The National Association of Sewer Service Companies (NASSCO) is requesting proposals to evaluate the potential release of organic chemicals in the steam exhaust and other release points during pipe rehabilitation using the trenchless, Cured-In-Place Pipe (CIPP) method. Proposals will be accepted until **5:00 pm Eastern Daylight Time (EDT) Friday May 25, 2018**.

Phase 1 of this Industry Study, completed on April 6, 2018, included an independent, third party review of recent publications that propose the presence of organic chemicals and other available literature relating to emissions associated with the CIPP installation process. Using information gained from this literature review, a scope of work for additional sampling and analysis of potential emissions during the field installation of CIPP using the steam cure process was developed.

This RFP is for the Phase 2 work, which will be executed under a separate contract based on the scope of work developed in Phase 1.

**GENERAL INFORMATION**

- The Scope of Work for this project is described in Phase 2 – Scope of Work as defined below.
- Any subcontracted work shall be specified in the submitted proposal.
- Proposal shall be submitted as one electronic PDF.
- All pages must be 8.5” x 11” in size.
- Proposal shall have a maximum of ten pages not including resumes and shall include the following items:
  - **Introduction**
  - **Project Team** – List of names and titles working on project including institutions and/or companies of employment
- **Detailed Description** of Phase 2 work including sampling and test methods and equipment to be used.
- **Schedule for completion of Phase 2** including current availability and commitment to schedule.
- **Price** - In addition to Total Project Price, proposals shall include a total price for complete administration and testing at one site (Unit Site Price), not including travel costs.
- **Price Breakdown** - Both the Total Project Price (with travel costs) and Unit Site Price (without travel costs) shall include a breakdown of cost components for comparison purposes.
- **Total Project Price** shall be for testing at six sites. Based on the Unit Site Price and applicable travel costs, NASSCO has the option of deleting testing at one or two sites (four or five sites tested) or adding testing at one or two sites (seven or eight sites tested).
- **Proof** of worker insurance and safety training for testing personnel that will be working on active CIPP job sites.
- **List** of related projects
- **References** – Provide name, phone number, and email address for at least three references.
- **Supporting resumes** for project personnel.

- Deliver proposals to **director@nassco.org** no later than **5:00 pm EDT Friday, May 25, 2018**
- **Basis of Contract Award** - The proposals will be evaluated for:
  - Content
  - Completeness in meeting the requirements of the RFP
  - Best value for the price submitted.
- **Questions** may be directed to **Lynn Osborn at technical@nassco.org before 5:00 pm EDT Wednesday, May 23rd, 2018.**
PHASE 2- SCOPE OF WORK

1. Overview

The work scope described below is designed to provide a comprehensive evaluation of air emissions from steam-cured cured-in-place pipe (CIPP) installations and potential impacts on workers and the surrounding community. It calls for measurement of styrene and other organic compounds at six CIPP installation sites, representing different pipe diameters (8”, 12”, and larger), and lengths, in order to capture variation in emissions. Measurements will be conducted before, during, and after curing at the termination manhole, as well as various locations in the surrounding outside area and inside nearby buildings. Worker exposure will also be measured via personal exposure monitors. Finally, dispersion modeling will be conducted to estimate compound concentrations at a large number of locations for a wide variety of meteorological conditions. Measured and modeled concentrations will be compared to appropriate health-based action levels to determine if any potential health risks exist for workers or citizens in the surrounding community.

2. Motivation

Concerns have arisen regarding the potential release of organic chemicals in the steam exhaust and other release points during pipe rehabilitation using the trenchless, steam-cured, Cured-In-Place Pipe (CIPP) method. Safety and health is of utmost importance, and that standards are in place to protect contractors, construction workers, the public and the environment.

A number of previous studies have examined the potential release of organic chemicals into stormwater runoff and surrounding water bodies during steam-cured CIPP installations. Only a few studies, however, have adequately sampled and measured the potential release of organic chemicals into air. These previous air studies have largely focused on emissions exiting the termination manhole directly and have not comprehensively examined potential impacts on workers or the surrounding community. Spatial variation of concentrations, and variations in concentrations with different meteorological conditions, are not well determined. Studies also do not adequately capture variations in concentrations from different kinds of pipe installation (different diameters, and lengths, etc.).

The work scope described below is designed to fill the gaps in the existing literature by providing a more comprehensive evaluation of air emissions from steam cured CIPP and potential impacts on workers and the surrounding community. The work scope allows evaluation regarding the presence of the chemicals below at a steam-cured CIPP job site and whether they, along with styrene, pose health concerns due to potential levels of exposure.
Compounds of Interest

Past literature reviews claim that steam-cured CIPP potentially emits the following compounds:

- Acetone*
- Benzeldehyde
- Benzene*
- Benzoic acid
- 1,3-butadiene*
- Carbon disulfide*
- Carbon tetrachloride*
- Chloroform*
- Cyclohexane*
- 1,4-dioxane*
- Ethanol
- Ethyl acetate*
- Ethylene glycol
- Ethylbenzene*
- Hexane*
- Isopropanol*
- Isopropylbenzene
- p-isopropyltoluene
- 2-methylbutane
- 2-methyl-2-butanol
- Methylene chloride
- Methyl ethyl ketone (MEK)*
- 2-methylnaphthalene
- Naphthalene
- Propionitrile
- n-propyl benzene
- Styrene*
- Toluene*
- 1,1,2-trichloro-1,2,2-trifluoroethane
- Trans-1,3-dichloropropene
- 1,2,4-trimethylbenzene*
- 1,3,5-trimethylbenzene*
- m,p-xylene*
- o-xylene*

Compounds marked with a “*” are on the US Environmental Protection Agency’s (EPA) TO-15 list “Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters and Analyzed By Gas Chromatography/Mass Spectrometry (GC/MS).” The selected research team (Phase 2 contractor) will measure and model TO-15 compounds, as described below.

Field Site Measurements of Compounds within and Around the CIPP Work Area

4.1. Site Selection

Six test locations (job sites) representing multiple CIPP installation contractors will be selected by the Phase 2 contractor. CIPP installation procedures at each site selected should be in accordance with industry best practices. Sites will be selected to represent a range of emission scenarios, including:

A. Three sites with different pipe diameters (8”, 12”, and larger, e.g., 24”), with approximately the same length;

B. Two sites with the same pipe diameter, but different pipe lengths;

The sites will represent the following controls at minimum:
• Only unsaturated polyester resin will be used (styrene-based).
• Only AOC and Interplastic resins will be used.
• Steam-cured only.
• Sites away from large traffic sources and other emission sources will be selected if possible to minimize interference.

At least two sites with publicly accessible or vacant buildings in close proximity to the termination manhole will be selected, so that concentrations inside these buildings can be measured. In addition, the impact of buildings in terms of downwash and limits on dispersion can be assessed.

Safety is the first priority when working on or visiting CIPP installation sites. Health and safety of testing personnel are the responsibility of the Phase 2 contractor. In addition, any required permitting and related costs are the responsibility of the Phase 2 contractor.

All samples collected in 4.2 through 4.9 must be tracked by a standard chain of custody.

4.2. Measurement of Air Emissions Directly from Termination Manhole

For each site selected in 4.1, measurements of concentrations of TO-15 pollutants will be conducted of steam exhaust and emissions coming directly from the termination manhole (not inside the termination manhole). Concentrations will be measured using one of the following devices. The same device type should be used for all six sites.

1. A device that continuously records instantaneous readings (e.g., portable/mobile mass spectrometer (MS)) or,

2. A device that collects time-averaged samples (e.g., canisters or sorbent tubes with subsequent lab GC/MS analysis according to EPA TO-15, or similar appropriate method).

Instantaneous readings are preferred because they better capture variation in the data.

Multiple concentration measurements will be conducted during each phase:

• Before curing (15 min. of continuous measurement or a 15-min. time-averaged sample),

• During curing (15 min. of continuous measurement or a 15-min. time-averaged sample). The optimum time to start collecting the sample is when the resin is experiencing exotherm. For small diameter sewers, this is about 15 – 20 minutes after steam starts flowing from the discharge point. Larger sewers will require more time.

• At the time that curing is completed and the CIPP is opened to the atmosphere (15 min. of continuous measurement, or 3 5-min. time-averaged samples),

• Additional post-opening measurements (1-hour of continuous measurement or four 15-min. time-averaged samples).
In addition to concentrations, the following measurements and observations will be conducted at each termination manhole:

- Multiple measurements of flow velocity and temperature of the steam plume and the gas from the curing liner,
- Diameters and heights of the release points for the steam plume and curing liner.

4.3. Measurement of Compounds in Air in the Area Surrounding the Termination Manhole and Other Work Area Locations

For each site selected in 4.1, measurements of concentrations of TO-15 pollutants will be conducted within and around the CIPP work area, to assess potential exposure of workers and the surrounding community. Concentrations will be measured using one of the methods listed in Section 4.2. Multiple measurements will be made to assess variability in concentrations as functions of time and space as follows:

**Measurements before liner installation (and before refrigerated truck holding the liner is opened):**

- Upwind background readings (15 min. of continuous measurement or a 15-min. time-averaged sample) to evaluate concentrations of pollutants entering the site,
- Baseline readings at the initiation (inlet) manhole (15 min. of continuous measurement or a 15-min. time-averaged sample).

**Measurements during liner installation:**

Near the refrigerated truck immediately after it is opened. (15 min. of continuous measurement.)

**Measurements during curing:**

- At the steam/air manifold before curing begins, sample flow out of the manifold for a background level of compressor and boiler discharge. Sampling can be through a side connection to the manifold or before discharge piping or hoses are attached to the manifold. Throttling valves should be used, proper personal protective equipment (PPE) must be worn and all safety procedures must be followed. (15 min. of continuous measurement or a 15-min. time-averaged sample).
- Downwind of termination (outlet) manhole a minimum of 10 ft. (15 min. of continuous measurement, walking around to capture different locations, or 5-min. time-averaged samples at three or more locations). Consideration should be given to natural site boundaries and public accessible areas. The optimum time to start collecting the sample is when the resin is experiencing exotherm. For small diameter sewers, this is about 15 – 20
minutes after steam starts flowing from the discharge point. Larger sewers will require more time.

Measurements after curing:

- Downwind of termination manhole (1-hour of continuous measurement, walking downwind at least 100 ft to capture different locations; or at least 10 5-min. time-averaged samples at different locations).

- Crosswind from termination manhole (1-hour of continuous measurement, walking crosswind at least 50 feet on each side of the termination manhole to capture different locations; or at least 10 5-min. time-averaged samples at different locations, 5 on each side of the manhole).

4.4. Meteorological Measurements

Compound concentrations downwind of a source are a function of:

1. The emission rate of the source, and

2. Atmospheric conditions, which transport and dilute pollutants.

The area measurements made in Section 4.3 are specific to the meteorological conditions on the day of sampling. So that we know the meteorological conditions on the day of sampling, meteorological measurements will be conducted.

At each of the six sites, a portable meteorological station will be used during monitoring to continuously measure wind speed, wind direction, temperature, relative humidity, atmospheric pressure and solar radiation, which are parameters likely to impact downwind concentrations. Meteorological measurements will be made during the entire period that concentration measurements are being conducted.

4.5. Personnel Sampling: Workers

To assess potential risk to workers over the course of a workday, personnel sampling will be conducted for two persons at each of the six sites over an 8-hour shift. Duties of the workers chosen for sampling will include opening the truck to take out the uncured liner, feeding the liner into the inlet manhole and monitoring the cure at the inlet and termination manholes (A and B ends).

Sampling will be conducted using sorbent tubes, with subsequent analysis according to EPA TO-15. The tubes will be attached to each person’s collar or shirt near the breathing zone, in order to represent the actual inhalation exposure without respiratory protection. Battery-operated personal sampling pumps will be used to maintain a constant flow rate to collect compounds on sorbent tubes.
4.6. Measurement of Indoor Concentrations in Buildings Near the Work Site

For at least for two sites, concentrations will be measured indoors in a building near the work site. This will allow measurement of any compounds that migrate through lateral piping into the building. Measurements will be conducted before the beginning of liner installation (15 min. of continuous measurement or a 15-min. time-averaged sample), and after the CIPP is opened to the atmosphere (1 hour of continuous measurement, or four 15-min. time-averaged samples). Measurements should be taken near possible sources of sewer or styrene gas, such as floor drains.

In addition, follow-up measurements will be conducted at the buildings to determine any residue of chemical compounds on surfaces, outside and inside. Follow-up measurements shall be within 48 hours of the completion of the CIPP installation.

4.7. Condensate Analysis

At each of the six sites, three samples of condensate will be collected after the steaming, and thus curing, is finished, and it is safe to collect the sample. Collection of the samples will require confined-space entry training, as well as appropriate personal protective equipment. It is recommended, therefore, that workers conducting the CIPP installation collect the samples.

The condensate samples will be analyzed for the compounds listed in Section 3 above using GC/MS. Liquid-liquid extraction with ethyl acetate or a similar solvent will enable direct injection of the extract into the GC/MS for speciation and quantitation.
4.8. Other Measurements

At each site, heights of the buildings surrounding the termination manhole will be determined (to the nearest foot if possible); this information is needed for the dispersion modeling to be conducted in Section 5.

At each site, collect a properly prepared CIPP sample from the installation contractor and test for degree of cure. One degree of cure test per site.

In addition, observations will be made of degree to which installation procedures follow standard guidelines, along with safety protocols and personal safety gear of workers (PPEs).

4.9. QA/QC

Source emission rate and ambient air monitoring: Blanks and standards will be measured, and instruments will be calibrated as appropriate.

Personnel sampling: After sample collection, the sorbent tubes will be immediately sealed, and transported to the laboratory for analysis in black bags to prevent any photo-driven reactions from occurring. Tube blanks (carried to the site but not worn by personnel) will also be analyzed. Two tubes will be attached to two of the persons, to provide sample duplicates. GC analysis duplicates will be measured.

5. Dispersion Modeling of Compound Concentrations under Various Meteorological Conditions

Air quality dispersion models are used to estimate air pollutant concentrations in the atmosphere. Given information about a source configuration and emission rate, dispersion models can estimate concentrations at any location downwind for any type of meteorological conditions. By running the model for a year’s worth of hourly meteorological data, maximum or worst-case concentrations can be estimated.

An appropriate model and software such as AERMOD will be used to estimate concentrations around the termination manhole at each of the six sites, using the following information:

- **Source information**: GPS data will be used to locate the termination manhole on the software UTM coordinate system. Source information (emission rates, flow velocities, temperatures, release heights, and release diameters) measured in Section 4.1 will be used as model inputs. The termination manhole will be modeled as a point source. The compound with the highest concentration to Effects Screening Level ratio ([https://www.tceq.texas.gov/toxicology/database/tox, or other similar databases](https://www.tceq.texas.gov/toxicology/database/tox, or other similar databases)) will be modeled as a worst case.
- **Meteorological data**: A year’s worth of hourly meteorological data from the closest available surface and upper air stations will be modeled, to encompass variability in meteorological conditions.
• **Building downwash:** Dimensions of buildings surrounding the termination manhole will be input into BPIP or similar software to capture plume building downwash effects. Heights of surrounding buildings will be estimated in Section 4.2. Building lengths and widths can be estimated using appropriate aerial photographs and Google Maps.

• **Receptor grid and terrain data:** A Cartesian receptor grid with 3 m x 3 m spacing will be utilized. The extent of the receptor grid will be large enough to capture maximum plume concentrations. A 7.5-minute digital terrain data will be utilized, covering the extent of the receptor grid.

• **Averaging time:** A 1-hour averaging time will be selected in the software.

• **Output:** Model output will include maps showing concentration isopleths superimposed over aerial photographs of the site. In addition, the percent of hours of the meteorological data that result in exceedances of the Effects Screening Level at one or more receptor locations will be provided.

6. **Determination of Health Risks**

Measured and modeled air concentrations from Sections 4 and 5 will be compared to appropriate health-based action levels, to determine if any potential health risks exist for workers or citizens in the surrounding community. Appropriate health-based action levels include Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), Effect Screening Levels and Air Monitoring Comparison Values Texas Commission on Environmental Quality (TCEQ) Texas Air Monitoring Information System (TAMIS) database, and other appropriate databases.

7. **Project Report**

The project report with Executive Summary will include methods, data collected, analysis, and findings from Sections 4 and 6 above, including site diagrams to show sampling locations. In particular, maximum and average concentrations measured at each site will be reported, along with standard deviations.

Interim draft reports shall be prepared after the completion of each site visit and reviewed with NASSCO.

For each site, the following information should be listed:

- Brand and product number of resin
- Is the resin utilized neat (no filler) or filled
- Monomer (styrene) content of resin in per cent
- List of initiators, promoters and inhibitors used and per cent of each
- Size of steam generator or boiler used in BTU/hr
Steam temperature

To determine if any potential health risks exists for the workers and/or persons in the surrounding community, dispersion model output will be provided, measured and modeled air concentrations from Sections 4 and 5 will be compared to appropriate health-based action levels. Statistical analyses will be conducted as appropriate.

To determine the impact of CIPP installation procedures and pipe characteristics, concentration measurements will be compared for different CIPP diameters, and lengths. In addition, estimates of styrene emissions per pound of resin cured will be compared for the different CIPP pipes studied.

Findings from Sections 4 through 6 will be compared to findings reported in the literature as per The University of Texas at Arlington (UTA/CUIRE) report, “Evaluation of Potential Release of Organic Chemicals in the Steam Exhaust and Other Release Points during Pipe Rehabilitation Using the Trenchless Cured-In-Place Pipe (CIPP) Method”.

The final report should be comprehensive, conclusive and use a scientific/technical methodology to address any further questions and doubts regarding steam-cured CIPP installations. Peer review by a professional environmental consultant of the research approach and findings, and a health professional for health risks, is required. In addition to above, the research team must come up with their own suggestions and testing procedures to properly eliminate any concerns and doubts in this area.

8. Budget Cost Estimate

Table 1 presents the summary of budget cost estimate for Phase 2 considering six sites and two options.

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<th>Item</th>
<th>Option 1</th>
<th>Option 2</th>
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<tr>
<td></td>
<td>Canister/Sorbent Tube</td>
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<td>TOTAL*</td>
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Table Notes:

*Total is either $190,400 ($31,700 per site) or $128,800 ($21,500 per site), dependent on whether canister/sorbent tube or mobile MS approach is chosen. Mobile MS option includes rental cost for two portable MS units.

**Additional travel money was included as contingency, since project locations were not determined.

9. Tentative Schedule

- Last time/day for questions on RFP – 5:00 pm EDT, May 23, 2018
- Proposals Due - 5:00 pm EDT, May 25, 2018
- Contract Award Date/Project Start date – June 15, 2018
- Interim draft site visit reports for each site visit – Completion of each visit
- Completion of site testing – October 15, 2018
- Interim Report on all site testing – October 15, 2018
- Completion of dispersion modeling – November 15, 2018
- Completion of determination of health risks – November 15, 2018
- Interim report on dispersion modeling and health risks – November 15, 2018
- Draft final report for review – December 1, 2018
- Final report – December 31, 2018
<table>
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<tr>
<th>Acronym</th>
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<tr>
<td>ACGIH</td>
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