. Inspections displaying poor digital video/audio quality will be rejected. Quality refers to, but is not limited to, grease or debris on lens, camera under water, image too dark, image washed-out, distorted image, or out of focus images, lines improperly cleaned, and poor/no audio.
    - i. Contractor will re-televiser rejected inspections and resubmit inspections at no additional cost to the Program Manager.
2. Map changes/undocumented manholes:
  - a. For map changes identifying undocumented manholes and network changes which were found as a result of field inspections or observations, a Map Edit Form shall also be prepared and supplied by the Subcontractor with a drawing or sketch and shall indicate special details, field measurement or distances, or locations about an observed undocumented manhole or a change to the sewer network. The Map Edit Form should also identify buried manholes and siphons that have been encountered.

- b. Contractor shall indicate all buried manholes identified in the field via Sonar/CCTV using the provided Buried Manhole Form. Any additional manholes that have not been located or verified via Sonar/CCTV but are impeding the completion of required Sonar/CCTV work should be designated as unable to locate (UTL) and be included on the form.
3. Incident observation and data collection:
  - a. The Subcontractor shall report all buried manholes, pipe collapses, large void, utility conflicts, Unable to Complete line segments, and heavy cleaning requests to the Program Manager through the program-defined reporting application (Teamworx) and shall fill out all required fields and attach picture documentation as necessary. At least one picture shall be included showing the incident or condition of the sewer line encountered that required it to be recorded. All reported incident observations will be monitored by the Program Manager and inadequate reporting will result in a meeting between the Program Manager and Subcontractor.
4. Sonar Reports:
  - a. The Subcontractor shall submit two hard copies of all details, i.e. a typed "Full Detail" report for each inspection, showing the position and full text of each defect encountered and their grades. The Subcontractor shall also supply an overall Summary Report detailing major defects and those inspections that require attention along with a statistical report showing lengths of sewers inspected and a breakdown of sizes and lengths inspected.
  - b. The Subcontractor shall supply a MS ACCESS database and free issue software for both the viewing of the media files and the Sonar images from within the database.
  - c. The Sonar Inspection shall include complete structural and service assessment to the equivalent PACP standard as that obtained through conventional CCTV imagery.
  - d. The Sonar inspection shall include measurement of flow depth and debris/silt depth.
  - e. A Color High Resolution Sonar image of cross sections of the sewer must be taken (saved) every 50 feet or more frequently should the internal profile or debris/silt depth of the sewer change from the previously saved image.
  - f. These images are to be cross-referenced to the reports and database(s) for ease of retrieval.

## **PART 4 MEASUREMENT & PAYMENT**

### **4.01 MEASUREMENT**

#### **A. CCTV & Sonar Inspection**

1. CCTV & Sonar inspection shall be measured by linear foot by each diameter of mainline sewer inspected and documented in accordance with the specification.

#### **B. Heavy Cleaning**

1. Heavy cleaning shall be measured by crew hour of heavy cleaning approved by the Program Manager and documented.

**4.02 PAYMENT**

**A. CCTV & Sonar Inspection**

1. CCTV & Sonar inspection shall be paid for at the unit price for each linear foot of each diameter inspected and documented in accordance with the specification.
2. The unit price for CCTV & Sonar inspection shall cover the entire cost of the required CCTV & Sonar inspection and reporting in accordance with PACP V 6.0.1 format, including but not limited to labor, mobilization and access, CCTV equipment, recording media, traffic control, light cleaning of mainline sewer, documenting results in PACP records and logs, digital format recordings, photo equipment, power supply for equipment, interim and final reports, and all other appurtenant work.
3. No additional payment will be made for:
  - a. Re-inspection due to rejected inspection and/or records for any reason
  - b. Incomplete electronic logs for either CCTV or Sonar digital records
  - c. Traffic control at major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit unless CCTV and Sonar inspection is assigned at the direction of the Program Manager.

**B. Heavy Cleaning**

1. Heavy Cleaning shall be paid for at the unit price per crew hour of each diameter of heavy cleaned sewers, or by hourly crew rate at the direction of the Program Manager and in accordance with the specification.
2. The unit price or hourly crew rate for Heavy Cleaning shall include the entire cost including but not limited to labor, mobilization and access, traffic control, appropriate disposal of sewer debris removed from sewer at permitted site and all other appurtenant work. Payment includes non-hydraulic jet efforts such as porcupines, cutters, power rodding, clam buckets, and other mechanical means, traffic control, and re-cleaning with hydraulic jet, labor, materials, and equipment necessary to clean mainline sufficiently to allow video reviewers a clear picture of pipe conditions.
3. No additional payment will be made for:
  - a. Additional passes of heavy cleaning if the inspection observation reveals roots, grease or other debris remaining in the sewer after the heavy cleaning passes.

**C. Traffic Control**

1. Traffic Control will be paid for from Section 02541-4.01 E

**4.03 PAYMENT WILL BE MADE UNDER:**

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
02542-4.01.A	CCTV & SONAR INSPECTION	LINEAR FEET
02542-4.01.B	HEAVY CLEANING FOR EACH LARGE DIAMETER MAINS	CREW HOUR

**END OF SECTION 02542**



**SECTION 02544**  
**MANHOLE GPS & MACP INSPECTION**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Work shall consist of locating sanitary sewer system facilities, gathering sub-meter grade GPS coordinates of manhole (including lamphole) covers, Manhole Assessment Certification Program (MACP) protocol Level 1 and Level 2 manhole inspections using the National Association of Sewer Service Companies (NASSCO) MACP Version 6.0.1 protocols, associated photographs, camera inspection of manholes and the associated pipe connections, and documentation of manholes not found, not on grade and/or not showing. The work shall also consist of completing an internal 3D manhole scan for each manhole with a depth greater than 25 feet or associated with large-diameter sanitary sewer interceptors (36-inch diameter and larger). Manholes to be located, documented and inspected are in both improved streets, arterial and primary roads, backyards and unimproved easements. Manholes may be elevated significantly above the existing ground level. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work, in addition to any equipment necessary to access all elevated manholes while remaining in compliance with The Loss Control Manual. Once new manhole coordinates are obtained, the updated source GIS map data shall be delivered to Program Manager in order to reflect the actual sewer system network.
- B. The Work covered by this section includes furnishing all labor, competent MACP certified technicians/crew leads, equipment, tools, accessories, and materials required to GPS, perform MACP Level 1 and Level 2 inspections, conduct 3D scan camera inspections where applicable and document the specified manholes.
- C. Selected Subcontractor(s) will be provided two Geo-databases; one will have supporting records (aerial photo overlays, outfall and block maps and as-builts, as available), and a maiden database which will include the asset ID for each manhole.

**1.02 SUBMITTALS**

- A. GPS Requirements
  1. Sub-meter GPS coordinates, ~~updated GIS map data~~ **ESRI Shapefile (.shp)**, Levels 1 and 2 MACP data and records, and camera inspection photos and 3D scan of the manholes shall be delivered to the Program Manager on clearly labeled external hard drive(s) which will become property of the Program Manager. Inspection data for any one asset shall not be delivered on multiple drives. MACP data files shall be formatted to facilitate upload into a MACP Exchange Database ~~or internet upload to an FTP site as approved by the Program Manager.~~
- B. Unless otherwise specified, all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.
- C. For rehabilitation jobs, only Post-Rehabilitation MACP submittals will be required by the Purchaser.
- D. Traffic Control
  1. A Traffic Control Plan shall be submitted to the Program Manager, including the following items:
    - a. Outline of permit acquisition procedure for lane closures.



- b. Methods for proper signing and barricades, which comply with local requirements and the City.
- c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN P.E. The City requires a two-week lead time for permit processing.
  - i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.
  - ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be required to modify the sample Traffic Control Plan to obtain a permit from the City.
- d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a Traffic Control Plan for all mobile operations in accordance with standard MUTCD specifications.

E. Permits

- 1. The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits required to perform this work.
  - 2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within the 25 feet railroad easement, as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way, the Subcontractor shall contact 48 hours in advance the Program Manager, who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.
  - 3. Permit required confined space entry plans in compliance with the Loss Control Manual.
- F. GPS calibration standards, including frequency, are to be followed in the field; specify which available base stations will be used for the work.
- G. Sample of sub-meter GPS coordinates delivered in electronic and pdf format.
- H. Copies of NASSCO certifications for all field staff conducting MACP Levels 1 and 2 inspections.
- I. Sample of MACP Level 1 and Level 2 documentation logs (with photo documentation comments and photos properly referenced) in MACP formats, in both electronic and pdf format.
- J. Equipment list, including GPS and 3D camera manufacturer and model equipment to be used.
- K. Sample of the GPS coordinate delivery in an ESRI ~~ArcPAD .axf~~ **Shapefile (.shp)** file format.
- L. Sample of the digital inspection data delivery in MS ACCESS database format.
- M. Sample of 3D manhole inspection and all software necessary to view inspections.

**1.03 DELIVERABLES**

A. Records

- 1. GPS Manhole Cover Coordinates

- a. Subcontractor's Level 1 Lamphole and Level 2 Manhole GPS coordinate delivery to the Program Manager shall be in an ESRI ~~ArcPAD-.axf~~ **Shapefile (.shp)** file format. ~~The updated GIS source map data reflecting the actual sewer system network shall also be delivered.~~ Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition. Subsequent data will not be accepted if GPS data is not obtained and delivered at the same time as inspection is conducted. The requested GPS control check file (MS EXCEL) shall also be delivered at this time.
2. Level 1 and Level 2 Inspection Documentation
    - a. Deliver complete MACP Level 1 for lampholes and Level 2 inspections for manholes in MACP electronic database and pdf electronic formats on an external hard drive. Delivery will be in MS ACCESS database format unless otherwise preapproved by the Program Manager. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.
3. 3D Camera Inspection
    - a. For manholes greater than 25-feet in depth or associated with lines 36-inches or greater in diameter, the Subcontractor shall provide the Program Team with the software required to view the digital film file in the way the Subcontractor can view it, including full control of the virtual pan and tilt. The digital files must include the following:
      - i. An unfolded view of the manhole with a minimum of 3,000 lines of vertical resolution.
      - ii. The capability to produce three-dimensional representation of the manhole structure.
      - iii. A distortion-free virtual pan and tilt allowing the review of the manhole structure from any angle at any depth. The virtual pan and tilt must consist of view from the bottom and top camera, any virtual pan and tilt that artificially creates this view from a single camera will be deemed unacceptable due to distorted images on the direct side view.
2. Camera Inspection Documentation
    - a. Include specified camera photo documentation of defects, leaks and pipe connections in the MACP Image reference field as appropriate, for the Level 2 documentation. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.
3. Manhole Reports
    - a. Deliver a summary report in PDF format of each manhole inspected. The report will include all MACP Level 1 & Level 2 data collected for the manhole. The report shall include the surface view photo of the manhole with the outlet pipe facing 6 o'clock as well as a downhole photo of the channel with the outlet pipe at 6 o'clock. Any defects noted in the manhole **and any pipe connections** shall also have an accompanying photo in the report.
4. ~~Draft Report and Final Report~~ **Data Deliverables and Reports**

- a. In addition to the electronic database and pdf format reports, ~~three copies of the Draft Report will contain hard copies of each of the MACP inspections with~~ **each MACP report will include photographs of camera** manhole defects and pipe connection photographs. The MACP compliant database of the inspections in ACCESS format shall also be submitted to the Program Manager electronically on an external hard drive.
- b. ~~Draft Report~~ **The MACP data for the Subcontractor's working week** shall be delivered to Program Manager **by the close of business on the Monday following a week after data acquisition.** ~~within fifteen working days of the last or final inspection.~~ The Program Manager will have ~~a two-one~~ **workweek** period to review and **accept or reject the MACP data.** ~~provide comments to the Subcontractor. The Subcontractor shall address all comments and submit the Final Report within one workweek from receipt of comments. At the Program Manager's discretion, a meeting will be held upon submittal of the Final Report to have the Subcontractor go over the processes used to address comments.~~

## 5. Quality

- a. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7) calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

## PART 2 PRODUCTS

### 2.01 EQUIPMENT

- A. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work. Expected terrain may require the use of four-wheel drive vehicles, ATVs, tracked vehicles, or other appropriate off-road vehicles. Additionally, the Subcontractor shall have all equipment necessary to access elevated manholes in accordance with the Loss Control Manual.
- B. All equipment used for the gathering of GPS coordinates, collection of condition assessment information, and digital 3D camera inspection of manholes shall be specifically designed and manufactured for the purpose intended under this Contract. The software and hardware for the electronic capture of the inspection defect observations must be consistent with NASSCO's MACP Level 1 and Level 2 requirements for the collection of data. ~~ESRI ArcPad 10.1~~ **GPS equipment is required to be sub-meter grade for** ~~is required for~~ GPS data collection and GIS map updates for manhole / lamphole facility locations. Export of the electronic inspection data to an MACP format Microsoft ACCESS database for analysis is required.
- C. The Subcontractor shall submit an equipment list to the Program Manager for approval before the commencement of the Work and shall certify that back-up equipment is available and can be delivered to the worksite in 72 hours.
  1. **Minimum Required** GPS Equipment
    - a. **At a minimum the** GPS Equipment shall be sub-meter grade, ~~Trimble Pro Series Receivers with Floodlight technology capability, Top Con GRS-1 Series equipment or equal (to be approved by Program Manager prior to mobilization).~~ GPS coordinates to be real-time or post-processed to achieve sub-meter accuracy. ~~Equipment must have ESRI ArcPad 10.1 installed for use in data acquisition.~~

2. Camera

- a. All camera systems used shall be digital format. The camera must have two independently or simultaneously controlled digital cameras, one facing in the downward direction and one facing in the upward direction. Each camera must have a minimum of 185-degree field of view. The inspection camera system must illuminate the interior of the manhole using a xenon strobe light. The light shall be positioned 360 degrees around the camera lens to distribute the light evenly onto the structure walls. The lighting must be able to illuminate manholes up to 120" in diameter without the need of any auxiliary lighting.
- b. A camera must also be able to obtain still images of the following specified pictures: Photo 1- surface view photos taken of the manhole should include a whiteboard (or similar) with the manhole ID number identified on it. The photographer should be standing with the outlet pipe facing their 6 o'clock position. Photo 2 - the downhole photo of the manhole channel should be taken with the outlet pipe facing their 6 o'clock position. Additional photos as specified by MACP guidance. The camera used for these images must be minimum 5 megapixel .jpg format for sufficient clarity and detail in the photos, and photos of at least 2 MB shall be submitted. If the 3D scan camera system cannot obtain photos of sufficient quality, a pole-mounted digital camera with lighting shall be used for the specified pictures in this paragraph.
- c. The 3D camera system shall produce individual images or frames with no more than ~~0.001~~ **0.1** inches of movement during image or frame exposure to produce crisp, clear images. The inspection camera must provide a minimum of 3,000 lines of vertical resolution in the side view and a minimum of 500 lines in the perspective view.
- d. Inadequate lighting, image distortions, blurry or murky images, low resolution, dirty lens and/or other quality issues will be a cause for rejection. If unsatisfactory, Subcontractor shall perform work until deliverable is of acceptable quality. No payment will be made for unsatisfactory inspections or until submittal is accepted.

3. Data Logger and Software

- a. MACP inspections and logs created and captured electronically during the MACP inspection of the manhole through the use of commercially available electronic data loggers are required. Paper records for data collection in the field shall not be used. NASSCO MACP protocols shall be used for capturing and recording the observations.
- b. The data logger equipment and software shall allow Program Manager direct access to the captured electronic data and provide for export of the data in accordance with MACP formats and standards.

4. Retrieval of Stuck Equipment

- a. The Subcontractor is responsible for hiring a licensed sub-Subcontractor to retrieve any equipment that becomes lodged in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor's own cost. Such retrieval by an appropriately licensed sub-Subcontractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor's equipment in the line shall be the responsibility of the Subcontractor.

### PART 3 EXECUTION

#### 3.01 INSPECTION

##### A. GPS Coordinates of Manhole Cover

1. Program Manager will provide Subcontractor with a digital copy of the original GIS source map indicating the sewer system network compiled from existing City records.
2. The Subcontractor shall capture and record sub-meter grade x, y and z coordinates of each manhole cover identified in the original GIS maiden data map provided with a unique asset identification (ID) number. Additional sanitary sewer lamphole and manholes found in the field in the course of the inspection work that are not provided in current mapping nor identified with a current unique asset ID shall be documented and GPS coordinates shall be recorded. A provisional manhole asset ID number shall be used by the Subcontractor by adding a ~~dash~~ period and a two-character number to the closest upstream manhole ID.
3. Record sub-meter GPS coordinates in NAD83 TN State Plane Coordinates horizontal, NAVD88 vertical in US Survey feet using properly-calibrated GPS equipment. If GPS coordinates cannot be obtained due to buildings, trees or cloud cover, Subcontractor shall note this on the inspection form and return at least one additional time at a different time of day or under different sky cover. If both attempts fail at securing the sub-meter coordinates, this is to be documented and reported in the submittal. Land surveying shall not be required where GPS is not available.
4. The Subcontractor shall be expected to use all reasonable means to locate the lampholes and manholes in the field. This includes walking the pipeline alignment, using measuring tapes or wheels from the last found manhole, using metal detectors, or other means. If manholes are not able to be found and documented or unknown manholes are found, record the reasons for not locating or not opening the manhole or the specifics of the new manhole found, and submit with supporting MACP documentation to the Program Manager daily.
5. Once GPS coordinates are obtained for known and newly discovered facilities, ~~the original GIS map data shall be delivered to the Program Manager to reflect the actual sewer system network~~ a ESRI shapefile (.shp) shall be delivered to the program Manager with the associated inspection data to reflect the actual sewer systems network spatial location for the assigned inspection area-.
6. The Subcontractor shall revisit predefined GPS control locations near project area at least one time per day per each GPS unit used as a quality control check on GPS accuracy. Subcontractor is to document these checks on a single log, which shall be kept on file for the duration of the project and shall be released to Program Manager on a weekly basis.

##### B. MACP MH Inspection

1. The Subcontractor shall document and record each sanitary sewer manhole inspection in MACP Level 1 format for lampholes and Level 2 format for manholes with supporting completed MACP format database. The complete NASSCO MACP Levels 1 and Level 2 protocols must be utilized for the lamphole and manhole inspections respectively and must be associated in the electronic database and pdf documentation with the unique asset ID provided.
2. The Subcontractor shall mark the direction of wastewater flow (one arrow per pipe) in and out of the manhole around the perimeter of the manhole cover on the street with discrete

- green arrows spray painted onto the road surface using a guide or template for the arrows. The arrows shall be a minimum of 12 inches and a maximum of 18 inches in length.
3. The Subcontractor shall follow the prescribed MACP Level 1 and Level 2 procedures and use the required nomenclature and formats to document the manhole interior and exterior conditions and defects.
  4. Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the field operations.
- C. Camera Inspection of Manholes and Associated Pipe Connections
1. For manholes greater than 25-feet in depth and manholes associated with lines 36-inches and larger in diameter, a 3D manhole scan shall be completed in conjunction with Level 2 manhole inspections of defects and include each sewer pipe connection in the manhole. The photo record of the inspection shall document defects and leaks and shall include a photo record of the connecting pipes in each manhole. Abbreviations, naming conventions, and numbering conventions shall be documented in MACP formats.
  2. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.
- D. Incident Observation and Data Collection
1. The Subcontractor shall report all Unable to Complete and surcharged manholes to the Program Manager through the program-defined reporting application (Teamworx) and shall fill out all required fields and attach picture documentation as necessary. For a surcharged manhole, at least one picture shall be included to document the level of surcharge. All reported incident observations will be monitored by the Program Manager and inadequate reporting will result in a meeting between the Program Manager and Subcontractor.

## **PART 4 MEASUREMENT and PAYMENT**

### **4.01 MEASUREMENT**

#### **A. GPS Coordinates of Manhole Cover**

1. The capture and associated documentation of sub-meter GPS x, y and z coordinates for each lamphole and manhole cover will be measured for payment per each lamphole and manhole located by GPS and its coordinates recorded in accordance with the specification, provided that documentation meets QA/QC standards.

#### **B. MACP Level 1 for Lamphole Inspections**

1. The inspection and recording of all lamphole observations in a MACP compliant fashion will be measured for payment per each lamphole inspected in accordance with the specification.

#### **C. MACP Level 2 for Manhole Inspections**

1. The inspection and recording of all manhole observations in a MACP compliant fashion will be measured for payment per each manhole inspected in accordance with the specification. For manholes greater than 25-feet in depth or associated with lines 36-inches in diameter or greater, a 3D manhole scan shall be included as part of the MACP Level 2 inspection.



**4.02 PAYMENT**

A. GPS Coordinates of Manhole Cover

1. The capture and associated documentation of sub-meter GPS x, y and z coordinates for each manhole cover shall be paid for at the unit price bid for each lamphole and manhole cover coordinates documented and recorded in accordance with the specification provided that QA/QC standards are met.
2. The unit price for each manhole cover GPS set of coordinates shall cover the entire cost of the GPS equipment and time necessary to gather the coordinates, including but not limited to calibrating the equipment; setup and access; traffic control; documenting results in prescribed MACP electronic formats, records and logs; power supply for equipment; interim and final reports; and all other appurtenant work.
3. No additional payment will be made for:
  - a. Location or re-inspection due to cars parked over manholes or other impediments to on grade and showing manhole covers.
  - b. Additional visit(s) to secure the proper GPS coordinates due to lack of adequate satellite coverage or reception.

B. MACP Level 1 for Lamphole Inspections

1. The inspection and recording of all lamphole observations in a MACP format shall be paid for at the unit price bid per each MACP Level 1 inspection performed in accordance with the specification, provided that QA/QC standards are met.
2. The unit price for each MACP lamphole inspection shall cover the entire cost of the inspection and reporting, including but not limited to setup and access, documenting results in records and logs, power supply for equipment, interim and final reports and all other appurtenant work.

C. MACP Level 2 for Manhole Inspections

1. The inspection and recording of all manhole observations in a MACP format shall be paid for at the unit price bid per each MACP Level 2 inspection performed in accordance with the specification, provided that QA/QC standards are met.
2. The unit price for each MACP manhole inspection shall cover the entire cost of the inspection and reporting, including but not limited to setup and access, documenting results in records and logs, digital photos, power supply for equipment, interim and final reports, and all other appurtenant work. This also includes the materials and labor to complete 3D scan of the manhole with all associated deliverables where applicable.

**4.03 PAYMENT WILL BE MADE UNDER**

Item No.	Pay Item	Pay Unit
02544-4.01.A	GPS COORDINATES OF MANHOLE COVER	EACH
02544-4.01.B	MACP LEVEL 1 LAMPHOLE INSPECTIONS	EACH
02544-4.01.C.1	MACP LEVEL 2 MANHOLE INSPECTIONS - NO 3D SCAN	EACH
02544-4.01.C.2	MACP LEVEL 2 MANHOLE INSPECTIONS WITH 3D SCAN	EACH

**END OF SECTION 02544**



**SECTION 02546**  
**SMOKE TESTING AND DYE WATER TRACING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Work will consist of smoke testing of sanitary sewer manholes, sewer pipes, sewer laterals and interceptors and confirming dyed water flooding of specified defects to identify and confirm sources of infiltration and inflow, including necessary public notices to areas affected by the smoke test and dye testing operations, notifications to individual buildings and residences, police, and fire, providing necessary barriers around access points to prevent injury to the public, securing the access to the sewer pipes to be tested, providing and operating blowers and smoke generators for performing the smoke test, and furnishing of all inspection documentation of observations concerning smoke test results.
- B. The Work covered by this section includes furnishing all labor, competent technicians/crew leads, equipment, tools, accessories, and materials required to execute the smoke testing, sub-meter GPS of smoke defect sources and directed dye tracing of the identified sewer segments and associated sewer laterals. Work is included on public and private property. Dye testing of specified defects associated with the manhole or sewer asset shall be performed in conjunction with CCTV of the same asset.
- C. Subcontractor will be provided two Geo-databases; one will have supporting records (aerial photo overlays, outfall and block maps, as-builts as available), and the second will be a maiden database which will include the asset ID for each manhole.

**1.02 SUBMITTALS**

- A. GPS Requirements
  - 1. GPS coordinates of the smoke located defects, photo records of the smoking defects, and associated record data shall be delivered to the Program Manager (from hereon Program Manager shall be interpreted as “Program Manager or his designee”) on external hard drive(s) which will become property of the Program Manager. Data files and photos shall be formatted to facilitate upload into a compatible Exchange ACCESS database or internet upload to an FTP site ~~using procedures approved~~ **only when requested** by the Program Manager.
- B. Unless otherwise specified all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.
- C. Traffic Control
  - 1. A Traffic Control Plan shall be submitted to the Program Manager, including the following items:
    - a. Outline of permit acquisition procedure for lane closures.
    - b. Methods for proper signing and barricades, which comply with local requirements and the City.
    - c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN PE. The City requires 2-week lead time for permit processing.

- i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.
  - ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be required to modify the sample Traffic Control Plan to obtain a permit from the City.
- d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a Traffic Control Plan for all mobile operations in accordance with standard MUTCD specifications.

D. Permits

1. The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits required to perform this work.
  2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within 25 feet of the railroad easement as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way the Subcontractor shall contact the Program Manager 48 hours in advance who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.
- E. Proposed electronic field documentation format, including provisions for capture and recording of GPS coordinates of smoke sources and photo records of sources.
- F. GPS calibration standards, including frequency, are to be followed in the field; specify which available base stations will be used for the work.
- G. Sample of sub-meter GPS coordinates delivered in electronic and pdf format.
- H. Equipment list, including GPS and camera manufacturer and model equipment to be used.
- I. Sample of the digital inspection data delivery in MS ACCESS database format.
- J. Manufacturer specification sheets and any associated material safety data sheets (SDS) for the smoke source and dye source to be used.
- K. Proposed public notification process including daily police and fire contacts, neighborhood door hanger canvassing, and other project and public contacts. All public notification shall be coordinated with the Program Manager.
- L. Proposed rapid response to smoke in buildings including the Subcontractor's use of whole house fans and other mechanisms to clear smoke form affected properties.
- M. Digital inspection data delivery will be in MS ACCESS database format.

**1.03 DELIVERABLES**

A. Records

1. Smoke Testing Logs, ~~Record Sketch~~, and Digital Photo Documentation
  - a. Smoke testing records shall be submitted to the Program Manager by the close of business on the Monday following a week after data acquisition.

- b. The address or house number shall be recorded. A description of the leak and possible cause shall also be recorded on the field data gathering and observation form.
  - ~~c. The reports shall provide a north arrow orientation. A sketch of the building and/or structure shall be drawn. A reference to the GPS documented field location shall be generally shown in the sketch.~~
  - d. The Subcontractor shall also submit an electronic database in an MS ACCESS database on an external hard drive that summarizes all of the information recorded on the field data gathering and observation forms and recorded via the GPS data collectors during smoke testing.
    - i. The electronic database shall include the information recorded on the forms and the sub-meter GPS coordinates obtained at the defect locations where smoke was observed.
    - ii. The external hard drive shall also include the digital pictures taken during smoke testing in .jpg file format which shall be linked to the defect locations where the pictures were taken via the GPS coordinates obtained.
    - iii. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.
  - ~~e. The Draft Report shall show the location of each defect, including dimensions referenced to the nearest manhole and pipe segment. For each pipe segment, the Subcontractor shall submit the electronic database and a report in pdf format that includes the data (including site photos) associated with any leaks that were found and a map showing the location of the pipe segment, nearby manholes, aerial photography, labeled street names, and an approximate location showing how the defect location is oriented with respect to a nearby manhole. GPS coordinates in the electronic database are accepted as the precise location of the defect.~~
  - ~~f. Draft Report shall be delivered to the Program Manager within fifteen working days of the last or final inspection.~~
  - ~~g. The Program Manager will review and provide comments within two workweeks from receipt of Draft Report. The Subcontractor shall address all comments provided and shall submit the Final Report within one workweek from receipt of comments. At the discretion of the Program Manager, a meeting will be held so Subcontractor can explain the processes used to address the comments provided.~~
2. Dye Tracing Logs, ~~Record Sketch~~ and Digital Photo Documentation
- a. Each dye tracing shall be identified in an observation log which shall include ~~a sketch showing the location and~~ the results, a digital photo of the dye source, and the downstream dye confirmation in the sewer. ~~The sketch shall include direction, street names, address, and relative dye application (Type 1, 2, or 3) to an identifiable feature.~~ A digital photograph shall document the dye transfer in the downstream manhole and include the pipe segment and closest downstream manhole asset ID.
3. Final Report & Deliverable
- a. Complete electronic database on an external hard drive of the smoke testing results including GPS coordinates of smoke sources and dye testing results, including linked digital photos. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.

~~b.—Three (3) color copies of the logs, record sketches, and digital photographs shall be submitted within fifteen working days of the last or final inspection.~~

B. Quality

1. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7) calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

**PART 2 PRODUCTS**

**2.01 EQUIPMENT**

A. Blowers

1. The smoke blower shall be specifically designed for the purpose intended and be a high-volume air blower capable of producing a minimum capacity of 4,000 cfm at a single manhole or the Subcontractor shall use two minimum 2,000 cfm blowers in a double blower configuration on two manholes at each end of the set-up. The blower base shall be gasketed with foam or other suitable sealing material to restrict the escape of smoke from between the manhole structure and frame and blower. A backup blower of equal capacity shall be available onsite at all times.

B. Cameras

1. All cameras used shall be digital format color cameras specifically designed or modified for use in sewer manhole inspection work. All cameras used during inspections shall have a minimum of 5 mega-pixels .jpg format for sufficient clarity and detail in the photos, and photos of at least 2 MB shall be submitted.

C. Sewer Plugs

1. Inflatable sewer plugs, sandbags, or other air flow restrictors or baffles shall be used to isolate individual sewer pipe segments for smoke testing. Any items used to restrict flow shall be removed immediately after intended use.

D. Ventilation Blower

1. The Subcontractor shall maintain a high capacity, whole house ventilation fan onsite during the smoke testing should any customer's building inadvertently fill with the smoke from the testing. The Subcontractor must be immediately responsive to any customer's smoke concerns or problems.

E. Dye Water Injectors

1. For localized courses of smoke to be confirmed by dyed water, the Subcontractor shall provide dye water injectors. These may be modified tree root fertilizer feeders or apparatuses developed by the Subcontractor. The injector shall be fitted with a garden hose, and a feed cup shall be capable of dispensing or dosing dye to the tip of the injector. The shaft of the dye water injector shall be a minimum of four feet long to enable injection directly into the soil adjacent to the smoke source.

F. **Minimum Required** GPS Equipment

1. At a minimum the GPS equipment shall be sub-meter grade, ~~Trimble Pro Series Receivers with Floodlight technology capability, Top Con GRS 1 Series equipment or equal.~~ GPS coordinates are to be real-time or post-processed to achieve sub-meter accuracy. GPS coordinates must be in NAD83 TN State Plane Coordinates horizontal, NAVD88 vertical in US Survey feet using properly-calibrated GPS equipment.

G. Retrieval of Stuck Equipment

1. The Subcontractor is responsible for hiring a licensed sub-contractor to retrieve any equipment/foreign objects that get stuck in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor's own cost. Such retrieval by an appropriately licensed sub-contractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor's equipment in the line shall be the responsibility of the Subcontractor.

**2.02 MATERIALS**

A. Smoke

1. The smoke used in smoke testing shall be acceptable for both indoor and outdoor use, shall be non-contaminating, and shall leave no residue to stain clothing, drapes, carpeting or other fabrics in building interiors. Smoke shall be non-hazardous to humans and pets and shall be generated from liquid smoke (Hurco's LiquiSmoke™, or equal), as approved by Program Manager. The liquid smoke product shall be accompanied by Material Safety Data Sheets (MSDS) for both the liquid used to generate the smoke and the smoke itself that demonstrates these product qualities. If two MSDS's are not available for the Subcontractor's proposed liquid smoke product, the Subcontractor shall use Hurco's LiquiSmoke™.

B. Dye

1. Tracer dyes may be in tablet, powder or liquid form. The Subcontractor shall secure several colors to distinguish multiple tracings within the same sewer pipe segment. Fluorescent yellow/green, fluorescent red, and/or fluorescent orange are preferred indicator colors.

**PART 3 EXECUTION**

**3.01 NOTIFICATIONS**

A. Public

1. Prior to conducting smoke testing field work, the Subcontractor shall provide notification to every residence and business that may be affected. The Subcontractor shall distribute the Program Manager approved door hangers between 48 and 72 hours prior to the start of the smoke testing effort. Door hangers shall be double-sided with the notification information in the English language on one side and in the Spanish language on the reverse side. The local fire department shall be notified of the smoke testing at least seven days in advance.
2. At a minimum, the notifications shall advise residents of what to expect during the smoke testing, to run water into all drains to ensure traps are not dry, and to alert them that they will observe smoke escaping from the roof plumbing vent. The notice shall also describe what to do should smoke escape to the interior of the house. The notice shall also describe any side effects of the smoke (e.g. potential for residual odor) and make SDS information available.

3. Door hanger notifications shall use a fluorescent color for visibility and incorporate any City-specific logo (if available and agreed upon by the Program Manager) to link the smoke testing to the City's sewer improvement effort.
4. One week (seven calendar days) prior to the scheduled smoke testing of public and health facilities such as schools, daycares, hospitals, and nursing homes, the Subcontractor and Program Manager shall meet in person and advise in writing the responsible person in charge of the facility of the expected activities and potential impacts to the facility. 24-hours before the test, the Subcontractor must advise the responsible person in charge by telephone of the scheduled tests the following day. At the conclusion of the test, a representative of the Subcontractor shall advise the responsible person in charge of the facility that testing has concluded and there will not be further impact. Records of the meetings with these facilities shall be maintained and shall include the date and time of the contact and the person contacted and shall be available for inspection at the Program Manager's request.

B. Program Manager

1. The Subcontractor shall provide daily morning updates prior to beginning daily field operations to the Program Manager, fire, police, or other agencies as directed by the Program Manager. List of entities and individuals requiring notification will be distributed prior to work commencing.

**3.02 SMOKE TESTING**

A. Field Operations

1. Testing shall not be done during rainy weather, and testing shall be closely monitored on windy days. If smoke coming out of the ground is blown away so quickly as to escape accurate detection, testing shall cease until such time that conditions permit.
  - a. Precipitation that creates active runoff along the curb and gutter shall be sufficient to suspend active smoke testing. The Subcontractor shall wait 24 hours after a rain event of ½ inch or greater before beginning smoke testing.
  - b. Should precipitation interrupt scheduled testing and cause a delay, the public notification procedures must be repeated.
2. The sewer pipe segments to be tested shall be isolated by means of air flow restrictors, sewer plugs, sandbags, or other devices in the upstream and downstream manholes that limit the smoke travel to only the segment being tested. Bypass pumping is not required but flow-through plugs can be utilized. Subcontractor shall exercise care in the restricting of flow so as not to create backups into private property or overflow of wastewater. The blowers and the smoke addition shall begin simultaneously and be continuous for the entire time of the field inspection for determining sources of smoke. The Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage, or sanitary sewer overflow during or as a result of the smoke testing operations
3. The maximum length of sewer pipe segment(s) to be tested shall be 500 linear feet at a time. Adjacent sewers with a combined length of 500 linear feet or less may be tested together. Any adjustments to the length of testing shall be approved by the Program Manager. Subcontractor shall monitor the air volume used, particularly on shorter segments tested so as not to blow water from the private property plumbing traps.



4. The minimum smoke blowing duration shall be 5 minutes to enable full coverage of the properties and backyards adjacent to sewer and to enable sufficient time for the smoke to filter out of the sewer defects and reach the surface.

**B. Smoke Observations and GPS Source Documentation**

1. The area near each manhole and along the length of the isolated test segment shall be visually checked for the appearance of smoke. Sufficient staff shall be onsite to enable the inspection of the entire perimeter around each building connected to the sewer pipe while the blowers and smoke are continuously operating in the segment being tested. Storm drain inlets, curb boxes, cleanouts, building laterals, downspouts, areaway drains, foundation drains, and other potential sources of smoke shall be visually checked. The blowers and smoke injection shall continue until all suspect sources have been evaluated, but for no less than 5 minutes.
2. The Subcontractor shall document observations regarding each leak identified. The locations where smoke is observed shall be recorded using handheld, sub-meter accuracy GPS data collectors. Information regarding the characteristics of the defect and its surrounding tributary area shall also be recorded. The information shall include the smoke source location (street, curb, swale, sidewalk, driveway, front yard, side yard, backyard, field, parking lot, downspout, etc.), the unique asset identification of manhole or sewer segment, the house address that is nearest to the discharge point of the smoke, type of property (public or private), surface cover (asphalt, concrete, grass, paver, or other), date, mini-basin number, test number, date, crew, weather condition, wind condition, smoke intensity, susceptibility to ponding, and other comments. Specific data fields and allowable values (as applicable) will be provided to Subcontractor by the Program Manager.

**C. Digital Photographs**

1. The Subcontractor shall take two date and time stamped pictures of each defect. Photo 1 shall be taken to identify the general area of the defect, and Photo 2 shall be a close-up picture of the defect. The precise location of the defect shall be identified using GPS equipment. The digital image files shall be linked to the field data gathering and observation form.
2. All cameras used shall be digital format color cameras specifically designed or modified for use in sewer manhole inspection work. All cameras used during inspections shall have a minimum of 5 mega pixels .jpg format for sufficient clarity and detail in the photos, and photos of at least 2MB shall be submitted.
3. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.

**3.03 DYE TESTING**

**A. Field Operations**

1. Suspected sources identified by smoke testing and directed by the Program Manager shall be confirmed through dyed water tracing or flooding during this portion of the project for Type 1 sources or during the CCTV portion of the investigations for Type 2 or 3 sources. Verification of the suspect source is achieved when dyed water is introduced at the suspect source and observed at the downstream manhole. The dye mixing, pouring, or flooding procedure will be governed by the type of source to be tested. The Subcontractor shall immediately notify the Program Manager of any dye that reaches a receiving stream. The Program Manager reserves the right to direct water flooding with no dye to minimize the impact to the receiving water body.



2. Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the field operations.

B. Type 1 Sources

1. Type 1 sources generally will be able to be dye traced by mixing limited quantities of dye colored water (e.g. maximum of five gallons) and pouring the water in the immediate vicinity of the suspect source, either in private or public space. Examples of Type 1 smoke sources generally are direct cross-connections to the sanitary sewer and include the following:
  - a. Driveway drain
  - b. Stairwell or areaway drain
  - c. Window well drain
  - d. Downspout connection
  - e. Sanitary sewer manhole:
    - i. With soil or grass surface cover
    - ii. With cracked or deteriorated paving
2. Dye will generally be poured into the source where smoke was observed. A positive confirmation results when the wastewater flow observed in the downstream manhole contains the transferred dye color.

C. Type 2 Sources

1. Type 2 Sources generally include injecting dye water for a minimum of 5 minutes duration into soil to affect the transfer of the dyed water to underground sewer defect, either in private or public space. The injection is achieved by using a root fertilizing type spike attached to a garden hose with a fertilizer cup filled with dye to affect the transfer of color, and pressure injecting the dyed solution into the ground at the source of the smoke. The Subcontractor must comply with all appropriate backflow prevention requirements if the hose is connected to the public water supply.
2. Examples of Type 2 sources include the following:
  - a. Drainage swales.
  - b. Public/private lateral connection transitions (generally at the property line).
  - c. Building lateral (public or private).
  - d. Sanitary sewer manhole:
    - i. With soil or grass surface cover.
    - ii. With cracked or deteriorated paving.
3. Dye will be injected into the soil at the location where smoke was observed. A positive confirmation results when the wastewater flow observed in the downstream manhole contains the transferred dye color.

D. Type 3 Sources

1. Type 3 Sources are generally public sector sources which require the plugging of storm sewers. The downstream storm sewer pipe, which includes the catch basin or storm sewer pipe segment which smoked, is plugged and filled with dyed water. The downstream sanitary manhole is observed for dye. If dye is observed, the parallel or adjacent sanitary sewer is televised concurrently to identify the specific sources of dye transfer.
2. The Subcontractor is responsible for meeting all requirements for dechlorinating the water used for dye flooding in accordance with local regulatory requirements so as not to create a problem with chlorinated water in receiving streams.
3. Examples of Type 3 sources include the following:
  - a. Catch basins.
  - b. Storm sewer pipes.

**PART 4 MEASUREMENT & PAYMENT**

**4.01 MEASUREMENT**

A. Smoke Testing

1. Smoke testing shall be measured by the linear foot of smoke testing performed along the centerline of the sanitary sewer pipe from center to center of manholes. For dead-end sewers, the length will be the CCTV inspected length.

B. Dye Tracing Per Type

1. Dye tracing shall be measured per each Type 1, Type 2, or Type 3 source tested

C. Dye Tracing Per Hour (Alternative Measurement to Section 5.02)

1. Alternatively, Dye Tracing may be measured at the Program Manager's direction per man-hour supplied by the Subcontractor to perform Type 1, Type 2, or Type 3 source testing.

**4.02 PAYMENT**

A. Smoke Testing

1. Smoke testing shall be paid by the linear foot of sanitary sewer pipe actually tested and include all labor, equipment and materials. Payment shall be made at the contract unit price without regard to the size of sewer pipe inspected. Separate measurement and payment shall not be made for any incidental work including, but not limited to, gaining access to the sewer; jobsite preparation; traffic control; safety provisions; blowers; liquid smoke; and providing of records, documentation, and photos, which shall be subsidiary to the bid price. No Payment shall be made for any smoke testing without receipt of the corresponding records, logs, and photographs.

B. Dye Tracing

1. Dye Tracing shall be paid by the unit actually tested as Type 1, Type 2, or Type 3 and will include all labor, equipment and material. Separate measurement and payment shall not be made for any incidental work including, but not limited to, gaining access to the sewer; jobsite preparation; traffic control; safety provisions; dye, injectors; and providing of records, documentation, and photos, which shall be subsidiary to the bid price. Concurrent

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CCTV inspection (in accordance with Section 02542 CCTV) required for Type 2 (if necessary) or Type 3 dye tracing shall be measured separately for payment. No Payment shall be made for any dye tracing without receipt of the corresponding records, logs and photographs.

C. Dye Tracing Per Hour (Alternative Measurement to Section 4.02)

1. Alternately, Dye Tracing shall be paid at the Program Manager’s direction by the man-hour for the Type 1, Type 2, or Type 3 testing and will include all associated equipment and material to perform the tests. Separate measurement and payment shall not be made for any incidental work including, but not limited to, gaining access to the sewer; jobsite preparation; traffic control; safety provisions; dye, injectors; and providing of records, documentation, and photos, which shall be subsidiary to the bid price. Concurrent CCTV inspection (in accordance with Section 02542 CCTV) required for Type 2 (if necessary) or Type 3 dye tracing shall be measured separately for payment. No Payment shall be made for any dye tracing without receipt of the corresponding records, logs and photographs.

**4.03 PAYMENT WILL BE MADE UNDER:**

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
02546-4.01.A	SMOKE TESTING	LINEAR FEET
02546-4.01.B.1	DYE TRACING TYPE 1	EACH
02546-4.01.B.2	DYE TRACING TYPE 2	EACH
02546-4.01.B.3	DYE TRACING TYPE 3	EACH
02546-4.01.C-1	DYE TRACING TYPE 1	CREW HOUR
02546-4.01.C.2	DYE TRACING TYPE 2	CREW HOUR
02546-4.01.C.3	DYE TRACING TYPE 3	CREW HOUR

**END OF SECTION 02546**