CITY OF ANN ARBOR
INVITATION TO BID

Southside Interceptor Sewer Lining Project - Phase VI

ITB No. 4642

Due Date: Thursday, October 8, 2020 at 10:00AM (Local Time)

Public Services Area / Engineering

Issued By:

City of Ann Arbor
Procurement Unit
301 E. Huron Street
Ann Arbor, MI 48104

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ATTACHMENTS

City of Ann Arbor Prevailing Wage Declaration Form
City of Ann Arbor Living Wage Forms
City of Ann Arbor Vendor Conflict of Interest Disclosure Form
City of Ann Arbor Non-Discrimination Ordinance Declaration Form and Notice

NOTICE OF PRE-BID CONFERENCE

Due to restrictions in place no pre-bid conference will be held for this ITB. Please contact staff indicated within this ITB Document with general questions regarding this project/ITB

INSTRUCTIONS TO BIDDERS

General

Work to be done under this Contract is generally described through the detailed specifications and must be completed fully in accordance with the contract documents. All work to be done under this Contract is located in or near the City of Ann Arbor.

Any Bid which does not conform fully to these instructions may be rejected.

Preparation of Bids

Bids should be prepared providing a straight-forward, concise description of the Bidder's ability to meet the requirements of the ITB. Bids shall be written in ink or typewritten. No erasures are permitted. Mistakes may be crossed out and corrected and must be initialed and dated in ink by the person signing the Bid.

Bids must be submitted on the "Bid Forms" provided with each blank properly filled in. If forms are not fully completed it may disqualify the bid. No alternative bid will be considered unless alternative bids are specifically requested. If alternatives are requested, any deviation from the specification must be fully described, in detail on the "Alternate" section of Bid form.

Each person signing the Bid certifies that he/she is the person in the Bidder's firm/organization responsible for the decision as to the fees being offered in the Bid and has not and will not participated in any action contrary to the terms of this provision.

Questions or Clarifications / Designated City Contacts

All questions regarding this ITB shall be submitted via email. Emailed questions and inquires will be accepted from any and all prospective Bidders in accordance with the terms and conditions of the ITB.

All questions shall be due on or before **Thursday, September 24, 2020 at 3pm** and should be addressed as follows:

Specification/Scope of Work questions emailed to ikotlyar@a2gov.org
Bid Process and Compliance questions emailed to cspencer@a2gov.org

Any error, omissions or discrepancies in the specification discovered by a prospective contractor and/or service provider shall be brought to the attention of **Igor V. Kotlyar, P.E. at ikotlyar@a2gov.org** after discovery as possible. Further, the contractor and/or service provide shall not be allowed to take advantage of errors, omissions or discrepancies in the specifications.

Addenda

If it becomes necessary to revise any part of the ITB, notice of the Addendum will be posted to Michigan Inter-governmental Trade Network (MITN) www.mitn.info and/or City of Ann Arbor web site www.A2gov.org for all parties to download.

Each Bidder must in its Bid, to avoid any miscommunications, acknowledge all addenda which it has received, but the failure of a Bidder to receive, or acknowledge receipt of; any addenda shall

not relieve the Bidder of the responsibility for complying with the terms thereof.

The City will not be bound by oral responses to inquiries or written responses other than written addenda.

Bid Submission

All Bids are due and must be delivered to the City of Ann Arbor Procurement Unit on or before **Thursday, October 8, 2020 at 10:00 AM (local time).** Bids submitted late or via oral, telephonic, telegraphic, electronic mail or facsimile **will not** be considered or accepted.

Each Bidder must submit one (1) original Bid and **one (1)** Bid copies in a sealed envelope clearly marked: **ITB No. 4642 - Southside Interceptor Sewer Lining Project - Phase VI.**

Bids must be addressed and delivered to:

City of Ann Arbor
Procurement Unit,
c/o Customer Services, 1st Floor
301 East Huron Street
Ann Arbor, MI 48104

All Bids received on or before the Due Date will be publicly opened and recorded immediately. No immediate decisions are rendered.

The following forms provided within this ITB Document must be included in submitted bids.

- **City of Ann Arbor Prevailing Wage Declaration of Compliance**
- **City of Ann Arbor Living Wage Ordinance Declaration of Compliance**
- **Vendor Conflict of Interest Disclosure Form**
- **City of Ann Arbor Non-Discrimination Ordinance Declaration of Compliance**

Bids that fail to provide these forms listed above upon bid opening will be rejected as non-responsive and will not be considered for award.

Hand delivered bids may be dropped off in the Purchasing drop box located in the Ann Street (north) vestibule of City Hall which is accessible to the public at all hours. The City will not be liable to any Bidder for any unforeseen circumstances, delivery or postal delays. Postmarking to the Due Date will not substitute for receipt of the Bid. Each Bidder is responsible for submission of their Bid.

Additional time for submission of bids past the stated due date and time will not be granted to a single Bidder; however, additional time may be granted to all Bidders when the City determines in its sole discretion that circumstances warrant it.

Award

The City intends to award a Contract(s) to the lowest responsible Bidder(s). On multi-divisional contracts, separate divisions may be awarded to separate Bidders. The City may also utilize alternatives offered in the Bid Forms, if any, to determine the lowest responsible Bidder on each division, and award multiple divisions to a single Bidder, so that the lowest total cost is achieved for the City. For unit price bids, the Contract will be awarded based upon the unit prices and the

lump sum prices stated by the bidder for the work items specified in the bid documents, with consideration given to any alternates selected by the City. If the City determines that the unit price for any item is materially different for the work item bid than either other bidders or the general market, the City, in its sole discretion, in addition to any other right it may have, may reject the bid as not responsible or non-conforming.

The acceptability of major subcontractors will be considered in determining if a Bidder is responsible. In comparing Bids, the City will give consideration to alternate Bids for items listed in the bid forms. All key staff and subcontractors are subject to the approval by the City.

Official Documents

The City of Ann Arbor officially distributes bid documents from the Procurement Unit or through the Michigan Intergovernmental Trade Network (MITN). Copies of the bid documents obtained from any other source are not Official copies. Addenda and other bid information will only be posted to these official distribution sites. If you obtained City of Ann Arbor Bid documents from other sources, it is recommended that you register on www.MITN.info and obtain an official Bid. Bidders do not need to be shown on the plan holders list provided by MITN to be considered an official plan holder.

Bid Security

Each bid must be accompanied by a certified check, or Bid Bond by a surety licensed and authorized to do business within the State of Michigan, in the amount of 5% of the total of the bid price.

Withdrawal of Bids

After the time of opening, no Bid may be withdrawn for the period of ninety (90) days

Contract Time

Time is of the essence in the performance of the work under this Contract. The available time for work under this Contract is indicated on page C-2, Article III of the Contract. If these time requirements can not be met, the Bidder must stipulate on Bid Form Section 3 - Time Alternate its schedule for performance of the work. Consideration will be given to time in evaluating bids.

Liquidated Damages

A liquidated damages clause, as given on page C-2, Article III of the Contract, provides that the Contractor shall pay the City as liquidated damages, and not as a penalty, a sum certain per day for each and every day that the Contractor may be in default of completion of the specified work, within the time(s) stated in the Contract, or written extensions.

Liquidated damages clauses, as given in the General Conditions, provide further that the City shall be entitled to impose and recover liquidated damages for breach of the obligations under Chapter 112 of the City Code.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

Human Rights Information

All contractors proposing to do business with the City shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the Section 9:158 of the Ann Arbor City Code. Breach of the obligation not to discriminate as outlined in Section 5, beginning at page GC-2 shall be a material breach of the contract. Contractors are required to post a copy of Ann Arbor's Non-Discrimination Ordinance attached at all work locations where its employees provide services under a contract with the City.

Wage Requirements

Section 4, beginning at page GC-1, outlines the requirements for payment of prevailing wages and for payment of a "living wage" to employees providing service to the City under this contract. The successful bidder and its subcontractors must comply with all applicable requirements and provide proof of compliance.

Pursuant to Resolution R-16-469 all public improvement contractors are subject to prevailing wage and will be required to provide to the City payroll records sufficient to demonstrate compliance with the prevailing wage requirements. Use of the Prevailing Wage Form provided in the Appendix section or a City-approved equivalent will be required along with wage rate interviews.

For laborers whose wage level are subject to federal, state and/or local prevailing wage law the appropriate Davis-Bacon wage rate classification is identified based upon the work including within this contract. **The wage determination(s) current on the date 10 days before bids are due shall apply to this contract.** The U.S. Department of Labor (DOL) has provided explanations to assist with classification in the following resource link: beta.SAM.gov.

For the purposes of this ITB the Construction Type of Highway (Building, Heavy, Highway or Residential) will apply.

Conflict Of Interest Disclosure

The City of Ann Arbor Purchasing Policy requires that prospective Vendors complete a Conflict of Interest Disclosure form. A contract may not be awarded to the selected Vendor unless and until the Procurement Unit and the City Administrator have reviewed the Disclosure form and determined that no conflict exists under applicable federal, state, or local law or administrative regulation. Not every relationship or situation disclosed on the Disclosure Form may be a disqualifying conflict. Depending on applicable law and regulations, some contracts may awarded on the recommendation of the City Administrator after full disclosure, where such action is allowed by law, if demonstrated competitive pricing exists and/or it is determined the award is in the best interest of the City. A copy of the Vendor Conflict of Interest Disclosure Form is attached.

Major Subcontractors

The Bidder shall identify on Bid Form Section 4 each major subcontractor it expects to engage for this Contract if the work to be subcontracted is 15% or more of the bid sum or over $50,000, whichever is less. The Bidder also shall identify the work to be subcontracted to each major subcontractor. The Bidder shall not change or replace a subcontractor without approval by the City.

Debarment

Submission of a Bid in response to this ITB is certification that the Bidder is not currently debarred, suspended, proposed for debarment, and declared ineligible or voluntarily excluded from participation in this transaction by any State or Federal departments or agency. Submission is also agreement that the City will be notified of any changes in this status.

Disclosures

After bids are opened, all information in a submitter's bid is subjected to disclosure under the provisions of Michigan Public Act No. 442 of 1976, as amended (MCL 15.231 et seq.) known as the "Freedom of Information Act." The Freedom of Information Act also provides for the complete disclosure of contracts and attachments thereto except where specifically exempted.

Bid Protest

All Bid protests must be in writing and filed with the Purchasing Agent within five (5) business days of the award action. The bidder must clearly state the reasons for the protest. If a bidder contacts a City Service Area/Unit and indicates a desire to protest an award, the Service Area/Unit shall refer the bidder to the Purchasing Agent. The Purchasing Agent will provide the bidder with the appropriate instructions for filing the protest. The protest shall be reviewed by the City Administrator or designee whose decision shall be final.

Any inquiries or requests regarding this procurement should be only submitted in writing to the Designated City Contacts provided herein. Attempts by any prospective bidder to initiate contact with anyone other than the Designated City Contacts provided herein that the bidder believes can influence the procurement decision, e.g., Elected Officials, City Administrator, Selection Committee Members, Appointed Committee Members, etc., may lead to immediate elimination from further consideration.

Cost Liability

The City of Ann Arbor assumes no responsibility or liability for costs incurred by the Bidder prior to the execution of a contract with the City. By submitting a bid, a bidder agrees to bear all costs incurred or related to the preparation, submission and selection process for the bid.

Reservation of Rights

The City of Ann Arbor reserves the right to accept any bid or alternative bid proposed in whole or in part, to reject any or all bids or alternatives bids in whole or in part and to waive irregularity and/or informalities in any bid and to make the award in any manner deemed in the best interest of the City.

Idlefree Ordinance

The City of Ann Arbor adopted an idling reduction Ordinance that goes into effect July 1, 2017. The full text of the ordinance (including exemptions) can be found at: www.a2gov.org/idlefree.

Under the ordinance, No Operator of a Commercial Vehicle shall cause or permit the Commercial Vehicle to Idle:

(a) For any period of time while the Commercial Vehicle is unoccupied; or

(b) For more than 5 minutes in any 60-minute period while the Commercial Vehicle is occupied.

In addition, generators and other internal combustion engines are covered

(1) Excluding Motor Vehicle engines, no internal combustion engine shall be operated except when it is providing power or electrical energy to equipment or a tool that is actively in use.

Environmental Commitment

The City of Ann Arbor recognizes its responsibility to minimize negative impacts on human health and the environment while supporting a vibrant community and economy. The City further recognizes that the products and services the City buys have inherent environmental and economic impacts and that the City should make procurement decisions that embody, promote, and encourage the City's commitment to the environment.

The City encourages potential vendors to bring forward emerging and progressive products and services that are best suited to the City's environmental principles.

ITB No. 4642 Southside Interceptor Sewer Lining – Phase VI

ORIGINAL

CITY OF ANN ARBOR, MI
301 EAST HURON STREET
ANN ARBOR, MI 48107

LANZO COMPANIES, INC.
28137 GROESBECK HIGHWAY
ROSEVILLE, MI 48066

CONTACT: BOB BEATY, P.E.
PHONE: 954-931-6581
EMAIL: Estimating@LANZO.ORG

LANZO COMPANIES

Building and restoring sustainable infrastructure to support the needs of our communities

LANZO COMPANIES

Building and restoring sustainable infrastructure to support the needs of our communities

28137 Groesbeck Highway
Roseville, Michigan 48066
Office: (586) 775-5819
Fax: (586) 775-8924
www.lanzo.net

City of Ann Arbor, MI

301 E. Huron Street,

Ann Arbor, MI 48107

Re: Southside Interceptor Sewer Lining Project – Phase VI ; ITB No. 4642

Lanzo Companies, Inc. is pleased to submit to you for review the following proposal to perform sanitary sewer cleaning, televising and pipeline rehabilitation services as needed for the City of Ann Arbor.

What makes our proposal unique is that it brings together three (3) companies under one roof; those being Lanzo Trenchless Technologies, Lanzo Construction, and Lanzo Materials; all firms qualified and experienced within scope of services required by this request for qualifications document.

The services of each of these companies, while proposed within this Lanzo Companies, Inc. submittal; offer all services as a sole source without additional markup for subcontractors.

Lanzo Companies, Inc. is a Michigan based Sewer & Water Rehabilitation company. Lanzo Companies, Inc. is the D'Alessandro family of construction companies established over fifty (50) years ago is deeply rooted in construction tradition. Lanzo Companies, Inc. was founded in 2015 to serve the Municipal needs for infrastructure cleaning, inspection and rehabilitation services. We specialize in all types of Water, Wastewater & Specialty Lining Operations. Our staff of engineers, project managers, health & safety professionals share and facilitate the company passion for excellence and are committed to the safe & timely completion of all projects. Our team of skilled equipment operators, experienced labor workforce, and highly qualified internal support staff has responded quickly to perform some of the most complex projects in the industry with an unwavering commitment to quality and customer satisfaction. Our company offers a wide range of services designed to upgrade America's infrastructure, improve energy efficiency, reduce operating costs, and protect the environment. Their abilities include a full range of pipeline services such as:

- Pipeline Cleaning
- CCTV Inspection
- CIPP Manhole-to-Manhole Lining
- CIPP Sectional Lining
- CIPP Service Lateral Lining
- Mechanical Joint Sealing
- NSF 61 certified CIPP Water Main Lining
- GRP/Segmented Panel Lining
- Slip lining (HDPE, Hobas, GRP)
- Carbon Fiber Reinforced Plastic (CFRP)
- Manhole Lining
- Joint Sealing via Chemical Grout Injection

LANZO COMPANIES

Building and restoring sustainable infrastructure to support the needs of our communities

28137 Groesbeck Highway
Roseville, Michigan 48066
Office: (586) 775-5819
Fax: (586) 775-8924
www.lanzo.net

On this project, Lanzo Companies, Inc. proposes to perform work in the following categories:

- Sewer inspection, cleaning and rehabilitation
- Sewer pre-and post-work video inspections
- Maintenance of Traffic (MOT)
- Isolation and by-pass pumping
- CIPP Reconstruction
- Erosion and Sediment Control
- Protruding Tap Removal
- Lateral Reinstatements

Attached are the resumes and certifications of our key personnel who will be supervising the projects in all categories that we are proposing to perform work.

Also attached are current equipment lists to assist in demonstrating our ability to meet the needs of the City of Ann Arbor, MI. This equipment is available for use in all categories of work which we are proposing to perform work. Along with our installation equipment I would like to note our wet-out facility capabilities both permanent and temporary for over the hole wet out applications for weight prohibitive installations. Our permanent facility is located at 28137 Groesbeck Highway, Roseville, MI 48066.

Thank you for considering Lanzo Companies, Inc. for work with the City of Ann Arbor, MI. If you have any questions or need further information concerning our proposal, please feel free to contact me at 954-979-0802.

Respectfully submitted;

Robert Beaty III
Assistant Secretary
Lanzo Companies, Inc.

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LANZO COMPANIES

Building and restoring sustainable infrastructure to support the needs of our communities

Bid Proposal

INVITATION TO BID

City of Ann Arbor
Guy C. Larcom Municipal Building
Ann Arbor, Michigan 48107

Ladies and Gentlemen:

The undersigned, as Bidder, declares that this Bid is made in good faith, without fraud or collusion with any person or persons bidding on the same Contract; that this Bidder has carefully read and examined the bid documents, including City Nondiscrimination requirements and Declaration of Compliance Form, Living Wage requirements and Declaration of Compliance Form, Prevailing Wage requirements and Declaration of Compliance Form, Vendor Conflict of Interest Form, Notice of Pre-Bid Conference, Instructions to Bidders, Bid, Bid Forms, Contract, Bond Forms, General Conditions, Standard Specifications, Detailed Specifications, all Addenda, and the Plans (if applicable) and understands them. The Bidder declares that it conducted a full investigation at the site and of the work proposed and is fully informed as to the nature of the work and the conditions relating to the work's performance. The Bidder also declares that it has extensive experience in successfully completing projects similar to this one.

The Bidder acknowledges that it has not received or relied upon any representations or warrants of any nature whatsoever from the City of Ann Arbor, its agents or employees, and that this Bid is based solely upon the Bidder's own independent business judgment.

The undersigned proposes to perform all work shown on the plans or described in the bid documents, including any addenda issued, and to furnish all necessary machinery, tools, apparatus, and other means of construction to do all the work, furnish all the materials, and complete the work in strict accordance with all terms of the Contract of which this Bid is one part.

In accordance with these bid documents, and Addenda numbered 1, the undersigned, as Bidder, proposes to perform at the sites in and/or around Ann Arbor, Michigan, all the work included herein for the amounts set forth in the Bid Forms.

The Bidder declares that it has become fully familiar with the liquidated damage clauses for completion times and for compliance with City Code Chapter 112, understands and agrees that the liquidated damages are for the non-quantifiable aspects of non-compliance and do not cover actual damages that may be shown and agrees that if awarded the Contract, all liquidated damage clauses form part of the Contract.

The Bidder declares that it has become fully familiar with the provisions of Chapter 14, Section 1:320 (Prevailing wages) and Chapter 23 (Living Wage) of the Code of the City of Ann Arbor and that it understands and agrees to comply, to the extent applicable to employees providing services to the City under this Contract, with the wage and reporting requirements stated in the City Code provisions cited. Bidder certifies that the statements contained in the City Prevailing Wage and Living Wage Declaration of Compliance Forms are true and correct. Bidder further agrees that the cited provisions of Chapter 14 and Chapter 23 form a part of this Contract.

The Bidder declares that it has become familiar with the City Conflict of Interest Disclosure Form and certifies that the statement contained therein is true and correct.

The Bidder encloses a certified check or Bid Bond in the amount of 5% of the total of the Bid Price. The Bidder agrees both to contract for the work and to furnish the necessary Bonds and insurance documentation within 10 days after being notified of the acceptance of the Bid.

If this Bid is accepted by the City and the Bidder fails to contract and furnish the required Bonds and insurance documentation within 10 days after being notified of the acceptance of this Bid, then the Bidder shall be considered to have abandoned the Contract and the certified check or Bid Bond accompanying this Bid shall become due and payable to the City.

If the Bidder enters into the Contract in accordance with this Bid, or if this Bid is rejected, then the accompanying check or Bid Bond shall be returned to the Bidder.

In submitting this Bid, it is understood that the right is reserved by the City to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

SIGNED THIS 8th DAY OF OCTOBER, 2020.

LANZO COMPANIES, INC.	
Bidder's Name	Authorized Signature of Bidder
28135 GROESBECK HIGHWAY, ROSEVILLE, MI 48066	ROBERT BEATY III, ASST. SECRETARY
Official Address	(Print Name of Signer Above)
(586) 775-5819	ESTIMATING@LANZO.ORG
Telephone Number	Email Address for Award Notice

LEGAL STATUS OF BIDDER

(The Bidder shall fill out the appropriate form and strike out the other three.)

Bidder declares that it is:

* A corporation organized and doing business under the laws of the State of FLORIDA, for whom ROBERT BEATY III, bearing the office title of ASST. SECRETARY, whose signature is affixed to this Bid, is authorized to execute contracts.

NOTE: If not incorporated in Michigan, please attach the corporation's Certificate of Authority

• ~~A limited liability company~~ doing business under the laws of the State of _____, whom _____ bearing the title of _____ whose signature is affixed to this proposal, is authorized to execute contract on behalf of the LLC.

* ~~A partnership, organized under the laws of the state of~~ _____ and filed in the county of _____, whose members are (list all members and the street and mailing address of each) (attach separate sheet if necessary):

_____

_____

_____

_____

_____

* An individual, whose signature with address, is affixed to this Bid: __ _____ (initial here)

Authorized Official

_____ **Date** October 8th, 2020

(Print) Name ROBERT BEATY III Title ASSISTANT SECRETARY

Company: LANZO COMPANIES, INC

Address: 28135 GROESBECK HIGHWAY, ROSEVILLE, MI 48066

Contact Phone (586) 775-5819 Fax (586) 775-8924

Email ESTIMATING@LANZO.ORG

ADDENDUM No. 1

ITB No. 4642

SOUTHSIDE INTERCEPTOR SEWER LINING PROJECT – PH VI

Bids Due: October 8, 2020 at 10:00 A.M. (Local Time)

The information contained herein shall take precedence over the original documents and all previous addenda (if any), and is appended thereto. **This Addendum includes 3 pages.**

Bidder is to acknowledge receipt of this Addendum No. 1, including all attachments (if any) in its Bid by so indicating on page ITB-1 of the Invitation to Bid Form. Bids submitted without acknowledgment of receipt of this addendum may be considered nonconforming.

The following forms provided within the ITB document must be included in submitted bids:

- **City of Ann Arbor Prevailing Wage Declaration of Compliance**
- **City of Ann Arbor Living Wage Ordinance Declaration of Compliance**
- **Vendor Conflict of Interest Disclosure Form**
- **City of Ann Arbor Non-Discrimination Ordinance Declaration of Compliance**

Bids that fail to provide these forms listed above upon bid opening will be rejected as non-responsive and will not be considered for award.

I. QUESTIONS AND ANSWERS

The following Questions have been received by the City. Responses are being provided in accordance with the terms of the ITB. Bidders are directed to take note in their review of the documents of the following questions and City responses as they affect work or details in other areas not specifically referenced here.

Question 1: Will the owner please provide a table of the segments to be lined.

Answer 1: The table of the segments to be lined is included in this Addendum.

Question 2: Will the Owner please provide a current copy of the plan holders list?

Answer 2: An unofficial plan holders list and all available information (inclusive of any issued addenda) can be found through MITN.info and the City's website.

Question 3: Are recent CCTV files available for the lines expected to be rehabilitated?

Answer 3: Some lines have been recently televised; this information will be available to the contractor.

Question 4: Is steam an allowable curing method?

Answer 4: Hot water is the required curing method.

BID FORM
Section 1 - Schedule of Prices
Project: ITB 4632 - Southside Interceptor Sewer Lining Project - Ph. VI

LINE No.	DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	AMOUNT ($)
130	Protective Fencing	LF	200	$ 10.00	$ 2,000 - 00
200	General Conditions, Modified, Maximum $100,000	LS	1	$ 80,000.00	$ 80,000 - 00
201	Project Supervision, Modified, Maximum $35,000	LS	1	$ 35,000.00	$ 35,000 - 00
202	Audiovisual Tape Coverage, Modified	LS	1	$ 3,000.00	$ 3,000 - 00
203	Minor Traffic Control, Modified, Maximum $50,000	LS	1	$ 40,000.00	$ 40,000 - 00
204	Barricade, Type III, High Intensity, Double Sided, Lighted, Furn	EA	10	$ 100.00	$ 1,000 00
205	Barricade, Type III, High Intensity, Double Sided, Lighted, Oper	EA	10	$ 15.00	$ 150 - 00
206	Channelizing Device, 42 inch, Furn	EA	75	$ 25.00	$ 1,875 - 00
207	Channelizing Device, 42 inch, Oper	EA	75	$ 4.00	$ 300 - 00
208	Lighted Arrow, Type C, Furn	EA	2	$ 620.00	$ 1,240 - 00
209	Lighted Arrow, Type C, Oper	EA	2	$ 45.00	$ 90 - 00
210	Plastic Drum, High Intensity, Lighted, Furn	EA	50	$ 35.00	$ 1,750 - 00
211	Plastic Drum, High Intensity, Lighted, Oper	EA	50	$ 12.00	$ 600 - 00
212	Sign, Type B, Temp, Prismatic, Furn	SF	300	$ 10.00	$ 3,000 - 00
213	Sign, Type B, Temp, Prismatic, Oper	SF	300	$ 2.00	$ 600 - 00
214	"No Parking" Sign	EA	20	$ 30.00	$ 600 - 00
215	Sewer Flow Control	LS	1	$ 406,000.00	$ 406,000 - 00 PT
216	Clean 36" Sanitary Sewer	LF	2,959	$ 10.00	$ 29,510. 00 10/8/20
217	Clean 42" Sanitary Sewer	LF	1,825	$ 15.00	$ 27,375 - 00
218	Level 2 MACP Inspect Manhole	EA	12	$ 370.00	$ 4,440 - 00
219	Removal and Disposal of Sludge and Debris Material	Ton	100	$ 150.00	$ 15,000 - 00
220	CIPP Line 36 inch Dia. Sanitary Sewer	LF	2959	$ 225.00	$ 665,775 - 00
221	Preline 36 inch Dia. Sanitary Sewer	LF	1500	$ 4.00	$ 6,000 - 00
222	CIPP Line 42 inch Dia. Sanitary Sewer	LF	1825	$ 265.00	$ 483,625 - 00
223	Preline 42 inch Dia. Sanitary Sewer	LF	1000	$ 6.00	$ 6,000 - 00
234	Inlet Filter, Special	Each	5	$ 375.00	$ 1,875 - 00
235	Internal Chimney Seal	Each	12	$ 675.00	$ 8,100 - 00
236	Reconstruct Flow Channel	Each	12	$ 1,250.00	$ 15,000 - 00
237	Manhole Cementitious Liner	Vf	150	$ 275.00	$ 41,250 - 00
238	Clean-Up & Restoration, Special	LS	1	$ 6,800.00	$ 6,800 - 00
290	Certified Payroll Compliance and Reporting	LS	1	$ 1,235.00	$ 1,235. 00
305	36" RCP Sewer, Trench Detail - Type I Modified	LF	50	$ 300.00	$ 15,000 - 00
306	42" RCP Sewer, Trench Detail - Type I Modified	LF	50	$ 410.00	$ 20,500 - 00

Total Base Bid $ 1,924,770.00

PT
10/8/20

BID FORM

Section 2 – Material, Equipment and Environmental Alternates

The Base Bid proposal price shall include materials and equipment selected from the designated items and manufacturers listed in the bidding documents. This is done to establish uniformity in bidding and to establish standards of quality for the items named.

If the Contractor wishes to quote alternate items for consideration by the City, it may do so under this Section. A complete description of the item and the proposed price differential must be provided. Unless approved at the time of award, substitutions where items are specifically named will be considered only as a negotiated change in Contract Sum.

If an environmental alternative is bid the City strongly encourages bidders to provide recent examples of product testing and previous successful use for the City to properly evaluate the environmental alternative. Testing data from independent accredited organizations are strongly preferred.

Item Number	Description	Add/Deduct Amount

If the Bidder does not suggest any material or equipment alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any material or equipment alternate under the Contract.

Signature of Authorized Representative of Bidder _____ Date 10/08/2020

ROBERT BEATY III, ASST. SECRETARY

BID FORM

Section 3 - Time Alternate

If the Bidder takes exception to the time stipulated in Article III of the Contract, Time of Completion, page C-2, it is requested to stipulate below its proposed time for performance of the work. Consideration will be given to time in evaluating bids.

If the Bidder does not suggest any time alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any time alternate under the Contract.

Signature of Authorized Representative of Bidder _____ Date 10/08/2020

ROBERT BEATY III, ASST. SECRETARY

BID FORM

Section 4 - Major Subcontractors

For purposes of this Contract, a Subcontractor is anyone (other than the Contractor) who performs work (other than or in addition to the furnishing of materials, plans or equipment) at or about the construction site, directly or indirectly for or on behalf of the Contractor (and whether or not in privity of Contract with the Contractor), but shall not include any individual who furnishes merely the individual's own personal labor or services.

Contractor agrees that all subcontracts entered into by the Contractor shall contain similar wage provision to Section 4 of the General Conditions covering subcontractor's employees who perform work on this contract.

For the work outlined in these documents the Bidder expects to engage the following major subcontractors to perform the work identified:

Subcontractor (Name and Address)	Work	Amount

If the Bidder does not expect to engage any major subcontractor, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT expect to engage any major subcontractor to perform work under the Contract.

Signature of Authorized Representative of Bidder _____ Date 10/08/2020

ROBERT BEATY III, ASST. SECRETARY

BID FORM

Section 5 – References

Include a minimum of ___ reference from similar project completed within the past __ years.

[Refer also to Instructions to Bidders for additional requirements, if any]

*** PLEASE SEE ATTACHED PROJECT SHEETS FOR DETAILED PROJECT DESCRIPTION ***

1) _____ _____ _____
Project Name Cost Date Constructed

_____ _____
Contact Name Phone Number

2) _____ _____ _____
Project Name Cost Date Constructed

_____ _____
Contact Name Phone Number

3) _____ _____ _____
Project Name Cost Date Constructed

_____ _____
Contact Name Phone Number

BID FORM

Section 6 – Contractor Information and Responsible Contractor Criteria

Backup documentation may be requested at the sole discretion of the City to validate all of the responses provided herein by bidders. False statements by bidders to any of the criteria provided herein will result in the bid being considered non-responsive and will not be considered for award.

Failure to provide responses to all questions may result in being deemed non-responsive.

Attach additional pages as needed if space below is insufficient.

Pursuant to Sec 1:312(20) of the City Code which sets forth requirements of a responsible bidder, Bidder is required to submit the following:

1. Organization Name: LANZO COMPANIES, INC.

Social Security or Federal Employer I.D. #: 81-1005288

Address: 28135 GROESBECK HIGHWAY

City: ROSEVILLE State: MICHIGAN Zip: 48066

Type of Organization (circle one below):

Individual	Partnership	Corporation	Joint Venture	Other
		XXX		

If "Other" please provide details on the organization:

Year organization established: 12/14/2015

2. Current owners/principals/members/managing members/partners of the organization:

*** PLEASE SEE ATTACHED FOR CORPORATE RESOLUTION ***

3. Assumed Names, "doing business as" d/b/a, and/or former organization names(s), if applicable: NO

Explanation of any business name changes:

2020 FLORIDA PROFIT CORPORATION AMENDED ANNUAL REPORT

DOCUMENT# P15000101023

Entity Name: LANZO COMPANIES, INC.

Current Principal Place of Business:

125 SE 5TH CT
DEERFIELD BEACH, FL 33441

Current Mailing Address:

125 SE 5TH CT
DEERFIELD BEACH, FL 33441

FEI Number: 81-1005288

FILED
May 30, 2020
Secretary of State
1980145576CC

Certificate of Status Desired: No

Name and Address of Current Registered Agent:

D'ALESSANDRO, GIUSEPPE SR
125 SE 5TH CT
DEERFIELD BEACH, FL 33441 US

The above named entity submits this statement for the purpose of changing its registered office or registered agent, or both, in the State of Florida.

SIGNATURE: GIUSEPPE D'ALESSANDRO 05/30/2020

Electronic Signature of Registered Agent — Date

Officer/Director Detail :

Title	CFO TREASURER
Name	PAWLOWSKI, KEVIN
Address	125 SE 5TH CT
City-State-Zip:	DEERFIELD BEACH FL 33441

Title	ASST. SECRETARY
Name	TILLI, JAMES M
Address	125 SE 5TH CT
City-State-Zip:	DEERFIELD BEACH FL 33441

Title	PRESIDENT
Name	D'ALESSANDRO, GIUSEPPE SR.
Address	125 SE 5TH COURT
City-State-Zip:	DEERFIELD BEACH FL 33441

Title	VP, SECRETARY
Name	NAVETTA, PAUL
Address	125 SE 5TH COURT
City-State-Zip:	DEERFIELD BEACH FL 33441

Title	ASST. SECRETARY
Name	BEATY, ROBERT
Address	125 SE 5TH CT
City-State-Zip:	DEERFIELD BEACH FL 33441

Title	VP
Name	TILLI, MATTHEW P
Address	125 SE 5TH CT
City-State-Zip:	DEERFIELD BEACH FL 33441

Title	EXECUTIVE VICE PRESIDENT
Name	PEYERK, CHRIS
Address	125 SE 5TH COURT
City-State-Zip:	DEERFIELD BEACH FL 33441

Title	ASST. SECRETARY
Name	D'ALESSANDRO, GIUSEPPE JR.
Address	125 SE 5TH COURT
City-State-Zip:	DEERFIELD BEACH FL 33441

Continues on page 2

I hereby certify that the information indicated on this report or supplemental report is true and accurate and that my electronic signature shall have the same legal effect as if made under oath; that I am an officer or director of the corporation or the receiver or trustee empowered to execute this report as required by Chapter 607, Florida Statutes; and that my name appears above, or on an attachment with all other like empowered.

SIGNATURE: KEVIN J PAWLOWSKI CFO 05/30/2020

Electronic Signature of Signing Officer/Director Detail — Date

Officer/Director Detail Continued :

Title	ASST. SECRETARY
Name	D'ALESSANDRO, SALVATORE
Address	125 SE 5TH COURT
City-State-Zip:	DEERFIELD BEACH FL 33441

Filed by Corporations Division Administrator Filing Number: 220306266760 Date: 10/06/2020

MICHIGAN DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS

FILING ENDORSEMENT

This is to Certify that the CERTIFICATE OF CHANGE OF REGISTERED OFFICE AND/OR RESIDENT AGENT

for

LANZO COMPANIES, INC

ID Number: 801997667

received by electronic transmission on September 30, 2020 ***, is hereby endorsed.***

Filed on October 06, 2020 ***, by the Administrator.***

The document is effective on the date filed, unless a subsequent effective date within 90 days after received date is stated in the document.

In testimony whereof, I have hereunto set my hand and affixed the Seal of the Department, in the City of Lansing, this 6th day of October, 2020.

Linda Clegg, Interim Director

Corporations, Securities & Commercial Licensing Bureau

4. If applicable, please provide a list of all bidder's litigation and arbitrations currently pending and within the past five years, including an explanation of each (parties, court/forum, legal claims, damages sought, and resolution).

NONE

5. Qualifications of management and supervisory personnel to be assigned by the bidder:

YES; PLEASE SEE ATTACHED FOR LANZO RESUME OF QUALIFICATIONS

6. State and local licenses and license numbers held by the bidder:

NONE

7. Will all subcontractors, employees and other individuals working on the construction project maintain current applicable licenses required by law for all licensed occupations and professions? *** NOT APPLICABLE ***

Yes No

8. Will contractors, subcontractors, employees, and other individuals working on the construction project be misclassified by bidder as independent contractors in violation of state or federal law?

XXX

Yes No

9. Submit a statement as to what percentage of your work force resides within the City of Ann Arbor, and what percentage resides in Washtenaw County, Michigan, and the same information for any major subcontractors.

NONE

10. Submit documentation as to employee pay rates.

11. Submit a statement whether bidder provides health insurance, pension or other retirement benefits, paid leave, or other benefits to its employees.

YES; BIDDER PROVIDES ALL BENEFITS MENTIONED ABOVE TO ITS EMPLOYEES

12. Submit a statement explaining bidder's Equal Employment Opportunity Programs for minorities, women, veterans, returning citizens, and small businesses along with supporting documentation or other evidence.

YES, BIDDER HAS AN EQUAL EMPLOYMENT OPPORTUNITY PROGRAM IN PLACE FOR ITS EMPLOYEES

13. Has bidder had any violations of state, federal or local laws or regulations, including OSHA or MIOSHA violations, state or federal prevailing wage laws, wage and hour laws, worker's compensation or unemployment compensation laws, rules or regulations, issued to or against the bidder within the past five years?

Yes — XXX No

If you answered "yes" to the question above, for each violation provide an explanation of the nature of the violation, the agency involved, a violation or reference number, any other individual(s) or party(ies) involved, and the status or outcome and resolution.

14. Does bidder have an existing Fitness for Duty Program (drugs and alcohol testing) of each employee working on the proposed jobsite?

XXX Yes — No

15. By attachment, please provide the following:

- Disclosure of any debarment by any federal, state or local governmental unit and/or findings of non-responsibility or non-compliance with respect to any public or private construction project performed by the bidder. Proof of insurance, including certificates of insurance, confirming existence and amount of coverage for liability, property damage, workers compensation, and any other insurances required by the proposed contract documents.

NONE - FOR any debarment by any federal, state or local governmental unit and/or findings of non-responsibility or non-compliance with respect to any public or private construction project performed by the bidder

PLEASE SEE ATTACHED FOR LANZO'S EVIDENCE OF COVERAGE FOR INSURANCE

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 2/28/2020

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME: Cindy Balfour
VTC Insurance Group Troy Office 1175 W. Long Lake Ste. 200 Troy MI 48098-4960	PHONE (A/C, No, Ext): (248) 828-3377 FAX (A/C, No): (248) 828-3741 E-MAIL ADDRESS: cbalfour@vtcins.com
	INSURER(S) AFFORDING COVERAGE — NAIC #
	INSURER A: Zurich American Ins. Co. — 16535
INSURED Lanzo Companies Inc 125 S.E. 5th Court Deerfield Beach FL 33441	INSURER B: American Guarantee & Liability — 26247
	INSURER C: Sirius International Ins. Corp — 1440076
	INSURER D:
	INSURER E:
	INSURER F:

COVERAGES **CERTIFICATE NUMBER:** 20-21 Master **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X COMMERCIAL GENERAL LIABILITY [ ] CLAIMS-MADE [X] OCCUR X XC&U Included X Contractual GEN'L AGGREGATE LIMIT APPLIES PER: [ ] POLICY [X] PRO-JECT [ ] LOC [ ] OTHER:			GLO306766701	3/1/2020	3/1/2021	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 2,000,000 $ 100,000 $ 10,000 $ 2,000,000 $ 4,000,000 $ 4,000,000
A	AUTOMOBILE LIABILITY X ANY AUTO [ ] ALL OWNED AUTOS [ ] SCHEDULED AUTOS X HIRED AUTOS X NON-OWNED AUTOS			BAP306767001	3/1/2020	3/1/2021	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 2,000,000 $ $ $
B	X UMBRELLA LIAB X OCCUR EXCESS LIAB [ ] CLAIMS-MADE [ ] DED [ ] RETENTION $			AUC323175901	3/1/2020	3/1/2021	EACH OCCURRENCE AGGREGATE	$ 5,000,000 $ 5,000,000
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) Y/N: N N/A If yes, describe under DESCRIPTION OF OPERATIONS below			WC306766901	3/1/2020	3/1/2021	X PER STATUTE [ ] OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ 1,000,000 $ 1,000,000 $ 1,000,000
A	Installation Floater			CPP321632101	3/1/2020	3/1/2021	$4,500,000. Limit $5,000. Ded	
C	Pollution & Prof. Liability			CPPL*0001315-1	3/1/2020	3/1/2021	$2,000,000. Limit $25,000. Ded	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

CERTIFICATE HOLDER

Informational Purposes
Evidence of Coverage
****
****

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Alan Chandler/SZEBRO

16. Does bidder have an on-going MIOSHA-approved safety-training program for employees to be used on the proposed job site?

XXX
Yes No

17. Does bidder have evidence of worker's compensation Experience Modification Rating ("EMR")?

XXX
Yes No

EMR = 0.76

18. Can bidder provide a ratio of masters and journeypersons to apprentices proposed to be used on the construction project job site, documentation of master or journeyperson certification or status and the source for same, and if not, the qualifications of employees who will be assigned to work on the project? *** PLEASE SEE ATTACHED FOR RESUME OF QUALIFICATIONS; KEY PERSONNEL RESUMES ***

XXX
Yes No

If, yes, Ratio = _____

19. Can bidder provide documentation that it participates in a Registered Apprenticeship Program (RAP) that is registered with the United States Department of Labor Office of Apprenticeship or by a State Apprenticeship Agency recognized by the Office of Apprenticeship?

XXX
Yes No

If bidder answered "yes" to the question above and is selected for this project, bidder will be required to submit the RAP to the City.

If bidder answered "no" to the question above, please provide details on how your organization assess the skills and qualifications of any employees who do not have master or journeyperson certification or status, or are not participants in a Registered Apprenticeship Program identified above.

EXPERIENCE OF SUCCESSFUL INSTALLATIONS AND QUALIFICATIONS OF KEY PERSONNEL OF LANZO COMPANIES, INC.

20. Will bidder comply with all applicable state and federal laws and visa requirements regarding the hiring of non-US citizens, and disclosure of any work visas sought or obtained by the bidder, any of the bidder's subcontractors, or any of the bidder's employees or independent contractors, in order to perform any portion of the project?

XXX
Yes No

VTC
INSURANCE
GROUP

September 10, 2019

Lanzo Companies Inc
125 S.E. 5th Court
Deerfield Beach, FL 33441

RE: Workers' Compensation Experience Modification

To Whom It May Concern:

Per your request, listed below are your experience modifications for the current and past 3 years.

03/01/2019 to 03/01/2020 – .76
01/01/2018 to 03/01/2019 – .86
01/01/2017 to 01/01/2018 – .98
01/01/2016 to 01/01/2017 - .91

If you should need any additional information, please do not hesitate to call.

Sincerely,

Alan Chandler
President

21. Can bidder provide audited financial information current within the past twelve (12) months, such as a balance sheet, statement of operations, and bonding capacity?

XXX
Yes No

(Evidence that bidder has financial resources to start up and follow through on the project(s) and to respond to damages in case of default as shown by written verification of bonding capacity equal to or exceeding the amount of the bidder's scope of work on the project. The written verification must be submitted by a licensed surety company rated "B+" (or better) in the current A.M. Best Guide and qualified to do business within the State of Michigan, and the same audited financial information for any subcontractor estimated to be paid more than $100,000.00 related to any portion of the project.) *** PLEASE SEE ATTACHED FOR LANZO'S FINANCIALS ***

22. Can bidder provide evidence of a quality assurance program used by the bidder and the results of any such program on the bidder's previous projects?

XXX
Yes No

Benitez &
Company CPAs
CERTIFIED PUBLIC ACCOUNTANTS AND ADVISORS

9100 Coral Way, Suite 10 · Miami, Florida 33165
305.261.8589 · Fax 305.261.8585
www.BenitezCPAs.com

Independent Auditors' Report

To the Board of Directors
Lanzo Companies Group
Deerfield Beach, Florida

Report on the Combined Financial Statements

We have audited the accompanying combined financial statements of Lanzo Companies Group (the "Group"), which comprise the combined statements of financial position as of December 31, 2019 and 2018, and the related combined statements of operations, (deficiency in assets) equity, and cash flows for the years then ended, and the related notes to the combined financial statements.

Management's Responsibility for the Combined Financial Statements

Management is responsible for the preparation and fair presentation of these combined financial statements in accordance with accounting principles generally accepted in the United States of America; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of combined financial statements that are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility

Our responsibility is to express an opinion on these combined financial statements based on our audits. We conducted our audits in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the combined financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the combined financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risks of material misstatement of the combined financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the combined financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the combined financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the combined financial statements referred to above present fairly, in all material respects, the combined financial position of Lanzo Companies Group as of December 31, 2019 and 2018, and the results of its combined operations and its combined cash flows for the years then ended in accordance with accounting principles generally accepted in the United States of America.

Benitez & Company, CPAs.
Certified Public Accountants

Miami, Florida
June 25, 2020

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LANZO COMPANIES GROUP
COMBINED STATEMENTS OF FINANCIAL POSITION
(Expressed in United States Dollars)

ASSETS	December 31, 2019	December 31, 2018
Current Assets:		
Cash and cash equivalents	$ 258,041	$ 623,902
Restricted cash (Note - 2)	101,592	101,592
Contracts receivable, net (Note - 3)	6,713,982	5,548,159
Inventory (Note - 4)	432,957	191,839
Prepaid expenses	169,462	35,705
Loan to employees	31,377	144,817
Contract assets (Note - 5)	6,468,380	6,878,347
Total current assets	14,175,791	13,524,361
Property and equipment, net (Note - 6)	12,854,381	13,381,644
Other Assets:		
Cash surrender value of life insurance, net of loans of $367,442	558,568	860,187
Investment in unconsolidated subsidiary (Note - 7)	461,630	416,254
Deposits	109,776	110,059
Loan to member (Note - 8)	607,453	607,452
Total other assets	1,737,427	1,993,952
Total assets	$ 28,767,599	$ 28,899,957

The accompanying notes are an
integral part of these combined financial statements.

LANZO COMPANIES GROUP
COMBINED STATEMENTS OF FINANCIAL POSITION
(Expressed in United States Dollars)

	December 31,	
LIABILITIES AND (DEFICIENCY IN ASSETS) EQUITY	2019	2018
Current Liabilities:		
Accounts payable and accrued expenses (Note - 9)	$ 14,569,206	$ 9,586,840
Credit line facility (Note - 10)	3,421,789	346,590
Federal income tax liability (Note - 19)	282,873	282,873
Current portion of equipment credit line facility (Note - 11)	41,054	-
Current portion of long-term debt (Note - 12)	1,406,817	1,537,590
Contract liabilities (Note - 5)	1,521,682	1,125,958
Total current liabilities	21,243,421	12,879,851
Loan from stockholders	70,113	-
Equipment credit line facility, net of current portion (Note - 11)	342,821	-
Long-term debt, net of current portion (Note - 12)	9,679,615	10,346,827
Due to affiliates	17,000	15,000
Total liabilities	31,352,970	23,241,678
Contingent liabilities (Note - 14)	-	-
(Deficiency in assets) Equity:		
Common stock (Note - 15)	7,695,039	7,695,039
(Deficit) retained earnings	(1,234,782)	6,180,946
Members' equity	1,490,300	3,047,741
Loans to related parties, net (Note - 16)	(461,067)	(1,387,497)
Due from officers (Note - 17)	(5,733,255)	(5,536,344)
	1,756,235	9,999,885
Treasury stock (Note - 18)	(4,341,606)	(4,341,606)
Total (deficiency in assets) equity	(2,585,371)	5,658,279
Total liabilities and (deficiency in assets) equity	$ 28,767,599	$ 28,899,957

The accompanying notes are an
integral part of these combined financial statements.

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A310

Bid Bond

KNOW ALL MEN BY THESE PRESENTS, that we

Lanzo Companies, Inc.
28135 Groesbeck Highway,Roseville, MI 48066

as Principal, hereinafter called Principal, and

Liberty Mutual Insurance Company
175 Berkeley Street,Boston, MA 02116

a corporation duly organized under the laws of the State of **Massachusetts**
as Surety, hereinafter called Surety, are held and firmly bound unto

City of Ann Arbor
301 East Huron Street,Ann Arbor, MI 48104

as Obligee, hereinafter called Obligee, in the sum of **Five Percent of Accompanying Bid**

Dollars (**5% of Bid**

for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for (Here insert full name, address and description of project)

Southside Interceptor Sewer Lining Project - Phase VI - ITB No. 4642

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this **8th** day of **October**, **2020**.

Lanzo Companies, Inc.

(Witness)

Ramvikhal Chikalgalli

ROBERT BRATY III (Principal) (Seal)

Assistant Secretary
(Title)

Liberty Mutual Insurance Company
(Surety) (Seal)

(Witness)

(Title)
Holly Nichols, Attorney in Fact

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: **8198083-013068**

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Nicholas Ashburn; Anne Barick; Robert D. Heuer; Paul M. Hurley; Michael D. Lechner; Mark Madden; Richard S. McGregor; Holly Nichols; Jason Rogers

all of the city of Troy state of MI each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 30th day of November , 2018 .

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

State of PENNSYLVANIA
County of MONTGOMERY ss

On this 30th day of November , 2018 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at King of Prussia, Pennsylvania, on the day and year first above written.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Teresa Pastella, Notary Public
Upper Merion Twp., Montgomery County
My Commission Expires March 28, 2021
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS: Section 12. Power of Attorney.
Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 8th day of October , 2020 .

By: _____
Renee C. Llewellyn, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

To confirm the validity of this Power of Attorney call 1-610-832-8240 between 9:00 am and 4:30 pm EST on any business day.

Administrative Use Only
Contract Date: _____

CONTRACT

THIS CONTRACT is between the CITY OF ANN ARBOR, a Michigan Municipal Corporation, 301 East Huron Street, Ann Arbor, Michigan 48104 ("City") and Lanzo Companies, Inc. ("Contractor"), a Michigan Corporation, 28137 Groesbeck Highway, Roseville, Mi 48066

Based upon the mutual promises below, the Contractor and the City agree as follows:

ARTICLE I - Scope of Work

The Contractor agrees to furnish all of the materials, equipment and labor necessary; and to abide by all the duties and responsibilities applicable to it for the project titled **ITB No. 4642 - Southside Interceptor Sewer Lining Project - Phase VI.** in accordance with the requirements and provisions of the following documents, including all written modifications incorporated into any of the documents, all of which are incorporated as part of this Contract:

Non-discrimination and Living Wage Declaration of Compliance Forms (if applicable)
Vendor Conflict of Interest Form
Prevailing Wage Declaration of Compliance Form (if applicable)
Bid Forms
Contract and Exhibits
Bonds
General Conditions
Standard Specifications
Detailed Specifications
Plans
Addenda

ARTICLE II - Definitions

Administering Service Area/Unit means **Public Services Area / Engineering**

Project means **ITB No. ITB No. 4642 - Southside Interceptor Sewer Lining Project – Ph. VI.**

Supervising Professional means the person acting under the authorization of the manager of the Administering Service Area/Unit. At the time this Contract is executed, the Supervising Professional is: **Nicholas S. Hutchinson, P.E.** whose job title is **City Engineer**. If there is any question concerning who the Supervising Professional is, Contractor shall confirm with the manager of the Administering Service Area/Unit.

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ARTICLE III - Time of Completion

(A) The work to be completed under this Contract shall begin immediately on the date specified in the Notice to Proceed issued by the City.

(B) The entire work for this Contract shall be completed within the scheduling requirements as specified in Detailed Specifications.

(C) Failure to complete all the work within the time specified above, including any extension granted in writing by the Supervising Professional, shall obligate the Contractor to pay the City, as liquidated damages and not as a penalty, an amount equal to $500 for each calendar day of delay in the completion of all the work. If any liquidated damages are unpaid by the Contractor, the City shall be entitled to deduct these unpaid liquidated damages from the monies due the Contractor.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

ARTICLE IV - The Contract Sum

(A) The City shall pay to the Contractor for the performance of the Contract, the unit prices as given in the Bid Form for the estimated bid total of:

One Million, Nine Hundred Twenty Four Thousand Seven Hundred Seventy and 00/100 Dollars ($1,924,770.00)

(B) The amount paid shall be equitably adjusted to cover changes in the work ordered by the Supervising Professional but not required by the Contract Documents. Increases or decreases shall be determined only by written agreement between the City and Contractor.

ARTICLE V - Assignment

This Contract may not be assigned or subcontracted any portion of any right or obligation under this contract without the written consent of the City. Notwithstanding any consent by the City to any assignment, Contractor shall at all times remain bound to all warranties, certifications, indemnifications, promises and performances, however described, as are required of it under this contract unless specifically released from the requirement, in writing, by the City.

ARTICLE VI - Choice of Law

This Contract shall be construed, governed, and enforced in accordance with the laws of the State of Michigan. By executing this Contract, the Contractor and the City agree to venue in a court of appropriate jurisdiction sitting within Washtenaw County for purposes of any action arising under this Contract. The parties stipulate that the venue referenced in this Contract is for convenience and waive any claim of non-convenience.

Whenever possible, each provision of the Contract will be interpreted in a manner as to be effective and valid under applicable law. The prohibition or invalidity, under applicable law, of any provision will not invalidate the remainder of the Contract.

ARTICLE VII - Relationship of the Parties

The parties of the Contract agree that it is not a Contract of employment but is a Contract to accomplish a specific result. Contractor is an independent Contractor performing services for the City. Nothing contained in this Contract shall be deemed to constitute any other relationship

between the City and the Contractor.

Contractor certifies that it has no personal or financial interest in the project other than the compensation it is to receive under the Contract. Contractor certifies that it is not, and shall not become, overdue or in default to the City for any Contract, debt, or any other obligation to the City including real or personal property taxes. City shall have the right to set off any such debt against compensation awarded for services under this Contract.

ARTICLE VIII - Notice

All notices given under this Contract shall be in writing, and shall be by personal delivery or by certified mail with return receipt requested to the parties at their respective addresses as specified in the Contract Documents or other address the Contractor may specify in writing. Notice will be deemed given on the date when one of the following first occur: (1) the date of actual receipt; or (2) three days after mailing certified U.S. mail.

ARTICLE IX - Indemnification

To the fullest extent permitted by law, Contractor shall indemnify, defend and hold the City, its officers, employees and agents harmless from all suits, claims, judgments and expenses including attorney's fees resulting or alleged to result, in whole or in part, from any act or omission, which is in any way connected or associated with this Contract, by the Contractor or anyone acting on the Contractor's behalf under this Contract. Contractor shall not be responsible to indemnify the City for losses or damages caused by or resulting from the City's sole negligence. The provisions of this Article shall survive the expiration or earlier termination of this contract for any reason.

ARTICLE X - Entire Agreement

This Contract represents the entire understanding between the City and the Contractor and it supersedes all prior representations, negotiations, agreements, or understandings whether written or oral. Neither party has relied on any prior representations in entering into this Contract. No terms or conditions of either party's invoice, purchase order or other administrative document shall modify the terms and conditions of this Contract, regardless of the other party's failure to object to such form. This Contract shall be binding on and shall inure to the benefit of the parties to this Contract and their permitted successors and permitted assigns and nothing in this Contract, express or implied, is intended to or shall confer on any other person or entity any legal or equitable right, benefit, or remedy of any nature whatsoever under or by reason of this Contract. This Contract may be altered, amended or modified only by written amendment signed by the City and the Contractor.

ARTICLE XI – Electronic Transactions

The City and Contractor agree that signatures on this Contract may be delivered electronically in lieu of an original signature and agree to treat electronic signatures as original signatures that bind them to this Contract. This Contract may be executed and delivered by facsimile and upon such delivery, the facsimile signature will be deemed to have the same effect as if the original signature had been delivered to the other party.

FOR CONTRACTOR

By_____

Its:_____

FOR THE CITY OF ANN ARBOR

By_____
Christopher Taylor, Mayor

By_____
Jacqueline Beaudry, City Clerk

Approved as to substance

By_____
Tom Crawford, City Administrator

By_____
Craig Hupy, Public
Services Area Administrator

Approved as to form and content

_____
Stephen K. Postema, City Attorney

PERFORMANCE BOND

(1) _____ of _____(referred to as "Principal"), and _____, a corporation duly authorized to do business in the State of Michigan (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for $ _____, the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.

(2) The Principal has entered a written Contract with the City entitled _____ _____ _____, for ITB No. _____and this bond is given for that Contract in compliance with Act No. 213 of the Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq.

(3) Whenever the Principal is declared by the City to be in default under the Contract, the Surety may promptly remedy the default or shall promptly:

(a) complete the Contract in accordance with its terms and conditions; or

(b) obtain a bid or bids for submission to the City for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, arrange for a Contract between such bidder and the City, and make available, as work progresses, sufficient funds to pay the cost of completion less the balance of the Contract price; but not exceeding, including other costs and damages for which Surety may be liable hereunder, the amount set forth in paragraph 1.

(4) Surety shall have no obligation to the City if the Principal fully and promptly performs under the Contract.

(5) Surety agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder, or the specifications accompanying it shall in any way affect its obligations on this bond, and waives notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work, or to the specifications.

(6) Principal, Surety, and the City agree that signatures on this bond may be delivered electronically in lieu of an original signature and agree to treat electronic signatures as original signatures that bind them to this bond. This bond may be executed and delivered by facsimile and upon such delivery, the facsimile signature will be deemed to have the same effect as if the original signature had been delivered to the other party.

SIGNED AND SEALED this _____ day of _____, 202_.

_____
(Name of Surety Company)

By _____
(Signature)

Its_____
(Title of Office)

Approved as to form:

_____
Stephen K. Postema, City Attorney

_____
(Name of Principal)

By _____
(Signature)

Its _____
(Title of Office)

Name and address of agent:

_____

_____

_____

LABOR AND MATERIAL BOND

(1) _____

of _____(referred to as "Principal"), and _____, a corporation duly authorized to do business in the State of Michigan, (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for the use and benefit of claimants as defined in Act 213 of Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq., in the amount of $ _____, for the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.

(2) The Principal has entered a written Contract with the Cityentitled _____

_____

_____

____, for ITB No. _____; and this bond is given for that Contract in compliance with Act No. 213 of the Michigan Public Acts of 1963 as amended;

(3) If the Principal fails to promptly and fully repay claimants for labor and material reasonably required under the Contract, the Surety shall pay those claimants.

(4) Surety's obligations shall not exceed the amount stated in paragraph 1, and Surety shall have no obligation if the Principal promptly and fully pays the claimants.

(5) Principal, Surety, and the City agree that signatures on this bond may be delivered electronically in lieu of an original signature and agree to treat electronic signatures as original signatures that bind them to this bond. This bond may be executed and delivered by facsimile and upon such delivery, the facsimile signature will be deemed to have the same effect as if the original signature had been delivered to the other party.

SIGNED AND SEALED this _____ day of _____, 202_

_____
(Name of Surety Company)

By _____
(Signature)

Its_____
(Title of Office)

_____
(Name of Principal)

By _____
(Signature)

Its _____
(Title of Office)

Approved as to form:

_____
Stephen K. Postema, City Attorney

Name and address of agent:

_____

_____

_____

GENERAL CONDITIONS

Section 1 - Execution, Correlation and Intent of Documents

The contract documents shall be signed in 2 copies by the City and the Contractor.

The contract documents are complementary and what is called for by any one shall be binding. The intention of the documents is to include all labor and materials, equipment and transportation necessary for the proper execution of the work. Materials or work described in words which so applied have a well-known technical or trade meaning have the meaning of those recognized standards.

In case of a conflict among the contract documents listed below in any requirement(s), the requirement(s) of the document listed first shall prevail over any conflicting requirement(s) of a document listed later.

(1) Addenda in reverse chronological order; (2) Detailed Specifications; (3) Standard Specifications; (4) Plans; (5) General Conditions; (6) Contract; (7) Bid Forms; (8) Bond Forms; (9) Bid.

Section 2 - Order of Completion

The Contractor shall submit with each invoice, and at other times reasonably requested by the Supervising Professional, schedules showing the order in which the Contractor proposes to carry on the work. They shall include the dates at which the Contractor will start the several parts of the work, the estimated dates of completion of the several parts, and important milestones within the several parts.

Section 3 - Familiarity with Work

The Bidder or its representative shall make personal investigations of the site of the work and of existing structures and shall determine to its own satisfaction the conditions to be encountered, the nature of the ground, the difficulties involved, and all other factors affecting the work proposed under this Contract. The Bidder to whom this Contract is awarded will not be entitled to any additional compensation unless conditions are clearly different from those which could reasonably have been anticipated by a person making diligent and thorough investigation of the site.

The Bidder shall immediately notify the City upon discovery, and in every case prior to submitting its Bid, of every error or omission in the bidding documents that would be identified by a reasonably competent, diligent Bidder. In no case will a Bidder be allowed the benefit of extra compensation or time to complete the work under this Contract for extra expenses or time spent as a result of the error or omission.

Section 4 - Wage Requirements

Under this Contract, the Contractor shall conform to Chapter 14 of Title I of the Code of the City of Ann Arbor as amended; which in part states "...that all craftsmen, mechanics and laborers employed directly on the site in connection with said improvements, including said employees of

subcontractors, shall receive the prevailing wage for the corresponding classes of craftsmen, mechanics and laborers, as determined by statistics for the Ann Arbor area compiled by the United States Department of Labor. At the request of the City, any contractor or subcontractor shall provide satisfactory proof of compliance with the contract provisions required by the Section.

Pursuant to Resolution R-16-469 all public improvement contractors are subject to prevailing wage and will be required to provide to the City payroll records sufficient to demonstrate compliance with the prevailing wage requirements. A sample Prevailing Wage Form is provided in the Appendix herein for reference as to what will be expected from contractors. Use of the Prevailing Wage Form provided in the Appendix section or a City-approved equivalent will be required along with wage rate interviews.

Where the Contract and the Ann Arbor City Ordinance are silent as to definitions of terms required in determining contract compliance with regard to prevailing wages, the definitions provided in the Davis-Bacon Act as amended (40 U.S.C. 278-a to 276-a-7) for the terms shall be used.

If the Contractor is a “covered employer” as defined in Chapter 23 of the Ann Arbor City Code, the Contractor agrees to comply with the living wage provisions of Chapter 23 of the Ann Arbor City Code. The Contractor agrees to pay those employees providing Services to the City under this Contract a “living wage,” as defined in Section 1:815 of the Ann Arbor City Code, as adjusted in accordance with Section 1:815(3); to post a notice approved by the City of the applicability of Chapter 23 in every location in which regular or contract employees providing services under this Contract are working; to maintain records of compliance; if requested by the City, to provide documentation to verify compliance; to take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee or person contracted for employment in order to pay the living wage required by Section 1:815; and otherwise to comply with the requirements of Chapter 23.

Contractor agrees that all subcontracts entered into by the Contractor shall contain similar wage provision covering subcontractor’s employees who perform work on this contract.

Section 5 - Non-Discrimination

The Contractor agrees to comply, and to require its subcontractor(s) to comply, with the nondiscrimination provisions of MCL 37.2209. The Contractor further agrees to comply with the provisions of Section 9:158 of Chapter 112 of Title IX of the Ann Arbor City Code, and to assure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity.

Section 6 - Materials, Appliances, Employees

Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation, and other facilities necessary or used for the execution and completion of the work. Unless otherwise specified, all materials incorporated in the permanent work shall be new, and both workmanship and materials shall be of the highest quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

The Contractor shall at all times enforce strict discipline and good order among its employees, and shall seek to avoid employing on the work any unfit person or anyone not skilled in the work

assigned.

Adequate sanitary facilities shall be provided by the Contractor.

Section 7 - Qualifications for Employment

The Contractor shall employ competent laborers and mechanics for the work under this Contract. For work performed under this Contract, employment preference shall be given to qualified local residents.

Section 8 - Royalties and Patents

The Contractor shall pay all royalties and license fees. It shall defend all suits or claims for infringements of any patent rights and shall hold the City harmless from loss on account of infringement except that the City shall be responsible for all infringement loss when a particular process or the product of a particular manufacturer or manufacturers is specified, unless the City has notified the Contractor prior to the signing of the Contract that the particular process or product is patented or is believed to be patented.

Section 9 - Permits and Regulations

The Contractor must secure and pay for all permits, permit or plan review fees and licenses necessary for the prosecution of the work. These include but are not limited to City building permits, right-of-way permits, lane closure permits, right-of-way occupancy permits, and the like. The City shall secure and pay for easements shown on the plans unless otherwise specified.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the contract documents are at variance with those requirements, it shall promptly notify the Supervising Professional in writing, and any necessary changes shall be adjusted as provided in the Contract for changes in the work.

Section 10 - Protection of the Public and of Work and Property

The Contractor is responsible for the means, methods, sequences, techniques and procedures of construction and safety programs associated with the work contemplated by this contract. The Contractor, its agents or sub-contractors, shall comply with the "General Rules and Regulations for the Construction Industry" as published by the Construction Safety Commission of the State of Michigan and to all other local, State and National laws, ordinances, rules and regulations pertaining to safety of persons and property.

The Contractor shall take all necessary and reasonable precautions to protect the safety of the public. It shall continuously maintain adequate protection of all work from damage, and shall take all necessary and reasonable precautions to adequately protect all public and private property from injury or loss arising in connection with this Contract. It shall make good any damage, injury or loss to its work and to public and private property resulting from lack of reasonable protective precautions, except as may be due to errors in the contract documents, or caused by agents or employees of the City. The Contractor shall obtain and maintain sufficient insurance to cover damage to any City property at the site by any cause.

In an emergency affecting the safety of life, or the work, or of adjoining property, the Contractor is, without special instructions or authorization from the Supervising Professional, permitted to act at its discretion to prevent the threatened loss or injury. It shall also so act, without appeal, if authorized or instructed by the Supervising Professional.

Any compensation claimed by the Contractor for emergency work shall be determined by agreement or in accordance with the terms of Claims for Extra Cost - Section 15.

Section 11 - Inspection of Work

The City shall provide sufficient competent personnel for the inspection of the work.

The Supervising Professional shall at all times have access to the work whenever it is in preparation or progress, and the Contractor shall provide proper facilities for access and for inspection.

If the specifications, the Supervising Professional's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Supervising Professional timely notice of its readiness for inspection, and if the inspection is by an authority other than the Supervising Professional, of the date fixed for the inspection. Inspections by the Supervising Professional shall be made promptly, and where practicable at the source of supply. If any work should be covered up without approval or consent of the Supervising Professional, it must, if required by the Supervising Professional, be uncovered for examination and properly restored at the Contractor's expense.

Re-examination of any work may be ordered by the Supervising Professional, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to be in accordance with the contract documents, the City shall pay the cost of re-examination and replacement. If the work is not in accordance with the contract documents, the Contractor shall pay the cost.

Section 12 - Superintendence

The Contractor shall keep on the work site, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Supervising Professional. The superintendent will be responsible to perform all on-site project management for the Contractor. The superintendent shall be experienced in the work required for this Contract. The superintendent shall represent the Contractor and all direction given to the superintendent shall be binding as if given to the Contractor. Important directions shall immediately be confirmed in writing to the Contractor. Other directions will be confirmed on written request. The Contractor shall give efficient superintendence to the work, using its best skill and attention.

Section 13 - Changes in the Work

The City may make changes to the quantities of work within the general scope of the Contract at any time by a written order and without notice to the sureties. If the changes add to or deduct from the extent of the work, the Contract Sum shall be adjusted accordingly. All the changes shall be executed under the conditions of the original Contract except that any claim for extension of time caused by the change shall be adjusted at the time of ordering the change.

In giving instructions, the Supervising Professional shall have authority to make minor changes in

the work not involving extra cost and not inconsistent with the purposes of the work, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a written order by the Supervising Professional, and no claim for an addition to the Contract Sum shall be valid unless the additional work was ordered in writing.

The Contractor shall proceed with the work as changed and the value of the work shall be determined as provided in Claims for Extra Cost - Section 15.

Section 14 - Extension of Time

Extension of time stipulated in the Contract for completion of the work will be made if and as the Supervising Professional may deem proper under any of the following circumstances:

(1) When work under an extra work order is added to the work under this Contract;

(2) When the work is suspended as provided in Section 20;

(3) When the work of the Contractor is delayed on account of conditions which could not have been foreseen, or which were beyond the control of the Contractor, and which were not the result of its fault or negligence;

(4) Delays in the progress of the work caused by any act or neglect of the City or of its employees or by other Contractors employed by the City;

(5) Delay due to an act of Government;

(6) Delay by the Supervising Professional in the furnishing of plans and necessary information;

(7) Other cause which in the opinion of the Supervising Professional entitles the Contractor to an extension of time.

The Contractor shall notify the Supervising Professional within 7 days of an occurrence or conditions which, in the Contractor's opinion, entitle it to an extension of time. The notice shall be in writing and submitted in ample time to permit full investigation and evaluation of the Contractor's claim. The Supervising Professional shall acknowledge receipt of the Contractor's notice within 7 days of its receipt. Failure to timely provide the written notice shall constitute a waiver by the Contractor of any claim.

In situations where an extension of time in contract completion is appropriate under this or any other section of the contract, the Contractor understands and agrees that the only available adjustment for events that cause any delays in contract completion shall be extension of the required time for contract completion and that there shall be no adjustments in the money due the Contractor on account of the delay.

Section 15 - Claims for Extra Cost

If the Contractor claims that any instructions by drawings or other media issued after the date of the Contract involved extra cost under this Contract, it shall give the Supervising Professional written notice within 7 days after the receipt of the instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property. The procedure shall then be as provided for Changes in the Work-Section l3. No claim shall be valid unless so made.

If the Supervising Professional orders, in writing, the performance of any work not covered by the contract documents, and for which no item of work is provided in the Contract, and for which no unit price or lump sum basis can be agreed upon, then the extra work shall be done on a Cost-Plus-Percentage basis of payment as follows:

(1) The Contractor shall be reimbursed for all reasonable costs incurred in doing the work, and shall receive an additional payment of 15% of all the reasonable costs to cover both its indirect overhead costs and profit;

(2) The term "Cost" shall cover all payroll charges for employees and supervision required under the specific order, together with all worker's compensation, Social Security, pension and retirement allowances and social insurance, or other regular payroll charges on same; the cost of all material and supplies required of either temporary or permanent character; rental of all power-driven equipment at agreed upon rates, together with cost of fuel and supply charges for the equipment; and any costs incurred by the Contractor as a direct result of executing the order, if approved by the Supervising Professional;

(3) If the extra is performed under subcontract, the subcontractor shall be allowed to compute its charges as described above. The Contractor shall be permitted to add an additional charge of 5% percent to that of the subcontractor for the Contractor's supervision and contractual responsibility;

(4) The quantities and items of work done each day shall be submitted to the Supervising Professional in a satisfactory form on the succeeding day, and shall be approved by the Supervising Professional and the Contractor or adjusted at once;

(5) Payments of all charges for work under this Section in any one month shall be made along with normal progress payments. Retainage shall be in accordance with Progress Payments-Section 16.

No additional compensation will be provided for additional equipment, materials, personnel, overtime or special charges required to perform the work within the time requirements of the Contract.

When extra work is required and no suitable price for machinery and equipment can be determined in accordance with this Section, the hourly rate paid shall be 1/40 of the basic weekly rate listed in the Rental Rate Blue Book published by Dataquest Incorporated and applicable to the time period the equipment was first used for the extra work. The hourly rate will be deemed to include all costs of operation such as bucket or blade, fuel, maintenance, "regional factors", insurance, taxes, and the like, but not the costs of the operator.

Section 16 - Progress Payments

The Contractor shall submit each month, or at longer intervals, if it so desires, an invoice covering work performed for which it believes payment, under the Contract terms, is due. The submission shall be to the City's Finance Department - Accounting Division. The Supervising Professional will, within 10 days following submission of the invoice, prepare a certificate for payment for the work in an amount to be determined by the Supervising Professional as fairly representing the acceptable work performed during the period covered by the Contractor's invoice. To insure the proper performance of this Contract, the City will retain a percentage of the estimate in accordance with Act 524, Public Acts of 1980. The City will then, following the receipt of the Supervising Professional's Certificate, make payment to the Contractor as soon as feasible, which is anticipated will be within 15 days.

An allowance may be made in progress payments if substantial quantities of permanent material have been delivered to the site but not incorporated in the completed work if the Contractor, in the opinion of the Supervising Professional, is diligently pursuing the work under this Contract. Such materials shall be properly stored and adequately protected. Allowance in the estimate shall be at the invoice price value of the items. Notwithstanding any payment of any allowance, all risk of loss due to vandalism or any damages to the stored materials remains with the Contractor.

In the case of Contracts which include only the Furnishing and Delivering of Equipment, the payments shall be; 60% of the Contract Sum upon the delivery of all equipment to be furnished, or in the case of delivery of a usable portion of the equipment in advance of the total equipment delivery, 60% of the estimated value of the portion of the equipment may be paid upon its delivery in advance of the time of the remainder of the equipment to be furnished; 30% of the Contract Sum upon completion of erection of all equipment furnished, but not later than 60 days after the date of delivery of all of the equipment to be furnished; and payment of the final 10% on final completion of erection, testing and acceptance of all the equipment to be furnished; but not later than l80 days after the date of delivery of all of the equipment to be furnished, unless testing has been completed and shows the equipment to be unacceptable.

With each invoice for periodic payment, the Contractor shall enclose a Contractor's Declaration - Section 43, and an updated project schedule per Order of Completion - Section 2.

Section 17 - Deductions for Uncorrected Work

If the Supervising Professional decides it is inexpedient to correct work that has been damaged or that was not done in accordance with the Contract, an equitable deduction from the Contract price shall be made.

Section 18 - Correction of Work Before Final Payment

The Contractor shall promptly remove from the premises all materials condemned by the Supervising Professional as failing to meet Contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute the work in accordance with the Contract and without expense to the City and shall bear the expense of making good all work of other contractors destroyed or damaged by the removal or replacement.

If the Contractor does not remove the condemned work and materials within l0 days after written notice, the City may remove them and, if the removed material has value, may store the material

at the expense of the Contractor. If the Contractor does not pay the expense of the removal within 10 days thereafter, the City may, upon 10 days written notice, sell the removed materials at auction or private sale and shall pay to the Contractor the net proceeds, after deducting all costs and expenses that should have been borne by the Contractor. If the removed material has no value, the Contractor must pay the City the expenses for disposal within 10 days of invoice for the disposal costs.

The inspection or lack of inspection of any material or work pertaining to this Contract shall not relieve the Contractor of its obligation to fulfill this Contract and defective work shall be made good. Unsuitable materials may be rejected by the Supervising Professional notwithstanding that the work and materials have been previously overlooked by the Supervising Professional and accepted or estimated for payment or paid for. If the work or any part shall be found defective at any time before the final acceptance of the whole work, the Contractor shall forthwith make good the defect in a manner satisfactory to the Supervising Professional. The judgment and the decision of the Supervising Professional as to whether the materials supplied and the work done under this Contract comply with the requirements of the Contract shall be conclusive and final.

Section 19 - Acceptance and Final Payment

Upon receipt of written notice that the work is ready for final inspection and acceptance, the Supervising Professional will promptly make the inspection. When the Supervising Professional finds the work acceptable under the Contract and the Contract fully performed, the Supervising Professional will promptly sign and issue a final certificate stating that the work required by this Contract has been completed and is accepted by the City under the terms and conditions of the Contract. The entire balance found to be due the Contractor, including the retained percentage, shall be paid to the Contractor by the City within 30 days after the date of the final certificate.

Before issuance of final certificates, the Contractor shall file with the City:

(1) The consent of the surety to payment of the final estimate;
(2) The Contractor's Affidavit in the form required by Section 44.

In case the Affidavit or consent is not furnished, the City may retain out of any amount due the Contractor, sums sufficient to cover all lienable claims.

The making and acceptance of the final payment shall constitute a waiver of all claims by the City except those arising from:

(1) unsettled liens;
(2) faulty work appearing within 12 months after final payment;
(3) hidden defects in meeting the requirements of the plans and specifications;
(4) manufacturer's guarantees.

It shall also constitute a waiver of all claims by the Contractor, except those previously made and still unsettled.

Section 20 - Suspension of Work

The City may at any time suspend the work, or any part by giving 5 days notice to the Contractor in writing. The work shall be resumed by the Contractor within 10 days after the date fixed in the

written notice from the City to the Contractor to do so. The City shall reimburse the Contractor for expense incurred by the Contractor in connection with the work under this Contract as a result of the suspension.

If the work, or any part, shall be stopped by the notice in writing, and if the City does not give notice in writing to the Contractor to resume work at a date within 90 days of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work suspended and will be entitled to the estimates and payments for all work done on the portions abandoned, if any, plus 10% of the value of the work abandoned, to compensate for loss of overhead, plant expense, and anticipated profit.

Section 21 - Delays and the City's Right to Terminate Contract

If the Contractor refuses or fails to prosecute the work, or any separate part of it, with the diligence required to insure completion, ready for operation, within the allowable number of consecutive calendar days specified plus extensions, or fails to complete the work within the required time, the City may, by written notice to the Contractor, terminate its right to proceed with the work or any part of the work as to which there has been delay. After providing the notice the City may take over the work and prosecute it to completion, by contract or otherwise, and the Contractor and its sureties shall be liable to the City for any excess cost to the City. If the Contractor's right to proceed is terminated, the City may take possession of and utilize in completing the work, any materials, appliances and plant as may be on the site of the work and useful for completing the work. The right of the Contractor to proceed shall not be terminated or the Contractor charged with liquidated damages where an extension of time is granted under Extension of Time - Section 14.

If the Contractor is adjudged a bankrupt, or if it makes a general assignment for the benefit of creditors, or if a receiver is appointed on account of its insolvency, or if it persistently or repeatedly refuses or fails except in cases for which extension of time is provided, to supply enough properly skilled workers or proper materials, or if it fails to make prompt payments to subcontractors or for material or labor, or persistently disregards laws, ordinances or the instructions of the Supervising Professional, or otherwise is guilty of a substantial violation of any provision of the Contract, then the City, upon the certificate of the Supervising Professional that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor 3 days written notice, terminate this Contract. The City may then take possession of the premises and of all materials, tools and appliances thereon and without prejudice to any other remedy it may have, make good the deficiencies or finish the work by whatever method it may deem expedient, and deduct the cost from the payment due the Contractor. The Contractor shall not be entitled to receive any further payment until the work is finished. If the expense of finishing the work, including compensation for additional managerial and administrative services exceeds the unpaid balance of the Contract Sum, the Contractor and its surety are liable to the City for any excess cost incurred. The expense incurred by the City, and the damage incurred through the Contractor's default, shall be certified by the Supervising Professional.

Section 22 - Contractor's Right to Terminate Contract

If the work should be stopped under an order of any court, or other public authority, for a period of 3 months, through no act or fault of the Contractor or of anyone employed by it, then the Contractor may, upon 7 days written notice to the City, terminate this Contract and recover from the City payment for all acceptable work executed plus reasonable profit.

Section 23 - City's Right To Do Work

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, the City, 3 days after giving written notice to the Contractor and its surety may, without prejudice to any other remedy the City may have, make good the deficiencies and may deduct the cost from the payment due to the Contractor.

Section 24 - Removal of Equipment and Supplies

In case of termination of this Contract before completion, from any or no cause, the Contractor, if notified to do so by the City, shall promptly remove any part or all of its equipment and supplies from the property of the City, failing which the City shall have the right to remove the equipment and supplies at the expense of the Contractor.

The removed equipment and supplies may be stored by the City and, if all costs of removal and storage are not paid by the Contractor within 10 days of invoicing, the City upon 10 days written notice may sell the equipment and supplies at auction or private sale, and shall pay the Contractor the net proceeds after deducting all costs and expenses that should have been borne by the Contractor and after deducting all amounts claimed due by any lien holder of the equipment or supplies.

Section 25 - Responsibility for Work and Warranties

The Contractor assumes full responsibility for any and all materials and equipment used in the construction of the work and may not make claims against the City for damages to materials and equipment from any cause except negligence or willful act of the City. Until its final acceptance, the Contractor shall be responsible for damage to or destruction of the project (except for any part covered by Partial Completion and Acceptance - Section 26). The Contractor shall make good all work damaged or destroyed before acceptance. All risk of loss remains with the Contractor until final acceptance of the work (Section 19) or partial acceptance (Section 26). The Contractor is advised to investigate obtaining its own builders risk insurance.

The Contractor shall guarantee the quality of the work for a period of one year. The Contractor shall also unconditionally guarantee the quality of all equipment and materials that are furnished and installed under the contract for a period of one year. At the end of one year after the Contractor's receipt of final payment, the complete work, including equipment and materials furnished and installed under the contract, shall be inspected by the Contractor and the Supervising Professional. Any defects shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days. Any defects that are identified prior to the end of one year shall also be inspected by the Contractor and the Supervising Professional and shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days. The Contractor shall assign all manufacturer or material supplier warranties to the City prior to final payment. The assignment shall not relieve the Contractor of its obligations under this paragraph to correct defects.

Section 26 - Partial Completion and Acceptance

If at any time prior to the issuance of the final certificate referred to in Acceptance and Final Payment - Section 19, any portion of the permanent construction has been satisfactorily completed, and if the Supervising Professional determines that portion of the permanent construction is not required for the operations of the Contractor but is needed by the City, the Supervising Professional shall issue to the Contractor a certificate of partial completion, and immediately the City may take over and use the portion of the permanent construction described in the certificate, and exclude the Contractor from that portion.

The issuance of a certificate of partial completion shall not constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates if the Contractor has failed to complete it in accordance with the terms of this Contract. The issuance of the certificate shall not release the Contractor or its sureties from any obligations under this Contract including bonds.

If prior use increases the cost of, or delays the work, the Contractor shall be entitled to extra compensation, or extension of time, or both, as the Supervising Professional may determine.

Section 27 - Payments Withheld Prior to Final Acceptance of Work

The City may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any certificate to the extent reasonably appropriate to protect the City from loss on account of:

(1) Defective work not remedied;

(2) Claims filed or reasonable evidence indicating probable filing of claims by other parties against the Contractor;

(3) Failure of the Contractor to make payments properly to subcontractors or for material or labor;

(4) Damage to another Contractor.

When the above grounds are removed or the Contractor provides a Surety Bond satisfactory to the City which will protect the City in the amount withheld, payment shall be made for amounts withheld under this section.

Section 28 - Contractor's Insurance

(1) The Contractor shall procure and maintain during the life of this Contract, including the guarantee period and during any warranty work, such insurance policies, including those set forth below, as will protect itself and the City from all claims for bodily injuries, death or property damage that may arise under this Contract; whether the act(s) or omission(s) giving rise to the claim were made by the Contractor, any subcontractor, or anyone employed by them directly or indirectly. Prior to commencement of any work under this contract, Contractor shall provide to the City documentation satisfactory to the City, through City-approved means (currently myCOI), demonstrating it has obtained the required policies and endorsements. The certificates of insurance endorsements and/or copies of

policy language shall document that the Contractor satisfies the following minimum requirements. Contractor shall add registration@mycoitracking.com to its safe sender's list so that it will receive necessary communication from myCOI. When requested, Contractor shall provide the same documentation for its subcontractor(s) (if any).

Required insurance policies include:

(a) Worker's Compensation Insurance in accordance with all applicable state and federal statutes. Further, Employers Liability Coverage shall be obtained in the following minimum amounts:

Bodily Injury by Accident - $500,000 each accident
Bodily Injury by Disease - $500,000 each employee
Bodily Injury by Disease - $500,000 each policy limit

(b) Commercial General Liability Insurance equivalent to, as a minimum, Insurance Services Office form CG 00 01 04 13 or current equivalent. The City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements specifically for the following coverages: Products and Completed Operations, Explosion, Collapse and Underground coverage or Pollution. Further there shall be no added exclusions or limiting endorsements that diminish the City's protections as an additional insured under the policy. The following minimum limits of liability are required:

$1,000,000	Each occurrence as respect Bodily Injury Liability or Property Damage Liability, or both combined.
$2,000,000	Per Project General Aggregate
$1,000,000	Personal and Advertising Injury
$2,000,000	Products and Completed Operations Aggregate

(c) Motor Vehicle Liability Insurance, including Michigan No-Fault Coverages, equivalent to, as a minimum, Insurance Services Office form CA 00 01 10 13 or current equivalent. Coverage shall include all owned vehicles, all non-owned vehicles and all hired vehicles. The City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements that diminish the City's protections as an additional insured under the policy. Further, the limits of liability shall be $1,000,000 for each occurrence as respects Bodily Injury Liability or Property Damage Liability, or both combined.

(d) Umbrella/Excess Liability Insurance shall be provided to apply excess of the Commercial General Liability, Employers Liability and the Motor Vehicle coverage enumerated above, for each occurrence and for aggregate in the amount of $1,000,000.

(2) Insurance required under subsection (1)(b) and (1)(c) above shall be considered primary as respects any other valid or collectible insurance that the City may possess, including any self-insured retentions the City may have; and any other insurance the City does possess shall be considered excess insurance only and shall not be required to contribute with this insurance. Further, the Contractor agrees to waive any right of recovery by its insurer against the City for any insurance listed herein.

(3) Insurance companies and policy forms are subject to approval of the City Attorney, which approval shall not be unreasonably withheld. Documentation must provide and demonstrate an unconditional and un-qualified 30-day written notice of cancellation in favor of the City of Ann Arbor. Further, the documentation must explicitly state the following: (a) the policy number(s); name of insurance company(s); name and address of the agent(s) or authorized representative(s); name(s), email address(es), and address of insured; project name; policy expiration date; and specific coverage amounts; (b) any deductibles or self-insured retentions which may be approved by the City, in its sole discretion; (c) that the policy conforms to the requirements specified Contractor shall furnish the City with satisfactory certificates of insurance and endorsements prior to commencement of any work. Upon request, the Contractor shall provide within 30 days a copy of the policy(ies) and all required endorsements to the City. If any of the above coverages expire by their terms during the term of this Contract, the Contractor shall deliver proof of renewal and/or new policies and endorsements to the Administering Service Area/Unit at least ten days prior to the expiration date.

(4) Any Insurance provider of Contractor shall be authorized to do business in the State of Michigan and shall carry and maintain a minimum rating assigned by A.M. Best & Company's Key Rating Guide of "A-" Overall and a minimum Financial Size Category of "V". Insurance policies and certificates issued by non-authorized insurance companies are not acceptable unless approved in writing by the City.

(5) City reserves the right to require additional coverage and/or coverage amounts as may be included from time to time in the Detailed Specifications for the Project.

(6) The provisions of General Condition 28 shall survive the expiration or earlier termination of this contract for any reason.

Section 29 - Surety Bonds

Bonds will be required from the successful bidder as follows:

(1) A Performance Bond to the City of Ann Arbor for the amount of the bid(s) accepted;
(2) A Labor and Material Bond to the City of Ann Arbor for the amount of the bid(s) accepted.

Bonds shall be executed on forms supplied by the City in a manner and by a Surety Company authorized to transact business in Michigan and satisfactory to the City Attorney.

Section 30 - Damage Claims

The Contractor shall be held responsible for all damages to property of the City or others, caused by or resulting from the negligence of the Contractor, its employees, or agents during the progress of or connected with the prosecution of the work, whether within the limits of the work or elsewhere. The Contractor must restore all property injured including sidewalks, curbing, sodding, pipes, conduit, sewers or other public or private property to not less than its original condition with new work.

Section 31 - Refusal to Obey Instructions

If the Contractor refuses to obey the instructions of the Supervising Professional, the Supervising Professional shall withdraw inspection from the work, and no payments will be made for work performed thereafter nor may work be performed thereafter until the Supervising Professional shall have again authorized the work to proceed.

Section 32 - Assignment

Neither party to the Contract shall assign the Contract without the written consent of the other. The Contractor may assign any monies due to it to a third party acceptable to the City.

Section 33 - Rights of Various Interests

Whenever work being done by the City's forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Supervising Professional, to secure the completion of the various portions of the work in general harmony.

The Contractor is responsible to coordinate all aspects of the work, including coordination of, and with, utility companies and other contractors whose work impacts this project.

Section 34 - Subcontracts

The Contractor shall not award any work to any subcontractor without prior written approval of the City. The approval will not be given until the Contractor submits to the City a written statement concerning the proposed award to the subcontractor. The statement shall contain all information the City may require.

The Contractor shall be as fully responsible to the City for the acts and omissions of its subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the General Conditions and all other contract documents applicable to the work of the subcontractors and to give the Contractor the same power to terminate any subcontract that the City may exercise over the Contractor under any provision of the contract documents.

Nothing contained in the contract documents shall create any contractual relation between any subcontractor and the City.

Section 35 - Supervising Professional's Status

The Supervising Professional has the right to inspect any or all work. The Supervising Professional has authority to stop the work whenever stoppage may be appropriate to insure the proper execution of the Contract. The Supervising Professional has the authority to reject all work and materials which do not conform to the Contract and to decide questions which arise in the execution of the work.

The Supervising Professional shall make all measurements and determinations of quantities. Those measurements and determinations are final and conclusive between the parties.

Section 36 - Supervising Professional's Decisions

The Supervising Professional shall, within a reasonable time after their presentation to the Supervising Professional, make decisions in writing on all claims of the City or the Contractor and on all other matters relating to the execution and progress of the work or the interpretation of the contract documents.

Section 37 - Storing Materials and Supplies

Materials and supplies may be stored at the site of the work at locations agreeable to the City unless specific exception is listed elsewhere in these documents. Ample way for foot traffic and drainage must be provided, and gutters must, at all times, be kept free from obstruction. Traffic on streets shall be interfered with as little as possible. The Contractor may not enter or occupy with agents, employees, tools, or material any private property without first obtaining written permission from its owner. A copy of the permission shall be furnished to the Supervising Professional.

Section 38 - Lands for Work

The Contractor shall provide, at its own expense and without liability to the City, any additional land and access that may be required for temporary construction facilities or for storage of materials.

Section 39 - Cleaning Up

The Contractor shall, as directed by the Supervising Professional, remove at its own expense from the City's property and from all public and private property all temporary structures, rubbish and waste materials resulting from its operations unless otherwise specifically approved, in writing, by the Supervising Professional.

Section 40 - Salvage

The Supervising Professional may designate for salvage any materials from existing structures or underground services. Materials so designated remain City property and shall be transported or stored at a location as the Supervising Professional may direct.

Section 41 - Night, Saturday or Sunday Work

No night or Sunday work (without prior written City approval) will be permitted except in the case of an emergency and then only to the extent absolutely necessary. The City may allow night work which, in the opinion of the Supervising Professional, can be satisfactorily performed at night. Night work is any work between 8:00 p.m. and 7:00 a.m. No Saturday work will be permitted unless the Contractor gives the Supervising Professional at least 48 hours but not more than 5 days notice of the Contractor's intention to work the upcoming Saturday.

Section 42 - Sales Taxes

Under State law the City is exempt from the assessment of State Sales Tax on its direct purchases. Contractors who acquire materials, equipment, supplies, etc. for incorporation in City projects are not likewise exempt. State Law shall prevail. The Bidder shall familiarize itself with the State Law and prepare its Bid accordingly. No extra payment will be allowed under this Contract for failure of the Contractor to make proper allowance in this bid for taxes it must pay.

Section 43

CONTRACTOR'S DECLARATION

I hereby declare that I have not, during the period _____, 20___, to _____, 20 , performed any work, furnished any materials, sustained any loss, damage or delay, or otherwise done anything in addition to the regular items (or executed change orders) set forth in the Contract titled _____, for which I shall ask, demand, sue for, or claim compensation or extension of time from the City, except as I hereby make claim for additional compensation or extension of time as set forth on the attached itemized statement. I further declare that I have paid all payroll obligations related to this Contract that have become due during the above period and that all invoices related to this Contract received more than 30 days prior to this declaration have been paid in full except as listed below.

There is/is not (Contractor please circle one and strike one as appropriate) an itemized statement attached regarding a request for additional compensation or extension of time.

_____ _____
Contractor Date

By _____
(Signature)

Its _____
(Title of Office)

Past due invoices, if any, are listed below.

Section 44

CONTRACTOR'S AFFIDAVIT

The undersigned Contractor,_____, represents that on _____, 20___, it was awarded a contract by the City of Ann Arbor, Michigan to_____ under the terms and conditions of a Contract titled _____. The Contractor represents that all work has now been accomplished and the Contract is complete.

The Contractor warrants and certifies that all of its indebtedness arising by reason of the Contract has been fully paid or satisfactorily secured; and that all claims from subcontractors and others for labor and material used in accomplishing the project, as well as all other claims arising from the performance of the Contract, have been fully paid or satisfactorily settled. The Contractor agrees that, if any claim should hereafter arise, it shall assume responsibility for it immediately upon request to do so by the City of Ann Arbor.

The Contractor, for valuable consideration received, does further waive, release and relinquish any and all claims or right of lien which the Contractor now has or may acquire upon the subject premises for labor and material used in the project owned by the City of Ann Arbor.

This affidavit is freely and voluntarily given with full knowledge of the facts.

_____ _____
Contractor Date

By _____
(Signature)

Its _____
(Title of Office)

Subscribed and sworn to before me, on this _____ day of _____, 20__
_____ , _____ County, Michigan
Notary Public
_____ County, MI
My commission expires on:

STANDARD SPECIFICATIONS

All work under this contract shall be performed in accordance with the Public Services Department Standard Specifications in effect at the date of availability of the contract documents stipulated in the Bid. All work under this Contract which is not included in these Standard Specifications, or which is performed using modifications to these Standard Specifications, shall be performed in accordance with the Detailed Specifications included in these contract documents.

Standard Specifications are available online:

http://www.a2gov.org/departments/engineering/Pages/Engineering-and-Contractor-Resources.aspx

DETAILED SPECIFICATIONS

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

1 of 8

a. General.- As detailed elsewhere in the Contract Documents and Drawings the work of this project is to be performed in a sensitive, valuable, natural area within the City of Ann Arbor (City). This Detailed Specification sets forth criteria that will be used by the City in determining if the Contractor has the necessary personnel, equipment, and experience to perform the work of this project.

b. Documentation to be provided.- The Contractor Qualifications detailed in this specification apply to the following items:

- Sewer Televising and Cleaning
- Cured-In-Place Pipe (CIPP) Lining
- Onsite Superintendent/Foreman

Contractor to complete the attached Reference Form and submit it as part of the bid submittal. **Not filling out the form or providing past experience may result in disqualification of the bid**. If subcontractors are to be used for any of the above items, they are to fill out a separate form.

The projects and total footage claimed to have been performed by the Contractor shall be supported by owner references. The Contractor shall submit information to document their experience.

1. **Sewer Televising and Cleaning.-** The Contractor performing the sewer televising and cleaning shall be fully qualified, experienced, and equipped to complete this work as shown on the Drawings and as indicated in the specifications. The Contractor shall have cleaned and televised a minimum of 100,000 lineal feet of sanitary sewers equal to or greater than 36 inches in diameter with lengths of the individual segments over 1,000 feet each in the past 7 years. The Contractor shall also have cleaned and televised at least 3 sanitary siphon sewers equal to or greater than 24 inches in diameter in the past 7 years. The Contractor shall have also worked a minimum of three projects in similar environmentally sensitive areas in the past 7 years. The Contractor shall provide detailed description of these environmentally sensitive projects and methods used to mitigate the work upon request of the Engineer.

2. **Sewer CIPP Lining.-** The Contractor performing the CIPP lining work shall be fully qualified, experienced, and equipped to complete this work expeditiously and in a satisfactory manner and shall be certified and/or licensed as an installer by the CIPP manufacturer. The Contractor shall have installed a minimum of 10,000 lineal feet of CIPP in sanitary sewers equal to or greater than 36 inches in diameter in the past 7 years and over 1,000,000 feet of lining in general over the past 7 years. Installations must have been in northern states and/or Canada. Contractor must also provide safety record for the past 7 years.

3. **Onsite Superintendent/Foreman.-** The full-time, onsite superintendent/ foreman shall be responsible for supervising all the work onsite, including but not limited to, the diversion of sanitary flow, bypass pumping, sewer televising and cleaning, and sewer CIPP lining, shall have supervised a minimum of 3 projects of this complexity in the past 7 years and shall have installed a minimum of 10,000 lineal feet of CIPP in sanitary sewers greater than 24 inches in diameter in the past 7 years.

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

2 of 8

1. Sewer Televising and Cleaning References
(Must be completed and submitted with Bid for consideration)

List sewer cleaning and televising projects of sewers equal to or greater than 36 inches in size that total (together) over 100,000 lineal feet with the lengths of the individual segments over 1,000 feet in the past 7 years and provide references. Also, list a minimum of 3 projects that include the cleaning and televising of the sanitary siphon sewers equal to or greater than 24 inches in size in the past 7 years and provide references. The Contractor shall have also worked a minimum of three projects in similar environmentally sensitive areas in the past 7 years.

Firm's Name: LANZO COMPANIES, INC.

Role on Project: PRIME CONTRACTOR / SUB CONTRACTOR

1.1. Client's Name: OAKLAND COUNTY WATER RESOURCES COMMISSIONER

Address: BUILDING 95 WEST, ONE PUBLIC WORKS DRIVE, WATERFORD, MI 48328

Contact Name: LAWRENCE GILBERT Contact Phone: (586) 469-5100

Type of Work: PROJECT NAME: OMIDDD SEGEMENT 4 REPAIR PROGRAM, CONTRACT 5

SCOPE OF WORK: REPAIR OF LOCALIZED CRACKS, FRACTURES USING CHEMICAL GROUT, INTERCEPTOR LINING AT SELECTED LOCATIONS, CLEANING, SEDIMENT REMOVAL AND CCTV INSPECTION.

Year Work Performed: 2015-2017 Work Amount ($): 9,303,900.00

1.2. Client's Name: OAKLAND COUNTY WATER RESOURCES COMMISSIONER

Address: BUILDING 95 WEST, ONE PUBLIC WORKS DRIVE, WATERFORD, MI 48328

Contact Name: GEORGE P. NICHOLS Contact Phone: (248) 975-9571

Type of Work: PROJECT NAME: OMIDDD SEGMENT 4 REPAIR; CONTRACT 6

SCOPE OF WORK: 14,100 LF OF CLENING, TELEVISING ; 5,400 LF OF 36" TO 48" INTERCEPTOR REHABILITATION THROUGH CURED-IN-PLACE PIPE LINING.

Year Work Performed: 2014-2017 Work Amount ($): 3,172,793.60

1.3. Client's Name: CITY OF HOLLYWOOD, FL

Address: 2600 HOLLYWOOD BLVD, HOLLYWOOD, FL 33020

Contact Name: JOSE POLANCO Contact Phone: (754) 208-9443

Type of Work: PROJECT NAME: GRAVITY SYSTEM CONDITION ASSESSMENT, RENEWAL & REPLACEMENT (I&I) PROGRAM LEVEL 2

SCOPE OF WORK: 13,762 LF OD 30" TO 48" CLEANING & TELEVISING. 110,834 LF OF 8" TO 48" CURED-IN-PLACE PIPE LINING

Year Work Performed: 2015-2017 Work Amount ($): 7,757,350.00

1.4. Client's Name: CITY OF HOLLYWOOD, FL

Address: 2600 HOLLYWOOD BLVD, HOLLYWOOD, FL 33020

Contact Name: JOSE POLANCO Contact Phone: (754) 208-9443

Type of Work: PROJECT NAME: TAFT STREET 60" SANITARY SEWER CIPP REHABILITATION

SCOPE OF WORK: CLEAN, TELEVISE AND CIPP REHAB OF 6,304 LF OF 60" SANITARY SEWER.

Year Work Performed: 2014 Work Amount ($): 2,484,295.35

1.5. Client's Name: MIAMI-DADE WATER & SEWER DEPARTMENT

Address: 3071 SW 38TH AVE, MIAMI, FL 33129

Contact Name: ALEXIS VALDES Contact Phone: (786) 552-4364

Type of Work: PROJECT NAME: INSTALLATION OF 4.1 MILES OF 54" FORCE MAIN (SUB CONTRACTOR TO LANZO CONSTRUCTION CO., FLORIDA)

SCOPE OF WORK: CLEANING & GROUTING OF 54" PCCP FORCE MAIN.

Year Work Performed: 2017-2018 Work Amount ($): 159,150.00

1.6. Client's Name: FLORIDA DEPT. OF TRANSPORTATION

Address: 719 SOUTH WOODLAND BLVD., DELAND, FL 32720

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

4 of 8

Contact Name: MICHAEL RANEY Contact Phone: (386) 740-3522

Type of Work: PROJECT NAME: E5T227 LINING & CLEANING OF VARIOUS SECTIONS OF STORM DRAINS

SCOPE OF WORK: 30" TO 48" CLEANING & TELEVISING - 4,805 LF

30" TO 48" CIPP LINING - 12,895 LF

Year Work Performed: 2015 Work Amount ($): 1,468,776.50

1.7. Client's Name: CITY OF WEST PALM BEACH

Address: 401 CLEMATIS STREET, WEST PALM BEACH, FL 33401

Contact Name: RUDY FERNANDEZ Contact Phone: (561) 882-5004

Type of Work: PROJECT NAME: 48" FORCE MAIN CIPP PHASE 2

SCOPE OF WORK: CLEANING, CCTV & CIPP OF 6,400 LF OF 48" FORCE MAIN

Year Work Performed: 2016-2018 Work Amount ($): 7,089,516.28

1.8 CLIENT'S NAME: WESTERN TOWNSHIP, MI
ADDRESS: 40905 JOY ROAD, CANTON, MI 48187
CONTACT NAME: CHRIS ELENBAAS PHONE: (734) 761-1010
TYPE OF WORK: PROJECT NAME - HAGGERTY ROAD 48" CIPP REHABILITATION
SCOPE OF WORK: CLEANING, TELEVISING & CIPP REHAB OF 4,350 LF OF 48" SANITARY SEWER

YEAR PERFORMED: 2013 WORK AMOUNT($): 1,491,635.32

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

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2. Sewer CIPP Lining References
(Must be completed and submitted with Bid for consideration)

List sewer CIPP lining projects of sewers equal to or greater than 36 inches in diameter that total (together) over 10,000 lineal feet in northern states and/or Canada in the past 7 years and over 1,000,000 feet of lining in general over the past 7 years, and provide references. Also, provide safety record for the past 7 years as an attachment.

Firm's Name: LANZO COMPANIES, INC.

Role on Project: PRIME CONTRACTOR

2.1. Client's Name: OAKLAND COUNTY WATER RESOURCES COMMISSIONER

Address: BUILDING 95 WEST, ONE PUBLIC WORKS DRIVE, WATERFORD, MI 48328

Contact Name: GEROGE P. NICHOLS Contact Phone: (248) 975-9571

Type of Work: PROJECT NAME: OMIDDD SEGMENT 4 REPAIR; CONTRACT 6

SCOPE PF WORK: 14,100 LF OF CLEANING & 5,400 LF OF 36" TO 48" INTERCEPTOR REHAB.

Year Work Performed: 2014-2017 Work Amount ($): 3,172,793.60

2.2. Client's Name: CITY OF HOLLYWOOD, FL

Address: 2600 HOLLYWOOD BLVD., HOLLYWOOD, FL 33020

Contact Name: JOSE POLANCO Contact Phone: (754) 208-9443

Type of Work: PROJECT NAME: GRAVITY SYSTEM CONDITIONAL ASSESSMENT, RENEWAL & REPLACEMENT (I&I) PROGRAM LEVEL 2

SCOPE OF WORK: 13,762 LF OF 30" TO 48" CLEAN & CCTV; 110,834 LF OF 30" TO 48" CIPP LINING

Year Work Performed: 2015-2017 Work Amount ($): 7,757,350.00

2.3. Client's Name: CITY OF HOLLYWOOD, FL

Address: 2600 HOLLYWOOD BLVD., HOLLYWOOD, FL 33020

Contact Name: JOSE POLANCO Contact Phone: (754) 208-9443

Type of Work: PROJECT NAME: TAFT STREET 60" SANITARY SEWER CIPP REHABILITATION

SCOPE OF WORK: 60" CLEAN, TELEVISE & CIPP REHAB - 6,340 LF

Year Work Performed: 2014 Work Amount ($): 2,484,295.35

2.4. Client's Name: FLORIDA DEPT. OF TRANSPORTATION

Address: 719 SOUTH WOODLAND BLVD., DELAND, FL 32720

Contact Name: MICHAEL RANEY Contact Phone: (386) 740-3522

Type of Work: PROJECT NAME: E5T227 LINING & CLEANING OF VARIOUS SECTIONS OF STORM DRAINS

SCOPE OF WORK: 30" TO 48" CLEANING - 4,850 LF; 15" TO 48" CIPP LINING OF 12,895 LF

Year Work Performed: 2015 Work Amount ($): 1,468,776.50

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

7 of 8

3. Onsite Superintendent/Foreman
(Must be completed and submitted with Bid for consideration)

List name of onsite superintendent/foreman and list a minimum of 3 projects of similar complexity totaling 10,000 lineal feet of CIPP lining in sanitary sewers greater than 24 inches in diameter that they have supervised in the past 7 years and provide references.

Superintendent/Foreman Name: PAUL TORRES, JR.

3.1. Client's Name: OAKLAND COUNTY WATER RESOURCES COMMISSIONER

Address: BUILDING 95 WEST, ONE PUBLIC WORKS DRIVE, WATERFORD, MI 48328

Contact Name: LAWRENCE GILBERT Contact Phone: (586) 469-5100

Type of Work: PROJECT NAME: OMIDDD SEGEMENT 4 REPAIR PROGRAM, CONTRACT 5

SCOPE OF WORK: REPAIR OF LOCALIZED CRACKS, FRACTURES USING CHEMICAL GROUT, INTERCEPTOR LINING AT SELECTED LOCATIONS, CLEANING, SEDIMENT REMOVAL AND CCTV INSPECTION.

Year Work Performed: 2015-2017 Work Amount ($): 9,303,900.00

3.2. Client's Name: OAKLAND COUNTY WATER RESOURCES COMMISSIONER

Address: BUILDING 95 WEST, ONE PUBLIC WORKS DRIVE, WATERFORD, MI 48328

Contact Name: GEORGE P. NICHOLS Contact Phone: (248) 975-9571

Type of Work: PROJECT NAME: OMIDDD SEGMENT 4 REPAIR; CONTRACT 6

SCOPE OF WORK: 14,100 LF OF CLENING, TELEVISING ; 5,400 LF OF 36" TO 48" INTERCEPTOR REHABILITATION THROUGH CURED-IN-PLACE PIPE LINING.

Year Work Performed: 2014-2017 Work Amount ($): 3,172,793.60

3.3. Client's Name: WESTERN TOWNSHIP, MI

Address: 40905 JOY ROAD, CANTON, MI 48187

Contact Name: CHRIS ELENBAAS Contact Phone: (734) 761-1010

Type of Work: PROJECT NAME - HAGGERTY ROAD 48" CIPP REHABILITATION

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

SCOPE OF WORK: CLEANING, TELEVISING & CIPP REHAB OF 4,350 LF OF 48" SANITARY SEWER

Year Work Performed: 2013 Work Amount ($): 1,491,635.32

3.4. Client's Name: CITY OF BIRMINGHAM, MI

Address: 151 MARTIN STREET, BIRMINGHAM, MI 48307

Contact Name: PAUL O'MEARA Contact Phone: (248) 530-1836

Type of Work: PROJECT NAME: BIRMINGHAM 2017 SEWER LINING PROGRAM
SCOPE OF WORK: CLEAN, TELEVISE AND CIPP LINING OF 6" TO 21" SANITARY SEWER OF 12,000 LF

Year Work Performed: 2018-2019 Work Amount ($): 786,997.00

3.5 CLIENT'S NAME: CLINTON TOWNSHIP, MI
ADDRESS: 40700 ROMEO PLANK, CLINTON TOWNSHIP, MI 48038
CONTACT NAME: SCOTT CHABOT PHONE: (586) 726-1234
TYPE OF WORK: PROJECT NAME - CLINTON TOWNSHIP SANITARY SEWER REHAB
SCOPE OF WORK: CLEANING, TELEVISING & CIPP REHAB OF 16,815 LF OF 27" SANITARY SEWER

YEAR PERFORMED: 2018-2019 WORK AMOUNT($): 1,960,785.00

LN 2050 OAKLAND - MACOMB INTERCEPTOR DRAIN (OMID)
SEGMENT 4 REPAIR PROGRAM CONTRACT 5

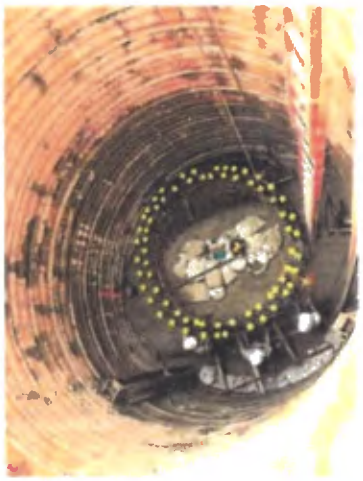
LANZO TRENCHLESS TECHNOLOGIES

OMID

Owner:
OCWRC
Building 95 West
One Public Works Drive
Waterford, Michigan 48328

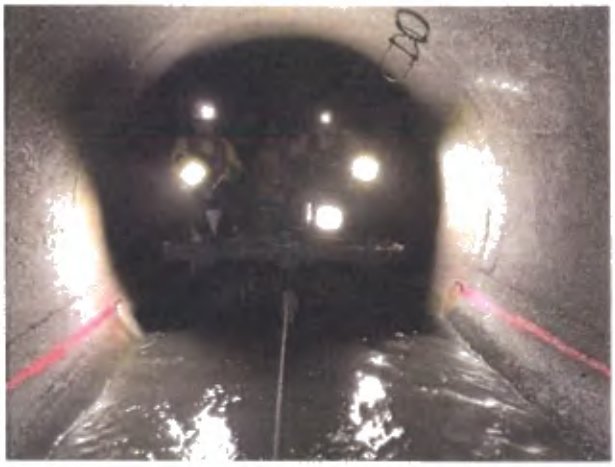
Owner Contact:
Lawrence Gilbert
(586) 469-5100

Final Project Amount
$9,303,900



Engineer:
Anderson Eckstein, and
Westrick, Inc.
51301 Schoenherr Rd.
Shelby Charter Township, MI
48315

Start Date: April 2015
Completion: December 2017



Contract 5 repair work is located along the Oakland Arm Interceptor in PCI-9 and PCI-10A/B extending mostly along Utica Road in the cities of Sterling Heights and Utica and the Township of Shelby. PCI-10A/B reaches of sewer extend through the southern and northern parts (respectively) of a nature preserve, now comprised of River bends Park and Holland Ponds Park.

The scope of work included the construction of 2 access shafts on each end of the project approximately 8 miles apart to afford access for the main equipment used for the rehabilitation project. These shafts were dropped over the pipe and the pipe was cut away for this purpose. Structural repairs to the tunnel included patching a breach in the wall located in the PCI-9 interceptor and repair of visible reinforcement and where reinforcement outline is visible. Also included in the scope of work is the injection of cementitious grout from within the tunnel in areas with suspected voids surrounding the interceptor, seal running and gushing leaks with chemical grout. Existing access manholes required modification and restoration. Repair of localized cracks and fractures using chemical grout, interceptor lining of selected locations and CCTV inspection after completion of repairs.

LN 2046 OAKLAND-MACOMB INTERCEPTOR DRAIN (OMID)
SEGMENT 4 REPAIR PROGRAM CONTRACT 6

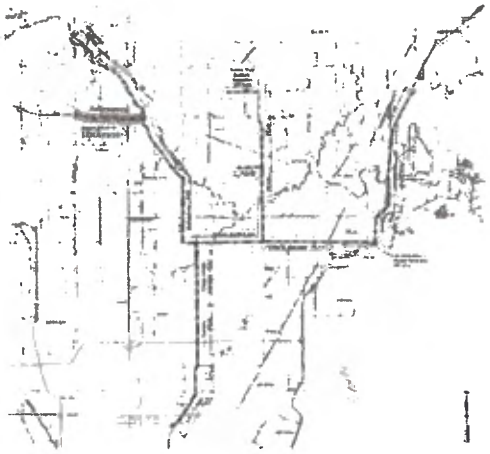
LANZO TRENCHLESS TECHNOLOGIES

Oakland - Macomb

Owner
Oakland-Macomb Interceptor
Drain Drainage District
Building 95 West- One Public
Works Drive
Waterford, Michigan 48328-1907

Owner Contact
George P. Nichols
(248) 975-9571
nicholsg@oakgov.com

Final Project Amount:
$3,172,793.60



Engineer:
NTH Consultants, Ltd.
2000 Brush Street
Detroit, Michigan 48226

Start Date: December 2014
Completion Date: December 2017

Contract 6 repair work is located along the Avon Arm Interceptor in PCI-11A extending mostly along Dobry Drive. Work included the installation of 5,400 LF of Cured In Place Liner of 36" to 48" interceptor, 14,100LF of Cleaning & TV. The scope of work included gaining access for Structural repairs to the interceptor included patching a breach in the wall & repair of visible reinforcement.Also included in the scope of work is the injection of cementitious grout from within the pipe in areas with suspected voids surrounding the interceptor, seal running and gushing leaks with chemical grout. Existing access manholes required modification and restoration. Repair of localized cracks and fractures using chemical grout, interceptor lining of selected locations and CCTV inspection after completion of repairs.

LL683 Gravity Sewer System Condition Assessment & Renewal & Replacement (I/I) Program Level 2

LANZO TRENCHLESS TECHNOLOGIES

City of Hollywood

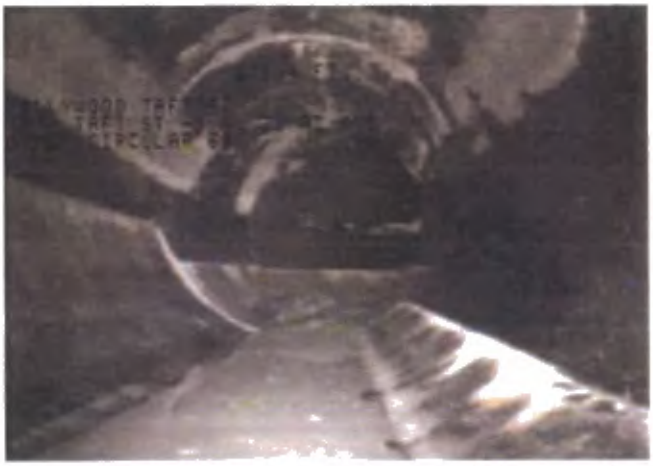
Owner
City of Hollywood
2600 Hollywood Boulevard
Hollywood, FL 33020

Owner Contact
Jose Polanco
(754) 208-9443
jpolanco@hollywoodfl.org

City of HOLLYWOOD FLORIDA

Start Date: April 2015
Completion Date: Sept 2017

Final Project Amount:
$7,757,350.00



Lanzo Trenchless Technologies was the prime contractor for this project and self-performed most of the work associated. The project included obtaining permits associated with the project, traffic control and cleaning and CCTV investigation of the sewers, Cured-In-Place Pipe rehabilitation, point repairs, grouting & other incidental work. After review of the videos, Lanzo designed the liner tubes per ASTM specifications and installed the liners. Rehabilitation included 110,834LF of 8" to 48" Gravity Mains at varying depths. Many of the sewers on this project posed a difficult challenge due to the amount of ground water infiltration.

LN 2055 Battle Creek Sewer Interceptor Rehabilitation

City of Battle Creek, MI

LANZO NORTH TRENCHLESS TECHNOLOGIES

Delivering innovative trenchless technology solutions to rehabilitate the world's diverse infrastructure

Owner
City of Battle Creek,
10 N Division Suite 214,
Battle Creek, MI 49014

Steven Luoma,
Ph. No: (517) 203-5437

To Date Project Amount:
$1,170,300.00
Actual Contract Amount:
$1,503,484.00

Engineer:
Lockwood, Andrews and Newnam, Inc.
2121 University Drive, Suite 100,
Okemos, MI 48864

Start Date – January 2016
Completion Date: October 2016

This Project is located in Springfield, MI across the Kalamazoo river starting from Battle Creek wastewater treatment plant. The Scope of work included rehabilitation of 5,511 linear feet of 48-inch fully deteriorated sanitary sewer pipe through Cured-In-Place Pipe lining (CIPP), rehabilitation of sanitary manholes, sanitary sewer spot repairs and sanitary manhole repairs.

28137 Groesbeack Highway, Roseville, Michigan 48066
www.Lanzo.net

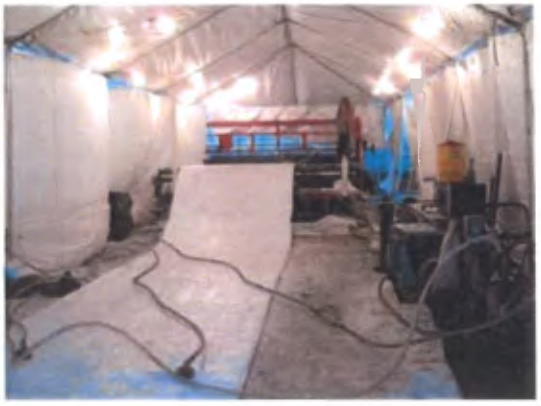
LN 2027 Western Township Haggerty Road 48-icnh Cured-In-Place Pipe Rehabilitation

LANZO TRENCHLESS TECHNOLOGIES

Western Township

Owner:
Western Township
40905 Joy Road
Canton, Michigan 48187

Final Project Amount
$1,491,635.32



Engineer:
Stantec Consulting Michigan
3754 Ranchero Drive
Ann Arbor, Michigan 48108

Chris Elenbaas
(734) 761-1010
Chris.elenbaas@stantec.com

Start Date – July 2013
Completion Date: Nov 2013

Provide equipment, materials and personnel to perform cleaning, CCTV and rehabilitation of sanitary sewers using the Cured-In Place pipe lining method. Work under this contract included 4,350 LF of 48" sanitary sewer located along Haggerty Road and Joy Road pavement. The 4,350 LF project included bypass, pipe cleaning and CCTV in addition to the over the hole CIPP liner installations.

LL654 Taft Street 60-inch Sanitary Sewer
Cured-In-Place Pipe Rehabilitation

City of Hollywood

Owner
City of Hollywood
2600 Hollywood Boulevard
Hollywood, FL 33020

Owner Contact
Jose Polanco
(954) 921-3930
jpolanco@hollywoodfl.org

Final Project Amount:
$2,484,295.35

Start Date: May 2014
Completion Date: Nov 2014

Lanzo Lining Services was the prime contractor for this project and self-performed all of the work associated. The project included any permits associated with the project, traffic control and cleaning and CCTV investigation of the sewers. After review of the videos, Lanzo designed the liner tubes per ASTM specifications and installed the liners. Many of the sewers on this project posed a difficult challenge due to the amount of ground water infiltration. Lanzo also engineered and installed a new 48" X 60" eccentric reducer. Lanzo also corrected multiple infiltration points in the line,caused by ground getting into the line. The size of these points ranged from pinholes to gushers like the one illustrated to the right.

LL 703 48-inch Force Main Cure-In-Place Pipe Lining
Phase 2 Contract No. 17673

City of West Palm Beach

LANZO TRENCHLESS TECHNOLOGIES

Owner
City of West Palm Beach
401 Clematis Street, 5th Floor
West Palm Beach, FL 33401

Owner Contact
Rudy Fernandez
(561) 882-5004
Rudy.Fernandez@jacobs.com

Final Project Amount:
$7,450,242.90

Contract Amount:
$7,089,516.28

Engineer:

Jacobs Engineering Group, Inc.
800 Fairway Dr. Suite #190
Deerfield Beach, FL 33441

Start Date: November 2, 2016
Completion Date: March 2018

This project was located from North Military Trail and Roebuck Road to Haverhill Road and Roebuck Road in West Palm Beach, Florida. An extensive bypass was needed to re-route the Force Main, using directional boring to partially bored under Military Trail. Four access pits were needed to being the installation of the Cured-In-Place pipe liner. These access pits measured 20 foot by 20 foot and were 20' deep. The CIPP installation could not be completed without installing the liner using the Wet Out over the Hole operation. Wet Over the Hole is a method used to impregnate the liner with chemicals on site, The liner was impregnated on site due to the weigh constrictions that the liner has if shipped from the manufactures. The 48-inch liner was inverted using water and cured using hot water that was circulated through each liner installation.

LN 2060 Birmingham 2017 Sewer Lining Program

City of Birmingham, Engineering Dept.

LANZO TRENCHLESS TECHNOLOGIES NORTH

Delivering innovative trenchless technology solutions to rehabilitate the world's diverse infrastructure

Owner
City of Birmingham,
151 Martin Street
Birmingham, MI 48307

Paul O'Meara
(248) 530-1836

To Date Project Amount
$786,997.00
Actual Contract Amount:
$786,997.00

Engineer:
Hubbell, Roth & Clark, Inc.
555 Hulet Drive,
Bloomfield Hills, MI 48303

Start Date – February 2018
Completion Date: May 2019

The Project was located on W Maple Road in Birmingham, Michigan. Cleaning and Televising was done from 6-inch to 21-inch Sewer followed by Cure-In-Place Pipe Rehabilitation. Leaks were sealed using Hydro Grouting. Manhole Joints were sealed and repaired. Fencing was done throughout the construction site.

This project includes cleaning and lining of various public sewers in three areas of Birmingham. Approximate quantities include 12,000 l.ft. of sewer lining, ranging in size from 6-inch to 21-inch diameter, minor manhole rehabilitation, plus other work to make a complete project. The CIPP rehabilitation was done through steam curing.

LN 2061 Clinton Township Sanitary Sewer Rehabilitation

Clinton Township, MI

LANZO NORTH
TRENCHLESS TECHNOLOGIES

Delivering innovative trenchless technology solutions to rehabilitate the world's diverse infrastructure

Owner
Charter Township of Clinton,
Clerk's Office,
40700 Romeo Plank,
Clinton Township, MI 48038

Scott Chabot, P.E.
(586) 726-1234

To Date Project Amount
$1,597,204.00
Actual Contract Amount:
$1,960,785.00

Engineer:
Anderson, Eckstein and Westrick, Inc.,
51301 Schoenherr Road,
Shelby Township, MI 48315

Start Date – April 2018
Completion Date: June 2019

This Project is located at the intersection of Canal Road and Garfield Road on Clinton Township, Michigan. The Scope of work included 16,815 Linear Feet of Cleaning and Televising from 10-inch to 27-inch of Sewer Pipe followed by Cure-In-Place Pipe Rehabilitation. Joints for various size pipe were tested and sealed. All the Sewer pipes getting rehabiltated were accompanied by By-pass Pumping. 1,250 SY of Pavement was restored. 15 Protruding Laterals were rapired and cut. The CIPP rehabilitation was done through steam curing system.

LL 684 FDOT Contract E5T27 Lining and Cleaning Various Sections of Storm Drains

LANZO TRENCHLESS TECHNOLOGIES

FDOT

Owner:
FDOT
719 South Woodland Boulevard
Deland, Florida 32720

Owner Contact:
Michael Raney
(386) 740-3524
Michael.Raney@dot.state.fl.us

Final Project Amount
$1,468,776.50

Engineer:
FDOT
719 South Woodland Boulevard
Deland, Florida 32720

Start Date: April 2015
Completion: September 2015

Lanzo Trenchless Technologies was the prime contractor for this project and self-performed 90% of the project. The project consisted of approx. 12,895LF of 15" to 48" diameter storm sewers, inclusive of any permits associated with the project, traffic control and cleaning and CCTV investigation of the sewers. After review of the videos, Lanzo designed the liner tubes per ASTM specifications and installed the liners. Many of the Sewers on this project posed a difficult challenge due to the amount of ground water infiltration. Lanzo also exposed and installed three (3) Manhole cover and frames to accommodate the lining of newly discovered conflict sewers.

LL 708 City of Ft. Lauderdale, Wastewater Conveyance System
Long-term Rehabilitation Program RFQ 466-11799, Project #12214

City of Fort Lauderdale

Owner
City of Fort Lauderdale
100 N Andrews Ave,
Fort Lauderdale, FL 33301

Owner Contact
Jean Examond
JExamond@fortlauderdale.gov
Phone: 954-828-4507

Engineer:
City of Fort Lauderdale
100 N Andrews Ave,
Fort Lauderdale, FL 33301

Start Date: January 2017
Contract Expiration: January 2020

Contract Amount:
$1,567,620.00

Lanzo Trenchless Technologies Inc South was the Prime Contractor on this project, and the scope of work included providing sanitary sewer rehabilitation for a continuing contract for the wastewater conveyance system long-term rehabilitation program on an as-needed basis as authorized by individual task orders for individual projects which includes the sanitary sewer rehabilitation of the conveyance systems for pump stations, and related work as needed at various locations throughout the City and the City's utility service area. Work was commonly stipulated to be performed on City roadways and right-of-ways, residential streets, as well as County and State roads. As of date there have been 3 work order issuances for this contract for a total amount of $854,468.00 with actual scope work including but not limited to 8", 10" & 15" Main Line Lining, Cleaning & Televising, Root Removal, and Lateral Lining.

Experience

Experience

Company Background

Lanzo Trenchless Technologies is a Michigan Based general contractor and engineering company specializing in infrastructure, construction, and rehabilitation services.
Lanzo Trenchless Technologies is a part of the D'Alessandro family of construction companies which are deeply rooted in the history of Michigan's construction tradition and was established over fifty (50) years ago. Lanzo encompasses a dynamic group of individuals that have come together to form one of the most progressive construction companies in the industry. Lanzo has formed alliances based on quality and integrity with customers throughout the country. Lanzo employs a highly diversified staff of over 160 people and provides a full range of construction services and contracting capabilities.

Lanzo has demonstrated the ability and the resources required for the construction management and successful completion of a variety of construction services including:

- Water Transmission and Wastewater Collection Systems
- Water and Wastewater Treatment Plant Construction
- Roads & Highway Construction
- Site work & Civil Construction
- Marine Construction
- Utility Construction
- Demolition
- Sewer/Watermain Rehabilitation
- HOBAS and HDPE Discrete Slip-lining
- Point Repairs, Emergency Repair Services, and Open-cut Excavation
- Pipe Bursting using fusion weld HDPE or fusion weld PVC liners
- Fully Deteriorated "Stand Alone" Rehabilitation of Pipes using the full range of Trenchless Technologies

Lanzo's staff of experienced professionals and skilled trade people has performed many annual and emergency projects with similar requirements contained within this RFP in various regions throughout the United States. With hundreds of small and large projects successfully completed, Lanzo uses its capabilities and experience to provide innovative solutions for the most complicated projects, and ensures that each project is completed on time, under budget, and built safely to the quality expectations of the customer. Lanzo delivers a multitude of self-perform capabilities, maintains its own local fleet of equipment.

Since 1993 Lanzo Trenchless Technologies has provided a cost-effective, less invasive alternative to replacing failing underground infrastructure through a multitude of trenchless methods. They were one of the first companies worldwide to use trenchless methodologies and they continue to lead the industry with innovation in design, expertise, and experience. Lanzo maintains that spirit of innovation by constantly expanding its services, equipment, and methods to deliver high quality and long-term solutions to private and public-sector clients. Time-tested and proven experience in all forms of cured-in-place pipe lining methodologies (CIPP) has established Lanzo as one of the premier lining contractors in the U.S. with a reputation for completing difficult work which has grown worldwide.

Experience

To date, Lanzo Trenchless Technologies has installed over fifteen million (15,000,000) lineal feet of sanitary sewer, force main, storm drain, NSF 61 potable water transmission, large diameter and non-circular CIPP applications throughout North America including over 4,000,000LF in wastewater collection systems within the past 5 years.

With its local presence, which includes a fully integrated state of the art wet out facility; Lanzo stands ready to meet the challenges posed by any municipalities rehabilitation initiative. Since 1993 this company has been the most responsive rehabilitation contractor capable of reacting in the shortest time to a myriad of needs including sewer breaks, collapses, watermain emergencies, and issues requiring an imminent response.

Lanzo has been instrumental throughout the US with many complex design build and emergency repairs one example of unique work is the rehabilitation of 22 outfalls in the City of Detroit. These combined sanitary and storm sewer outfalls ranged in size from 36" to 84" diameters that were fully deteriorated and some over 100 years old. This work uniquely demonstrates the complexity and diversity of Lanzo's capabilities with over 20,000 linear feet of lining on this project alone.

Lanzo Trenchless Technologies owes its success to an emphasis on safety, consideration of the community, and quality installation by experienced crews. Based upon our conservative design and superior resins utilized; we provide third party testing as well as an unprecedented unconditional five (5) year warranty on all technologies provided for herein.

Lanzo Trenchless Technologies delivers a multitude of self-perform capabilities, maintains its own local fleet of equipment. Lanzo provides to its customers a distinct advantage through operating two state of the art wet out facilities both in Michigan and Florida. The Florida and Michigan facilities have produced over ten million (10,000,000) Lineal feet of CIPP meeting ASTM F-1216 and ASTM F-1743 without failure during these past twenty (24) years.

- **Cured-In-Place Pipe Lining (CIPP):** Lanzo Trenchless Technologies is uniquely positioned as one of the most experienced cured-in-place installers in the world. Considered 'pioneers' in the industry, our initial introduction to the trenchless technology industry was during a time when direct inversion methods, as described in the ASTM F-1216, were not "public domain". As one of the industry's original in-liner licensees, Lanzo was actively engaged in the creation and ratification of ASTM F-1743 that describes the pull and invert method. At that time, the pull and invert method was considered an alternate. It has since been specified and utilized successfully by Lanzo Trenchless Technologies as well as other contractors in what are now tens of millions of feet of installations.

  Today we offer both direct inversion and pull and invert technologies depending on which is best suited for the application. We also offer remote impregnated epoxy, UV light, steam and ambient cured methods. With millions of feet installation experience in all technologies, Lanzo can offer valuable insight and comparisons while providing solution scenarios to meet your community's environmental, timing, and budget objectives.

LANZO TRENCHLESS TECHNOLOGIES

Experience

- **Large Bore Sewer, Storm Drain & Non-Circular Pipeline Repair:** Lanzo Trenchless Technologies has a reputation for taking on and successfully completing the most challenging underground renovation applications like those found in large bore, sewer, and storm drain applications. Large diameter and non-circular installations of CIPP, Carbon Fiber, and Structural Foam materials require a more thorough understanding of project specifics as well as design and application

- **NSF 61 Water Main Rehab:** All potable water main repairs must be NSF 61 certified to insure all products compliance with recognized safety measures. Due to the potential impact to the community, water main rehabilitation projects demand the most experienced installers. Lanzo Trenchless Technologies offers several CIPP repair methods that are certified, fully structural, and proven in stand-alone applications for water main renewal or catastrophic repair and rehabilitation.

- **Carbon Fiber:** The most significant advancement in the field of CIPP within the past decade has been the implementation of a space aged technology known as sequential carbon fiber epoxy or "Carbon Fiber Rehabilitation". This method has been implemented to preempt catastrophic line breaks in PCCP large diameter water and pressure mains throughout the United States. Lanzo remains one (1) of only two (2) companies nationally qualified, licensed, and certified to provide this preemptive rehabilitation method.

- **Segmental and Glass Panel Liners:** Lanzo has extensive experience with both segmental, as well as, glass panel liners which allow our CIPP technology to be adapted to applications requiring bends, transitions, and non-circular installation. Our product options include GRP, Cellular Foam, as well as Polymer Concrete. Be assured that we are staffed and ready to provide the turnkey services required on any of the most challenging combinations of shapes and configurations of your fully structural "stand alone" requirements.

- **Slip Lining:** Lanzo Trenchless Technologies proudly received an award from for installation of the worlds "Largest application" of HDPE in its eight thousand (8,000) linear foot singular Fusion Weld seventy-two (72") project for Miami Dade Water and Sewer Department (WASD). Lanzo has enjoyed decades of success including miles of Large Bore HDPE, Hobas, and Fusion Weld products including several projects for DWSD. We remain a licensed installer of Sekisui SPR (spiral wound) PVC, Sekisui Norditube, RS Technic Citiliner and have proprietary access to breaking products such as Fusion Weld PVC among others.

- **Pipe Bursting:** Lanzo has installed over a quarter million (250,000') linear feet of various Pipe Bursting applications including Sanitary Sewer Laterals, Mainlines, and Watermains.

- **Manhole & Tunnel Renovation:** With over 100 alternative manhole rehabilitation methods available, the common denominators in determining a successful manhole or tunnel rehabilitation include experience and careful analysis of the site-specific criteria. While many materials may prove to be suitable solutions "in a lab", for the harsh sulfide

gas, industrial chemical, and adverse temperature environments, the real test comes in the field where materials, along with Lanzo expertise, and workmanship come together for long term solutions.

- **Pipeline Cleaning & CCTV Video Inspection:** With the advent of the Pipeline Assessment and Certification Program (PACP), along with the established defect classification protocol, we have entered a new era of pipeline inspection. However, before lines can be televised for inspection, they must be properly cleaned. Lanzo Trenchless Technologies has been directly involved in the preparation of over 8 million feet of pipeline ranging in size from 4" through 144" in gravity, pressure, municipal, and industrial applications. Whether we are desilting a vitrified clay sewer pipe or detuberculating a cast iron water main, the pipe must be made ready for accurate documentation of all defects, anomalies, and services encountered. Lanzo Trenchless Technologies is certified and qualified to perform cleaning and PACP certified CCTV-Video inspection services on all infrastructure rehabilitation applications.

North American Society for Trenchless Technology
2007 No-Dig Conference & Exhibition

San Diego, California
April 16-19, 2007

Large Bore Rectangular Box Culvert and Non Circular Rehabilitation with CIPP

Fred Tingberg Jr.[1]

[1] Lanzo Lining Services, Deerfield Beach, Fl / Roseville, MI

Abstract: This paper addresses the site specific challenges that lie inherent in rehabilitating large diameter non circular pipe and concrete box culverts using the cured in place pipe methods described in ASTM F 1216, as well as ASTM F 1743. This paper details the pipe preparation requirements including corner grouting to allow for fully deteriorated design modeling as a large bore non circular case. It focuses on several case histories detailing the design thru installation including a triple barrel renovation of a 8'-8" x 6'-0" rectangular box culvert. At the time of its installation, the triple barrel box was the largest cured in place installation of this kind in the world. This direct inversion installation using methods described in ASTM F 1216 utilized over one million pounds of isophtallic polyester resin. Due to the tubes being too large to transport over the highway; three (3) tubes, each measuring twelve hundred foot, were installed in a period of less than one month using the "over the hole" method of field wet out and inversion.

INTRODUCTION

There are many benefits available when considering cured in place pipe in non circular application. This rehabilitation method not only offers maximum retention of hydraulic storage potential, but it has been proven to increase flow capacity by reducing the systems Manning's coefficient. The unique ability of this rehabilitation method to take the shape of its container most often precludes the need to bridge problematic gaps or annular spaces (post rehabilitation) with substances such as grout.

Generally speaking, the risk associated with relying on post applied grout materials regard unfilled spaces between the liner and host. These types of voids not only make the resultant structure suspect, but offer capacity for the storage and flow of unwanted or detrimental contaminants. In many rehab methods, the regulation of grout pressures and a continuous flow of grout material between the profile of a rough liner exterior and a host pipe is far from an exact science. An example of an undesirable condition which may occur should a gap remain between the rehabilitation and the host pipe is the infamous "annular space". The detrimental effects of this phenomenon include a condition known as "piping" where flow may continue within the utility after rehabilitation between the liner and the host pipe. Although an internal video inspection may seem to reveal all is well, external to the liner pipe; water, silt, and other effluents may continue to flow while eroding the host pipeline and potentially undermining the soil envelope. Given the objective in trenchless rehabilitation to renew the host pipe to a full service life expectation of fifty (50) years or more; it is important to disallow such phenomenon.

A tremendous advantage afforded the designer of CIPP rehabilitations is the ability to rely on this method to accommodate inline diameter and directional changes efficiently and economically. This paper shall

document the successful fully deteriorated structural rehabilitation of large bore non circular pipeline and box culvert installations with both transitions and directional changes using cured in place pipe methods described in ASTM F 1216 and F 1743. Reliable grout methods for disallowing gaps, voids, and annular spaces shall be presented.

F 1216 vs. F 1743

With direct inversion becoming "public domain" in 1995, several experienced contractors were afforded the opportunity to obtain large bore experience with either method. There are some significant observations which should be noted as to where there may lie advantage in quality and/or installation efficiency when comparing these technologies.

ASTM F 1743 describes the pull in place of an impregnated tube followed by the inversion of a secondary constituent known as a calibration hose. ASTM F 1216 describes the direct inversion of an impregnated tube into the host pipe to be rehabilitated. Although, either method has been put to task in many large bore applications; the success of the repair invariably mirrors the experience of the installation crew, the quality of data extracted during the pre lining pipeline survey, pre lining pipeline preparation, and testing. This being stated, we point to Black Point WWTP, a Miami Dade Treatment Facility which was rehabilitated over ten (10) years ago using methods described in ASTM F 1743 (Figure 1). The failure mode in this 96" to 72" to 48" three tiered reducing concrete pipe oxygenation train was classic sulfide attack of the crown, "the father" of sanitary sewer pipe failures. This four hundred fifty (450) foot rehabilitation was allowed by staging a seven (7) day shutdown for each of the three critical treatment plants influent lines. Each pipe to be rehabilitated had three inline eccentric reducers, one ninety (90) degree, and two (2) forty five (45) degree bends. Further complicating matters was that each single shot transitioned from 44mm to 37.5mm to 24.0mm material containing approximately one hundred thousand (100,000) pounds of epoxy vinyl ester resin. Sufficed to say that attempting this rehabilitation with methods described in ASTM F 1216 could be compared to an Olympic gymnast coming off the uneven bars and "sticking the landing" after a routine with a difficulty factor of ten (10)!

After thorough cleaning and debris removal; pipeline preparation consisted of trowel filling all voids, cracks, and fissures with calcium aluminate cement. Although the structural properties of grout or cements utilized is not factored into the CIP tube design; it is important to achieve a continuous bearing surface insuring contact between the liner and host pipe at all places. The goal is to utilize a material which insures attaining the commonly achievable densities of compacted granular backfill or concrete. The ASTM F 1743 installation method allowed for the liner to be winched into place while a careful comparison could be made, in the pipe, between the position of the different material stages and the pipeline anomalies themselves. Once the tube was properly positioned; the inversion of a calibration hose ensued and a precise rehabilitation product was assured.

Conversely, in an outfall installation called B 29 on the Detroit River we encountered a 72" x 54" x60" three tiered transition over a one thousand (1000') foot distance rehabilitated using methods described in ASTM F 1216. A post rehabilitation inspection using both non destructive, as well as core sampling revealed the liner to be fully in contact with the host pipe throughout the length of the rehabilitation. The Judges.....9.9, 9.9, 10.0!

The parameters affecting successful inversion of a large bore rectangular box culvert or transitional CIPP installation include:

- Experience of the installation crew
- Pre inversion pipeline preparation
- Accurate survey data
- Testing

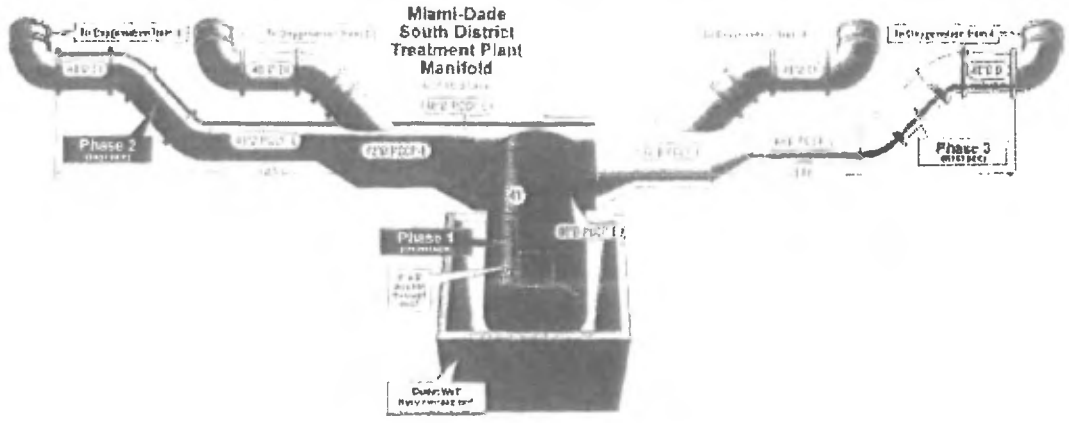


Figure 1 Transitional 96"x72"x48" Cured in Place Rehab favoring methods listed in ASTM F 1743

DESIGN CONSIDERATIONS

It is not the intent of this paper to spend a great deal of time rehashing the design methods stated in ASTM F 1216, ASTM F 1743, or the WRc Design Types 1 thru 3. Rather it is recommended that these designs be compared for applicability to the conditions encountered. There are many installations of CIP technology that have been in place for adequate duration to demonstrate the viability of this methodology in fully structural application meeting the criteria set forth in each of the afore mentioned design approaches.

In the rectangular shapes encountered during the box culvert rehabilitations presented it was extremely significant that full contact between the host pipe and liner was assured. This was achieved by installing fillets in each of the corners allowing the tube to take on an elliptical configuration. Validation of the fully deteriorated structural design could then proceed by considering the liner as an ovalized non circular application, as opposed to a rectangle. Fillet dimensions were calculated after a comparison of the areas between the rectangle to be rehabilitated and the circular tube to be utilized which, when inverted into a box culvert, took on the shape of an ellipse.

In all cases the loss of area did not exceed 12% which was then regained hydraulically due to the intrinsic efficiencies of flow characteristics in cured in place pipe. Ovality generally ranged in the 8% to 14% range which caused substantial wall thickness increases when compared with comparable circular rehabilitations; but none that proved prohibitive in handling or tube inversion ability. No rectangular box rehabilitated exceeded a span to rise ratio of 2:1.

Key design parameters

- Design Method ASTM F 1216 /1743 vs. WRc Type I, II, or III
- Span to rise ratio
- Ovality of the resultant Non circular Liner
- Capacity change and tolerance for area reduction
- Fillet design and dimensions
- Inversion length
- Wall thickness

- Weight of materials being installed
- Over the hole vs. factory impregnated

INSTALLATION

There can not be enough emphasis placed on pipe preparation prior to installation of any trenchless rehabilitation. The properties, quality, and life expectancy achieved are always dependant upon the clean and televise protocol adopted by the installer. Not only are these efforts the eyes and ears of the operation on a production basis, but they set the stage for the installation's ultimate efficiency and technical success. In the cases of rectangular box culvert, large bore, and transitional liner application; not only are the cleaning crews making the pipeline available for the critical survey step, but they prepare the pipe for placement of the fillets and tube installation.

During the pre installation survey; defects and dimensions catalogued are compared with visual and CCTV data collected. Prior to tube fabrication, analysis of the design dimensions and pipeline configuration must take place. With critical lead times as long as three (3) weeks in mammoth tube fabrication, the urge to rush the pre installation survey must be resisted.

The fillets are placed with a gravity fed trowel methodology at the inverts, while a mesh coping may be used to keep material at the crown locations. Since the tube will expand upwardly as it is being installed it may not be necessary to grout the crown prior to inversion. Alternatively, crown material may be either pumped from the inside of the tube at fifty (50) foot intervals, pumped from above ground through placement tubes (if access exists), or through placement tubes longitudinally which are extracted as pumping proceeds. Excessive grout pressures must be avoided since this may cause undue pressures on the liner application. Optimum results, however, are assured through gravity or mechanical pre inversion grout placement methods.

Once the host pipe is fully prepared and geometrically modified the stage is set for the non circular CIPP inversion. The installation may commence over the hole in cases where installation quantities exceed those which can be transported, or conventionally, out of a reefer trailer or low boy hauled "cool box".

An additional factor of safety may be implemented by increasing the anticipated resin consumption by a sacrificial quantity of between 5% and 15%. This additional material insures intimate contact between the liner and host pipe, while enhancing structural characteristics in the finished product and filling all cracks and voids.

In transitional liner applications (concentric diameter changes or eccentric increaser/reducer applications) it should also be noted that it takes a distance of approximately three times the largest diameter over a longitudinal distance within the host pipe to make the transition desired. In other words in a five (5') foot diameter equivalent round pipe it may take as much as fifteen (15') of longitudinal distance to make a diameter change. This is also significant when performing pre installation grout preparation on the host pipe.

The tube should generally be installed such as to overlap the smaller diameter liner into the larger diameter host. In this case the effects of grout and sacrificial resin may be counted on for support in order to avoid or minimize the phenomenon of fins. Fins occur when there is plainly more material than can be distributed over the hydraulic radius. Cut away investigation of fining has demonstrated that this is not a defect but rather the manifestation of excess material. This material may be cut, ground out or sanded if there remains concern that a hydraulic inefficiency or debris flow blockage might ensue.

Table 1. Boxes rehabilitated by methods described

	METHOD	WALL THICKNESS/LENGTH	FILLET DIMENSIONS	ROUND EQUIVALENT
72" X 48"	OVER THE HOLE	38.5MM / 1605LF	18"X12"	60"
84" X 60"	FACTORY IMPREGNATED	38.5MM / 910LF	18"X18"	72"
72" X 104"	OVER THE HOLE	47.5MM / 3600 LF	18"X24"	89"
63" X 72"	FACTORY INPREGNATED	36MM / 700LF	NONE REQUIRED	66"
78" TRAPEZOIDAL	OVER THE HOLE	42MM / 3525LF	18"X18"	72"

TESTING

The benefits of third party testing have been well documented and utilized over millions of feet of CIPP installation. The ability to demonstrate properties achieved in the field by flexural modulus and flexural strength testing of a composite resin/felt coupon not only validates the preliminary design basis but additionally:

- Proves the wet out phase was adequate
- Insures that the prescribed cure / cool cycle was thorough
- Serves as a secondary check of design wall thickness
- May be utilized for resin verification

Upon conclusion of a large bore non circular or rectangular box culvert installation it may also be advisable to do some internal pipeline verification of the corners using either destructive or non destructive means. The simplest is a core sample where a small tap is drilled to insure that there is an intimate contact between the host pipe and liner. A batch of ambient cure resin or epoxy and hardener may be utilized to fill these taps upon conclusion of the verification. Where tapping a good liner is not desired; a "sounding" of the area with a rubber mallet may be performed. Voids behind the liner will sound hollow when struck. Should voids be detected there are several methods which can be utilized to insure a suitable end result ranging from resin injection to cutting out the suspect area and performing a "hand lay up" or sectional repair. For comparison purposes, consider that in the over ten thousand (10,000') lineal feet of large bore non circular and box culvert rehabilitation documented in this paper the need to perform this type of repair occurred twice while impacting only some forty (40') feet of pipe.

CONCLUSIONS

In this paper we have documented the rehabilitation of over two (2) miles of non circular, transitional, and rectangular box culverts which were successfully renovated to fully deteriorated model stand alone structures with a renewed full service life expectancy using cured in place pipe methods described in ASTM F 1216 and ASTM F 1743. The successes were attributable to contractor experience, superior pre installation pipe preparation, accurate dimensional survey, and post installation testing. The pre lining grouting methods successfully utilized were explained while alternative methods were presented for consideration.

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Queen City Makeover

MSDGC Goes Trenchless to Maintain System, Reduce Overflows

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- Pipe Ramming Through a Landfill

CAPACITY TO BE DIVERSE

Combination of Trenchless Methods Applied to Michigan Interceptor Project

By Fred Tingberg

In late 2014, Lanzo Trenchless Technologies received a call from NTH Consulting and Drain Commission officials asking if there was interest to competitively bid on the latest contracts in a series of projects called the Oakland-Macomb Interceptor Drain (OMID). The tasks to be performed included deep interceptor pipeline and structure rehabilitation on problematic segments of sewer straddling Oakland and Macomb Counties in southeast Michigan. This 50-year-old concrete system ran adjacent to a crucial roadway (M 59) connecting the east and west sides of heavily populated suburban Metro Detroit.

There was concern as to competitive market interest on a project that would be mixing several different trenchless technologies in one or two construction packages valued in the $20 million range.

THE PROBLEM

Engineers had identified that the system was succumbing to sulfide attack of reinforced concrete pipe and manholes that were installed during the late 1970s. As part of Segment 4 Repairs, it was deemed a priority to evaluate and repair more than seven miles of large diameter interceptor sewers some 40 ft beneath the active county thoroughfare to preempt any "catastrophic" failures.

The successful contractor would need to provide a suite of services, including permanent access road construction, high volume sewage control management, cementitious grout in place liners, fully deteriorated model CIPP, large bore spot repairs, cementitious grouting of voids, access manhole restoration, localized crack/failure repairs using chemical grout and CCTV.

Sealed proposals were reviewed by a board overseen by Oakland County Water Commissioner Jim Nash, Macomb County Public Works Commissioner Anthony V Marrocco, and State of Michigan Department of Agriculture and Rural Development's Michael Gregg. Under an MDEQ permit using State "SAW" Loan and EPA funded money; the board solicited to contract work in both the Oakland Arm (PCI-9 / PCI 10), as well as the Avon Arm (PCI 11) Interceptors. NTH served as lead consultant while a local engineering firm, FKE was similarly retained with intimate knowledge of the system, prevailing defects and the pipeline's potential for trenchless rehabilitation.

Pre-qualified contractors were required to "self-perform" much of the construction trade work by dollar volume. This provision added quality to the specification, minimized risk and insured that the general contractor selected would perform the work as specified while providing first quality materials and workmanship.

Contractors performing the lining work had to demonstrate a proven record of performance in pipeline rehabilitation with minimum lineal footage and minimum successful years of experience for each of applications specified. Additionally, like conditions and necessary skill set for projects of this scale were considered.

Having experience in all of the proposed technologies, Lanzo tendered bids on both projects and was selected with an overall price of under $16 million. Additionally, Lanzo offered a five-year warranty on all materials and workmanship associated with the contracts.

George Nichols, P.E. Oakland County drain commission civil engineer III, would oversee the OMID Segment 4 Repair Program, specifically Contracts 5 and 6, serving as project manager. "Our objective was to reduce system inflow and infiltration (I&I) while structurally stabilizing the Interceptors being investigated," he said.

Work was difficult and dangerous, requiring the utmost care in safety consideration, monitoring and management. The initial phase of the contract included constructing permanent gravel roads for access and to insure constructability of the project.

The grout-in-place liners was comprised of a Permacast product, which was selected for its corrosion resistance and structural properties. The Permacast pipelining material product was specially designed for dry shot application and is fully compatible with Conshield, which was specified to prevent Microbially Induced Corrosion (MIC) while resisting the attack of sewer gases.

The Permacast material also contained a Crystal X additive which creates a crystalline waterproofing membrane to auto heal any cracks which might develop. This material may be put on in multiple lifts without cold joints.

For the chemical portion, a premixed liquid acrylamide grout was formulated and shipped by Avanti International for ease of application and to facilitate a high rate of installation.

Lanzo also used "Fully Deteriorated Design Model" cured-in-place (CIPP) liners, which would offer stand alone structural characteristics while meeting the demands of a 50-year service life expectancy.

High-quality isophthallic polyester resin manufactured by Interplastic was used in tubes weighing as much as 40,000 lbs each.

One of the early tasks was to tunnel a 16-ft diameter shaft down to the 96-in. diameter sewer crown, create access and build a platform for staging of both the chemical and cementitious grouting activities within the pipeline.

Challenges included working in and around flow that could not be disrupted during the construction process. Much of the work was conducted above existing flow lines by holding cementitious delivery hoses at elevations above the hydraulic grade line. A cabled Hammerhead Winch System was erected to pull construction carts between access points as far as 1,200 ft apart. Specially fabricated platforms and this mobile carriage delivery system insured the transport of materials to respective rehabilitation sites within the pipeline.

As part of the Segment 4 repairs, a suite of trenchless methods were used, including CIPP, cementitious Centripipe and grout-in-place liners.

As part of the inspection process, any reinforcing steel that was identified as suspect was slated to be replaced as directed by the engineer.

The owner's objective was to perform as many repairs possible given this unique opportunity to have total access to this critical trunk sewer interceptor during the project.

Lanzo Trenchless North principal Angelo D'Alessandro was involved in periodic evaluation meetings where additional rehabilitation of lines already under bypass was considered.

"The cost to bypass, access and enter these sewers is high. It's in everyone's best interest to make hay while the sun is shining," said D'Alessandro. An opportunity was identified given a window of time to provide expanded services, while already under bypass, in order to minimize future risk while conserving cost moving forward.

Anticipation of repairs as specified, while thorough, did not cover every inch of pipeline. The cost to return vs. the cost of making additional repairs while in the pipeline was considered. Engineers discussed the ability to anticipate areas which would be the next in line to undergo attack. Work in additional "areas of concern" was then added and performed concurrent with the specified schedule of services.

It was decided to perform additional CIPP lining which would offer a "one and done" approach to select line segments. This would effectively take these lines out of any future consideration for maintenance or ongoing evaluation. Given a CIPP service life expectation of at least 50 years, the cost of evaluating the sewers every eight years or so affords diminished returns when major flow control management (bypass), maintenance of traffic and social cost of disruption is considered.

On a grand scale, the OMID projects represented an overall $160 million effort by the board which has been under construction since about 2009. Segment 4 activities are ongoing with an anticipated completion date of spring 2016.

Fred Tingberg is manager of business development at Lanzo Trenchless Technologies.

DIRECTIONAL DRILLING

Contractor Savings

As the water crisis continues to challenge businesses in California and elsewhere, many businesses are looking to relieve environmental pressures through sustainable practices. Nevertheless, decreased water consumption and recycling efforts can also retain profits for many contractors — a win-win for contractors and the environment. While fluid recycling is becoming increasingly common due to advances in HDD technology, contractors are pursuing the process for a variety of reasons.

Cost is one key driver. The cost of additives and disposal fees for 1,000 gals of drilling fluid can range from up to $600 or more — and this does not include water and transportation costs.

Also, because drilling fluid is being recycled during the pumping process, lower fluid volumes mean fewer additives and less water consumption. For example, an operation with a 30,000-lb pullback drill unit may pump 20,000 gals of fluid throughout the project. Yet, when a micro recycling system is used, the actual fluid loss may only be 1,500 gals of drilling fluids throughout the entire operation. And because reduced drilling fluid lowers the number of vac systems and trucks needed for mud extraction, it can also lower fuel costs substantially.

Using fewer additives, water and transportation resources can save contractors hundreds to thousands of dollars throughout the drilling process.

Additionally, most HDD projects use a stand-alone mud-mixing system, employing more machines throughout the operation. Mud-recycling systems, however, can also mix fluids and reduce the need for a vacuum trailer or truck, requiring fewer machines and operators.

Environmental Relief

Emissions, drilling fluids and water consumption are diminished during the

And although HDD fluid recycling still requires a skilled operator for maximum efficiency, the benefits of increased hole velocity include increased production, improved tooling life and reduced risk of inadvertent returns. For utility contractors, this means fewer trips to haul water supplies and dispose of fluids. For the environment, this means less water consumption and additive and landfill use after the process is complete.

"Green" Cured in Place Pipe Utilization, Styrene Free Emerging Methods and Resin Systems

Fred Tingberg Jr.

Business Development Manager Lanzo Lining Services Deerfield Beach, Fl

ABSTRACT: This paper compares Non Styrenated, UV Light, Remote Epoxy CIPP, and Sequential Wrapped Carbon Fiber/ Epoxy technology in applications where the presence of VOC's, fumes, vapors, is unacceptable, undesirable or impractical. Several recent case histories of successfully installed CIPP applications are presented where the application did not allow for Styrene emissions either in the Vapor Phase during Cure or during the release of liquid Styrene laden process water during commissioning of the pipeline. UV cure technology is also compared which, while styrenated, requires no process water resulting in styrene concentrations well below those realized during typical CIPP installation. Finally in NSF 61 Certified Application there is no room for introduction of solvents, reagents, and residuals into the distribution side of the municipal water stream.

The practical limits of Styrene usage in the trenchless industry has become controversial citing environmental, exposure, and safety issues. The use of non-styrenated, UV Cure, and Remote Impregnated Epoxy Resins in CIPP installation sidesteps this debate while offering the benefits of close fit, full structural, and pressure rated cured in place pipe.

Issues associated with styrene usage, such as cycle water contamination and airborne odor concentration has been largely eliminated in Europe through the evolution of UV, as well as, Remote impregnated epoxy technologies. While it remains to be seen as to the timing of this change within the US; both sides along with the economics of this issue will be presented within this paper.

The movement towards more "Green" materials in construction has been largely accepted in concept while the Owner/End users must weigh the economic impact of such materials as compared with alternative means of using styrenated products and more common technologies. While styrene utilization remains commonplace within our industry; Green or sensitive application requires containment, absorption, and/or shielding methodologies. This paper shall demonstrate the successful installation of CIPP without Styrene in applications where Odors, Exposures, or Contamination could not be tolerated.

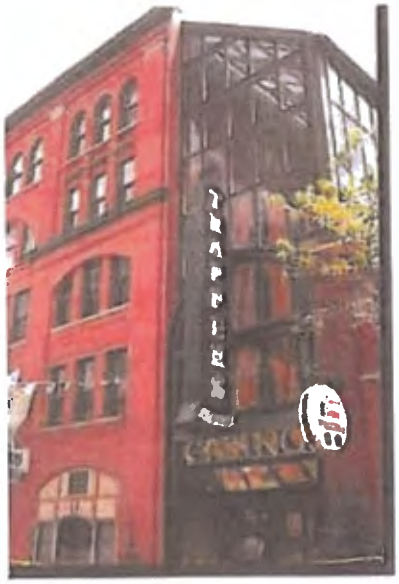
INTRODUCTION

The issue of styrene utilization in CIPP installation is recently become controversial within the United States stirring debate within and outside of the Trenchless Construction Industry [1]. Experts point to the five year lag in technology implementation between Europe and the United States arguing that today's snapshot overseas would demonstrate less usage of styrenated resins in favor of UV and Remote Impregnated Epoxy Technologies. In this country the increasing use of CIPP has been an adaptive process while solving the gamut of trenchless application ranges from small to large and non-circular diameter, pressure rated, storm drain, industrial sewer and process pipes has largely been accomplished with little or no effect being attributed to the use of a common, inexpensive, and in CIPP, practical solvent known as styrene.

On the other hand; as we strive to become more environmentally responsible; what were once novel process are coming under increased scrutiny for the monitoring, exposure to, installation and transport of VOC laden constituents.

Additionally; the need to contain, shield, absorb or eliminate solvents needs to compare with cost to provide the user with an end result that is both cost effective and practical.

Exhibit #1: Non Styrenated Gravity Sewer Rehabilitation at Indoor Casino:



(Figure#1 Trappers Alley, Detroit Michigan)

Greek town was selected for downtown survival and revival in the seventies. Part of this effort was the development of Trappers Alley as a brick mall encasing of a street whose history dated back to the fur trading days of the eighteenth century.

Seemingly unconsidered in this development was the existence of a one hundred (100) year old 18" to 15" transition sewer some twenty feet below the surface of what was now a full service gaming casino and restaurant complex.

When numerous complaints emanating from ongoing backups, odor issues, and flow restrictions failed to be satiated with routine and ongoing cleaning and plumbing efforts; CIPP became the solution of choice.

One of the parameters made necessary was the zero tolerance for Casino Closing during the rehabilitation effort. Additionally, the two hundred plus foot installation with an inline transition and multiple service reinstatements would require an around the clock installation schedule. The issue of styrene emissions were discussed and deemed by the management company to be unacceptable.

A styrene free resin was selected and approved based on its property where during exotherm it remained virtually odor free. Fully deteriorated structural properties along with common cycle times and installation method made the selection an easy one to make.

Exhibit 2: Non Styrenated Pressure Pipe in Water Fountain Application at Detroit's Renaissance Center:

(Figure #2 Renaissance Center Fountain overlooking the Detroit River)

At the same time the Casino Project was being constructed a call came in from the Management Company responsible for the Renaissance Center in Downtown Detroit. A pressure pipe beneath the plaza facing the Detroit River had become deteriorated causing shutdown of a critical and decorative centerpiece of the complex also the focal point of each summer's Downtown Detroit's multi heritage festival schedule.

While there was no declaration of NSF 61 water main requirement; the fact that children commonly come in contact with this water during the summer festivities gave the owner cause to seek a "green resin". In fact, the styrene free resin used at the Greek town Casino project had recently been submitted to NSF 61 for leach testing in accordance with the UL/NSF 61 certification process. This rendered substantial chemical analysis available for submission to Engineers reviewing the project offering comfort with regard to the fountain application.

The project required CIPP lining of twin twelve (12") inch water transmission lines rated at 100 psi. The ASTM F 1743 (pull and invert) method implemented during installation allowed for a successful installation, pressure test and return to service within one week of project commencement.

Exhibit 3: UV Cured Trunk and Collection Sewer Interceptor:

(Figure #3 Light Train inserted into a 30" Trunk Sewer on Division Street)

UV cured CIPP utilizes resin which while styrenated allows only minimal emissions since:

- There is no Process Water release upon conclusion of the lining process
- The tube is encapsulated in a protective black plastic which acts as a UV shield
- Fully deteriorated design relies more heavily on Tube Reinforcement than resin during wall selection [2]

During installation of the Division Street Interceptor Project for the City of Dover over five (5,000') thousand feet of trunk transmission and residential collection sewers were lined on an extremely tight schedule within and around the Downtown area. Cycle time to install was significantly reduced in that the typical inflate/ cure/cool/ process water release was sidestepped in favor of the Air inflate/UV Cure steps used with UV methodology. Additionally; there were no residential complaints or calls from residents concerning the matter of Styrene Odors which may be ordinarily be expected during the implementation of standard styrenated polyesters and vinyl esters.

Exhibit # 4: Remote Impregnated NSF 61 Certified Epoxy Water main:

Remote Impregnated Epoxy looms as a highly desirable CIPP methodology. This method allows for the transport of the entire wet out procedure to the respective jobsite; while using the beneficial properties of 100% solids, 0 VOC's, structural epoxy which has tremendous structural, adhesion, and life span benefits. The process is applicable to Gravity, Pressure, High Corrosion, and NSF 61 Potable Water application. This process enjoys widespread acceptance within Europe and has proven to be an Engineers favorite since it is so repeatable, recordable, and controllable.

A 3,000 lf NSF 61 Residential Distribution Water main of 8" through 12" was installed tested at 100 psi on Theodore in Clinton Township, Michigan and using this technology [3]. Remote Impregnated Epoxy methods include products such as Norditube, Aquapipe, and Blue Line Citi Liner by RS Tecknik.

Exhibit #5: Non Styrenated Gravity Storm Sewer Culverts in Environmentally Sensetive Wetlands:

A styrene free resin was selected and approved based on its property that no styrene could be released into the environment which might pose a risk to Fish and Wildlife. Fully deteriorated structural properties and a fifty (50) year service life expectation were desired using the direct inversion methods described in ASTM F 1216. No styrene was released since none existed in the products delivered to this environmentally sensitive Wetland application. On another note in the wetland application thermal shock must also be considered prior to process water release. While ASTM F 1216 discusses cooling to 100'F prior to release, process water might be cooled further, transported out, or pumped onto adjacent ground in an effort to eliminate any chance for Fish kills or other undesirable environmental effect. Several installations of 36" & 48" Non Sytrenated CIPP were installed in culverts throughout the Loxahatchee Water Reclamation District during this project

Exhibit #6: NSF 61 Certified Carbon Fiber/ Epoxy Matrix Sectional Lining in Cylinder Pipe Watermains:

In the late Seventies (70's) and Early Eighties (80's) a large quantity of defective Prestressed Concrete Cylinder Pipe became distributed to major municipalities throughout North America. This pipeline product became depended on for Potable Water distribution in High Pressure Transmission Mains. Only recently have these utilities become "condition assessed" for potential to allow catastrophic line break and failure. The utilization of a space age process involving sequential Carbon Fiber wrapping technology allows for the implementation of NSF 61 certified internal sleeving to preempt line breaks given pressure ratings of 150psi or more. One such installation of this technology was a 54" 150 psi Water Transmission Line in Metro Dade County. The strict UL certified NSF guidelines allow for no harmful solvents to remain residual in what will become the rehabilitated water supply. This technology shows great promise for growth as the Nation prepares to forge forward with new Federal mandates for Water Infrastructure Rehab and Renovation.

Other means and methods:

A reagent known as "Sty Redux" has also been utilized on certain projects where strict limits have been placed on concentrations of styrene in the process water released. This compound, when added to the process water within a water cured inversion column, causes the styrene present to polymerize for easy collection upon release of the cooling water that was utilized. The implementation of a Pre Liner should be added if the concerns include Styrene emissions in a gas phase up through the lateral stacks of the sanitary applications being rehabilitated.

Frac Tank water collection, Pre liner utilization, and closed system containment are all ways which can be utilized to diminish any levels of styrene which ultimately become released into the environment.

The Numbers:

Regarding Styrene; the author of this paper has been associated with over eight Million (8,000,000) lineal feet of CIPP installation using styrenated resins during which time we are not aware of one individual whose health has been directly impacted by exposure to the styrene emissions prevalent using conventional methods described in ASTM F 1216 or F 1743. Styrene concentrations as they pertain to recognized levels are:

Human recognition	2ppm
Monitored during Wet out	17ppm
TWA (NIOSH)	50ppm [4]
IDLH (NIOSH)	5000ppm

Putting this in perspective then; the Human Nose can detect 2 parts per million of styrene while in accordance with OSHA guidelines the "Time Weighted Average" for exposure is 50 parts per million during a forty (40) hour workweek. The Immediately Dangerous to Life and Health exposure limit tops 5000 parts per million. While in the mixing room within a CIPP wet out facility it is uncommon to monitor concentrations greater than 17 parts per million. Given this insight; it is safe to say that odors associated with styrene in and around the CIPP process as we presently know it; may represent more nuisance than hazard. However; certain individuals may possess sensitivities to this or any other solvent which is perhaps why the potential for eliminating its use is compelling. Additionally, the implementation of Styrene laden resins in wetlands and waterways may pose risk to wildlife if one or more of the methods listed in this paper are not utilized.

Cost:

The bottom line is that what we as a society are willing to pay to "go green", eliminate solvents, or minimize sensitivities. When so many millions of feet have been successfully installed within The United States and elsewhere; using an efficient, cheap, and proven styrene based material such as iso polyester and vinyl ester resins; those leading us into the next generation of Rehab methodology or toward the European Model will need to provide persuasive guidance.

Estimate Cost of comparative technologies eliminating or minimizing Styrene Exposure

Conventional Styrenated Resin Application	$ 4 - $ 8 per diameter inch [5]
Non Styrenated Resin Application	$ 6 - $10 per diameter inch
Remote Epoxy Impregnated Application	$ 8 - $12 per diameter inch
UV Light Cured Application	$10 - $16 per diameter inch
Sequential Wraped Carbon Fiber / Epoxy Matrix	$75-$100 per diameter inch

Many factors must be weighed along with these crude estimates such as site specific information, access, cycle time allowable and others.

Conclusions:

The intent of this paper was to discuss and compare methods where the use of styrene emissions needed to be sidestepped, minimized or eliminated. The use of styrene continues in the face of Federal initiative suggesting against its use along with the persistent nuisance represented by emissions of odors and release of chemicals within our environment and at the home sites of the unsuspecting public at large.
For purposes of this presentation the facts surrounding the applications listed; made selection a non styrenated or a reduced emission styrenated product, as opposed to solvent styrene based product forthright and justifiable.
Simply adding these products to the specifications will no more insure their utilization than the specification of "silver plating" as an equal alternate to "galvanized" in storm drain culvert manufacture.
Objectives such as the removal of styrene, elimination of the nuisance and risks associated with solvents, or the desire for properties such as reduced cycle time and higher physical properties; will only be achieved by direct specification of the Owner/Engineer.

References:

[1] Guideline for the Use and Handling of Styrenated Resins in Cured in place Pipe
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[3] Tingberg, Fred. "Trenchless Cured in Place Watermain Rehabilitation meeting NSF 61." North American Society for trenchless technology 2008 no-dig conference & exhibition. (2008)

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[5] Lanzo Lining Services Engineering Design Guide 2nd addition, 2010. Print

LANZO
Lining Services, Inc.

ENGINEERING DESIGN GUIDE FOR REHABILITATION WITH CURED-IN-PLACE PIPE

Second Edition

LANZO COMPANY HISTORY

Lanzo has been a leading competitor in the construction industry for over 45 years. Lanzo was founded in Roseville, Michigan with offices presently in Detroit, Michigan, Atlanta, Georgia and Deerfield Beach, Florida. Lanzo employs a highly diversified staff of over 400 people providing a full range of construction services with contracting capabilities including:

Professional Services

- Construction Management
- Engineering Design/Build

Trenchless Technologies

- Cured-in-Place Pipe Lining
- "Over the hole" Application
- Noncircular, Box Culvert and Large Bore CIPP
- NSF61 Certified Waterline Rehabilitation
- Air Duct/Plenum Reconstruction
- Lateral Rehabilitation
- Interface seal technology

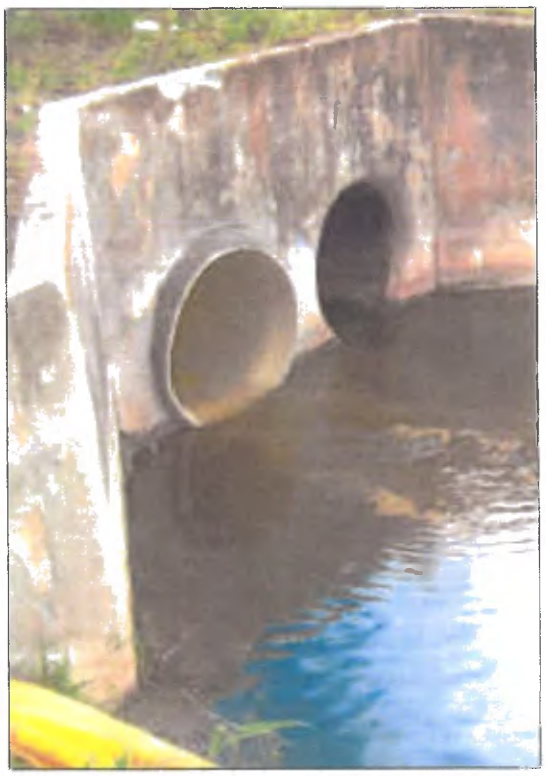
Heavy Construction

- Road & Highway Construction
- Site Work/Civil Construction
- Water Transmission
- Wastewater Collection Systems
- Water/Wastewater Treatment Facilities
- Marine Construction
- Demolition

Land Development

- Acquisitions
- Design Build

At Lanzo, we value our employees and the residents of the communities within which we serve. Our mission at Lanzo is to provide safe, high quality, cost-effective and on-time construction. Lanzo is an equal opportunity employer meeting all Federal, State and Municipal health & safety regulations. We hold the highest level of ethics and are committed to ensuring the safety of our employees along with both the convenience and safety of the residents of the communities we service.



Trenchless renovation in storm drain application

Environmentally friendly "Green Resin Formulations"

FORWARD

At the time of this publication, Lanzo Lining Services marks seventeen years serving the municipal, industrial, and public works rehabilitation marketplaces with a quality cured-in-place pipe (CIPP) liner. Having installed over 6,000,000 linear feet of sanitary sewer, force main, storm drain, NSF 61 potable water transmission, large diameter, and non-circular CIPP, we offer this newly revised second edition of the Lanzo Lining Services Design Guide as continued confirmation of our experience with design and application.

With millions of feet of CIPP in service throughout the world, it is not necessary to state the applicability or validity of CIPP as a proven rehabilitation technology. Over the years the industry has witnessed the introduction of many new products competing for a portion of the pipeline rehabilitation market. Several seemingly logical technologies have dissipated due to a number of reasons that include short term failure, lack of marketplace support, poor installation practices, and inexperienced contractors. Some products have failed in aggressive environments unanticipated by the designer or installer.

Lanzo Lining Services success can be attributed to five primary directives:

1. An emphasis on safety
2. Consideration of the community.
3. Quality installation by experienced crews.
4. A conservative design approach and superior resins.
5. Third party testing of each liner run.

DAILY THIRD PARTY TESTING vs. CATEGORIC LONG-TERM TESTING

The mere use of long-term testing for product selection is inadequate. The participation in a long-term testing program, while notable, does not insulate the customer from workmanship flaws, inferior resin or batch irregularities, or day-to-day jobsite fluctuations. There is no better way to prove quality and product reliability than to take a test specimen from the actual installation being lined and have it tested by a third party laboratory. For instance, the ability to retrieve samples from CIPP installations with properties in excess of 350,000 psi flexural modulus demonstrates that the submitted design basis has been validated. This additionally proves out the quality of the liner wet out, the adherence by the installer to ASTM installation practices, and the quality of the resin actually used on the day of the installation. The existence of over six million feet of Lanzo installed CIPP in service throughout the United States and Canada may serve to qualify our technology as viable, conservative, and safe.

INNOVATION

Our service is the daily solution of problems and pursuit of a quality installation. This is not simply the installation of a product, but rather the accomplishment of a complete sequence of events ranging from resin preparation and wet out to installation, utility reinstatement and jobsite cleanup with minimal disruption to the surrounding community. In the evolution of our company, many new product developments, installation tools, and refined practices have combined to make the use of our service a practical occurrence. Our conservative use of the highest design standards and field proven methods have been applied to diameters as large as 120", circular and non-circular storm drain applications, pressure rated force main and NSF 61 certified water main "stand alone" pipe liner installations.

CONTENTS

INTRODUCTION

OBJECTIVE OF THE MANUAL

This manual is intended to serve both as a general reference as well as an educational tool for the owner or project engineer designing infrastructure rehabilitation projects. The technology presented includes cured-in-place pipe, NSF61 certified water main transmission and potable water distribution pipeline rehabilitation, lateral lining, large diameter circular and non circular structural pipeline repair as installed by Lanzo Lining Services.

Cured-in-place pipe is prepared and installed by first saturating a specially fabricated tube with a thermosetting resin. The flexible, resin-saturated tube is installed by pulling it in place or inverting the liner into itself directly through the host pipe using either an existing or constructed access point. With the use of a static head of water, steam pressure, or pressurized air; the resin-saturated tube is pressed tightly against the existing "host" pipe. The water or steam is then continuously circulated through a heater in order to quickly polymerize the thermoset resin which forms a new pipe within the existing "host" pipe. Lateral connections are easily identified where the liner dimples and may quickly be reinstated robotically. All of these steps are typically accomplished without the need to excavate demonstrating truly trenchless technology.

Members of both the public and private sectors are finding the benefits of cured-in-place pipelining immeasurable. This trenchless rehabilitation technology allows placement of pipe within a pipe with "stand alone" structural characteristics while eliminating infiltration and exfiltration at a lower cost, in less time, and with fewer inconveniences to the owners and the communities served.

LANZO LINING SERVICES CONSTRUCTION EXPERIENCE

Lanzo Lining Services is among a handful of companies proven competent in the use of a wide array of cured in place pipelining technologies to rehabilitate deteriorated water, sewer, and drainage pipelines.

Lanzo Lining has successfully installed over six million (6,000,000) linear feet of cured-in-place pipe throughout the United States and Canada, in pipe sizes ranging from 6" to 144". Our specialties include large diameter, non-circular, pressure, high temperature, and corrosive environments in collection, transmission, treatment plant, industrial, NSF 61 potable water main, environmentally sensitive," green" and storm drain applications. [1,2].

Lanzo Lining Services has installed over 1,000,000 feet of large bore CIPP, of which over 250,000 feet has been placed using "over the hole" wet out/installation technology; where factory liner preparation or transport to the remote jobsite location was not possible. We have installed non-styrenated polyester, non-styrenated vinyl ester, and epoxy resin impregnated tubes where environmentally sensitive, potable water transmission or air plenum ventilation application prohibits the use of styrene or other VOC's.

"Over the hole" wet out and installation of large bore circular, non-circular, and box culvert applications

THE CORROSIVE PIPELINE ENVIRONMENT

Accelerated aging caused by hydrogen sulfide-related corrosion has generally caused premature failure of our nation's sanitary sewer infrastructure. Awareness of the existence of corrosion and concern about its effect on the sewer system has been an issue since concrete and ductile iron first started displacing clay and brick as the primary materials in sanitary sewer construction. Even though it was known that some corrosion would take place, precautions taken in the sewer design and pipe thickness were intended to produce the 100+ year life expectancy of the sewer system [3]. However, within the last 25 years, hydrogen sulfide-related corrosion has accelerated at an alarming rate throughout the U.S. and has been documented by the Environmental Protection Agency (EPA) in a number of studies [3,4,5,6]. The primary cause of the accelerated corrosion has been attributed to the proliferation of several strains of Desulfiobrio bacteria in response to the reduction of cyanide and other heavy metal pollutants regulated by the EPA [3,4]. An anaerobic bacteria living in the slime layer on the lower hemisphere of the pipe reduces sulfur-containing compounds to hydrogen sulfide (H2S). An aerobic strain living in the slime on the crown of the pipe oxidizes hydrogen sulfide to sulfuric acid (H2SO4). Routine wastewater pH measurements often indicate the effluent to remain in a range of pH 5-8, which would not ordinarily be of concern. However, the area of most concern with materials having low acid resistance is in the slime layer itself where the aerobic bacteria live. The aerobic bacteria have been observed to produce sulfuric acid up to 5% by weight (i.e., pH ~ 0.28) and remains viable in concentrations as high as 7% (i.e., pH < 0.15) [4,7]. At these acid concentrations unprotected concrete or ferrous metals are readily decomposed, producing holes in the top of the pipe commonly found during inspection.

ADMINISTRATIVE ORDER/CONSENT DECREE

Sewage overflow restrictions, overflow monitoring, and stiff penalties for non-compliance imposed by the EPA and state water agencies have motivated municipal sanitation departments to develop aggressive programs to maintain and/or rehabilitate their systems [4]. These programs have fostered the growth and acceptance of number of trenchless pipe rehabilitation techniques, as well as creative maintenance solutions [4,6,8]. The most popular current ongoing maintenance program utilized by many sanitation districts is the development of chemical treatment protocols and inventive application techniques to control hydrogen sulfide corrosion [4,6,8]. Depending on the program objectives, regular addition of one or more chemicals can reduce existing hydrogen sulfide, neutralize the acids, temporarily shock the bacteria, or accomplish all three. Chemicals commonly used for this purpose includes strong oxidizing agents (i.e., hydrogen peroxide, sodium hypochlorite (active ingredient in bleach), chlorine, potassium permanganate), weak oxidizing agents (i.e., oxygen and air injection), acid neutralizing bases (i.e., sodium hydroxide), and iron salts [4,6]. Use of magnesium hydroxide has been utilized as a thick alkaline chemical coating on the crown of cementitious pipe in order to neutralize the acid gases and kill the acid forming bacteria.

In general, this nation's sanitation system has changed dramatically within the last several decades and will continue to evolve. Studies demonstrate that decreased flows related to water conservation efforts increase the corrosive environment in sewer systems [9]. It is suggested that municipal efforts to reduce inflow and infiltration (I/I) through rehabilitation will also increase hydrogen sulfide-related corrosion and concentrate all other chemical agents present [10]. These and other unpredictable changes may necessitate lining to fortify existing pipelines against an increasingly aggressive corrosion environment [11].

Finally as the nation's infrastructure becomes tighter and additionally rehabilitated; the concentration of the many chemicals contributing to system deterioration will naturally increase. This will further emphasize the need to completely renovate our systems and finish the job started.

ALLOWABLE LEAKAGE BY SPECIFICATION

Infiltration & inflow reduction

Maximum flow capacity

As a continuous and joint free pipe material, CIPP has been part of a "Green Revolution" even before the environmental community first coined this phrase. The evolution of specified materials has allowed the Engineering Community to reduce the allowable passage of effluent through the joints of newly installed or rehabilitated pipelines, thus improving the overall environment. As late as the 1980's a leakage level of 200 gallons per inch-mile-day was commonly found in new vitrified clay pipe installations and this has now been reduced to a level of 50 gallons per inch-mile-day available with Unibell installations of PVC pipe today. The impact of a zero leakage system such as CIPP should prove instrumental as efforts to move towards a "greener" society remain emphasized. CIPP offers the luxury of a "pressure rated" sewer pipe where leakage either in or out of the system was previously commonplace in new installations.

CIPP BACKGROUND AND APPLICATION

NSF 61 Certified water main rehabilitation

ASTM F1743 Pull & Invert technology

The full technology development of cured-in-place pipe as an industry is attributed to Insituform Technologies back in the early 70's in the United Kingdom. As the technology grew, installation techniques, materials advancements and product marketing were all combined to spawn the international multibillion-dollar business it is today. Recent estimates place the total number of cured in place pipe feet installed at over 100 million feet worldwide. At the present time the North American market has become the largest in the world for CIPP as for many other trenchless technologies.

Cured-in-place pipe has achieved wide popularity and acceptance because it is one of the most versatile methods of trenchless pipeline renewal that exists today. Many of the key features of CIPP are summarized as follows:

1. CIPP is able to span a diameter range of 4 inches to over 120 inches.
2. CIPP has been used to rehabilitate sections of pipe over 3000 feet in length.
3. CIPP can rehabilitate non circular pipe configurations such as ovals, boxes, bends and transitional diameters without digging.
4. Used to rehabilitate partially, as well as, fully deteriorated pipe.
5. Used for gravity, internal pressure and vacuum applications.
6. CIPP is used in extremes of temperature and pH.
7. Specialized products meet NSF61 certification for potable water pipe distribution, green resin applications in sensitive environmental areas, and ventilation applications where styrene use is prohibited
8. CIPP eliminates inflow and infiltration, as well as exfiltration.
9. The smooth inner surface of CIPP increases the flow capacity of the existing pipe.
10. CIPP has ASTM F1216 [12] and ASTM F1743 [13] installation specifications.
11. CIPP tube and resin materials are specified by ASTM D5813 [14].

CIPP INSTALLATION DETAILS

In this section of the manual a general description of the various installation techniques will be described for both the direct inversion and pulled-in-place installation techniques. The descriptions and figures detailed are not intended to encompass all aspects of any given installation. Variable job site, underground piping, and climatic conditions may necessitate a variety of modifications to these descriptions that are intended to produce the same installed product. The basic categories involved with CIPP installation involve the following steps:

1. Inspection
2. Pipe and job site preparation
3. Tube preparation
4. Tube installation
5. Tube curing and cool down
6. Lateral reinstatement and finishing steps

Inspection - Initially before any lining tubes are prepared the existing pipe must be CCTV inspected for debris, roots, damage, offset joints or any other anomaly that does not allow for proper CIPP installation. Inspection also involves measurement of the pipe diameter, pipe length, manhole depths and records of pipe location and other job site conditions (i.e. overhead power lines, or railway, backyard easement, excessive sewerage flows, etc.) that can be properly planned for to help the project proceed efficiently. CIPP can easily be installed over dirt and debris, through severely offset joints or around protruding laterals, and in multiple bends as severe as 90'. CIPP will not eliminate existing pipe defects, but rather will contour the configuration of the host pipe being lined. It must be determined that later inspection with CCTV or water jet cleaning may occur and that bumps or fins in the liner will not disallow equipment from passing through the rehabilitated pipeline.

Pipe Preparation - Preparation for lining may involve internal mechanical cleaning and grinding to remove roots, protruding laterals, or other obstructions in the pipe. Collapsed pipe or severely offset joints (i.e. 40% of the diameter) typically require point excavations at those locations. Loose dirt, debris, or tuberculation may require high pressure water or mechanical cleaning with a final pre-lining inspection showing the full circumference of the pipe.

Tube Preparation - After the engineered tube of proper diameter and thickness for the pipe being rehabilitated has been matched to the host pipe length; it is ready for resin-impregnation. Most liner preparation and resin saturation takes place in the controlled environment of a workshop where the resin and tube temperatures are controlled to desired conditions. The resin and resin-saturated tube may be refrigerated to slow the chemical reaction and provide an additional factor of safety during the transportation and installation of the liner. The tube is prepared by first evacuating the air from it to create a condition for vacuum impregnation. Secondly, the catalyzed resin is introduced

into the tube under vacuum so that air is completely displaced with resin while saturating the fabric. The tube is moved through pinch rollers calibrated to the proper thickness so that a controlled amount of resin is introduced into the tube. The tube is then loaded into a refrigerated truck for transportation to the job site. For projects where either the diameter is large and/or the length of the liner is long, this process will take place at the construction site and the liner will go from wet out directly into the pipe being rehabilitated. When properly handled and stored, resin-saturated tubes can be stable for up to a week or more.

Tube Installation - The following installation descriptions are intended to be a generalized overview of common direct inversion and pulled-in-place installations. Since there are so many variables associated with each project and the job site conditions on projects, an overview is provided here to familiarize the reader with general knowledge of this technology. While direct inversion and pulled-in-place installations are performed in a different manner and require different equipment, the decision to choose one installation method over another is related to the project, job site and piping conditions. On a single project it may be advantageous to use both techniques, as well as variations of each to maximize quality and efficiency of the installed product. Both techniques have been used successfully for pipe diameters from 4 inch to greater than 120 inch. The installation techniques described below use water as the installation and curing media since it is by far the most common and reliable method of installing CIPP. However, steam and air pressure may also be used as job conditions dictate. Each technique can be considered a tool in the toolbox of a CIPP installer. As such, each one has its place at the appropriate time to successfully complete a project safely, on time and within budget.

Direct inversion of CIPP is installed to meet or exceed the requirements of specification ASTM F1216 . Initially the tube is attached to a top ring or pulled through a column and turned inside out and attached to an elbow. In both cases, the tube is turned inside out with the use of a hydrostatic head of water as shown in Figure 1. As the water is carefully introduced into a column, the resin-saturated tube is allowed to invert upon itself and progress longitudinally through the pipe in a continuous and controlled manner.

figure1: Direct inversion installation per ASTM F1216

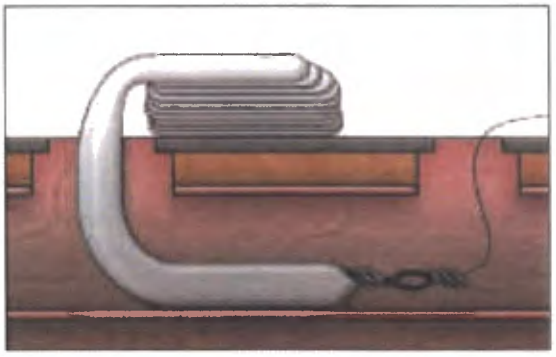


figure 2: Liner pulled-in-place per ASTM F1743

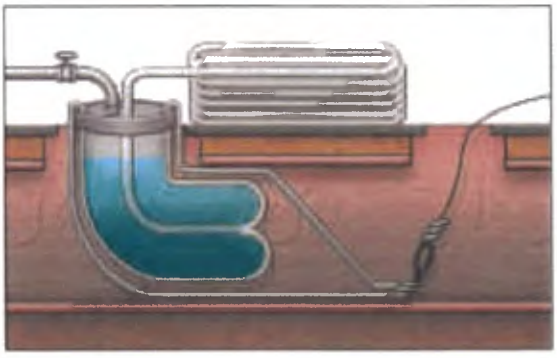


figure 3: Calibration hose or pre liner utilization

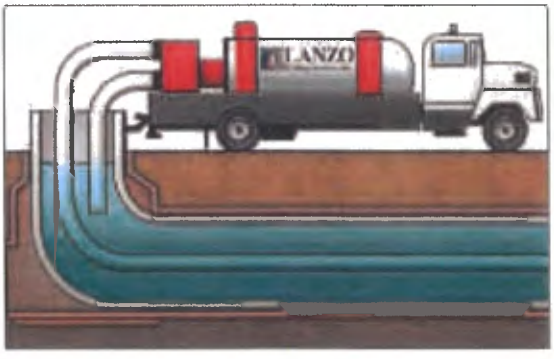


figure 4: Curing liner with hot water or steam

The direct inversion method is the most popular method, available in virtually all sizes, and especially suited to the "over the hole" technique.

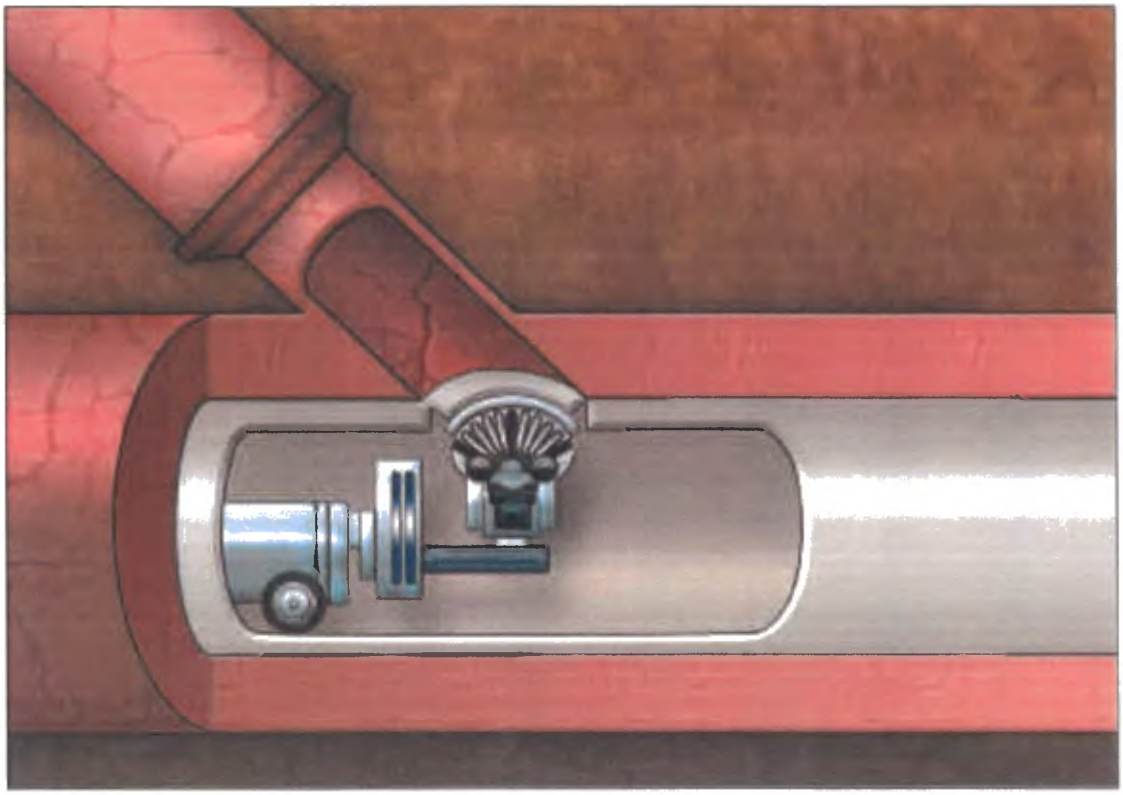
Pulled-in-place CIPP installation is installed to meet or exceed the requirements of specification ASTM F 1743. For this technique a cable is strung through the existing pipe and attached to the tube. Once attached, the tube is carefully pulled into position as shown in Figure 2. In order to reduce potential friction between the pipe and the liner, hydrant water may be introduced into the pipe through the manhole, allowing the tube to easily slide down the pipe. Through the choice of tube materials and careful pulling techniques, pulling forces rarely exceed 10-20% of the maximum tensile properties of the fabric tube. Tube stretch is less than the maximum 5% specified in ASTM F1743, but is usually less than half that value. For a more detailed estimation of maximum tensile strength of a tube and estimated pulling forces, contact Lanzo Lining Services.

Pull in place employs a second installation step. A calibration or retractable hose is inverted into the center of the resin-saturated tube by a hydrostatic head of water. This hose sequentially inflates the resin-saturated tube from one access point to another and holds it tight against the existing pipe as shown in Figure 3. Any residual water trapped in the pipe is directed downstream as the calibration hose inflates and longitudinally progresses within the tube sequentially from one end of the pipe to the other.

Pull in place is extremely instrumental in the many special applications such as Pressure pipe, transitional sizes, NSF 61 water main, ventilation plenum rehabilitation, and large diameter applications where particular placement challenges exist.

CIPP Curing and Cool Down - Once installed by direct inversion or pulled-in-place the tube is cured through the use of circulating heated water, introduction of steam, or the use of an ultraviolet (UV) light.

When water is used, it is taken into the water heater from the column and discharged out into the center of the installed tube at the downstream end. The heated water circulates back to the column at the upstream end where the cycle in



Robotic reinstatement of house connection or "lateral" sewer

continued throughout the curing process as shown in Figure 4.

When steam is used as a heat source, the steam is typically introduced at one end and flows through the length of the liner and out the downstream end through a specialized manifold that helps control temperature and internal pressure. New innovations in steam generation technology allow for dryer steam and can also allow the installer to cure at much higher temperatures than circulating hot water.

UV light is a third method of curing CIPP and requires specialized resins and photo sensitive initiators. UV light curing technology is relatively new in North America, but has been used for many years overseas and is proving to have advantages for many different applications. Liners can be stored and transported without refrigeration and still be viable months. When the lights are turned on, curing takes place within minutes.

Whether cured with water or steam, the process must be carried out in a controlled manner with the temperature monitored at both ends of the tube with thermocouples placed between the liner and the host pipe. In addition, the water/steam temperature is monitored at the heater and may also be monitored at the downstream end of the liner. Where intermediate access points exist, the curing process of the tube may also be monitored at those locations also.

Most often the tube is cured in a two-staged heating process and cooled down in a controlled manner to a temperature below 100F. The times and temperatures of these different stages are highly variable based on tube diameter, length, thickness, resin type, catalyst formulation, size of the water heater, environmental and job site conditions. In general, thick tubes require extended curing and cooling times, while thinner tubes may be cured more rapidly. The variable cure times and tube thickness relate to the slow heat transfer into and out of the tube, as well as the requirement to control the exothermic (i.e. heat producing) reaction that occurs when the thermoset resin in the tube polymerizes.

Lateral Reinstatement and Finishing Steps - Once installed, cured and cooled down the CIPP is fully opened on both ends while any lateral connections leading to the pipe are then reinstated. When the pipe is too small for a man entry, CCTV is used to re-locate lateral connections and remotely operated cutting machines are used to re-open the lateral connection. At the manhole connections an end sealing procedure may be utilized which helps eliminate infiltrating water from tracking down or around the host pipe and/or CIPP and re-entering the collection system at the manhole. Where there is heavy groundwater some type of lateral sealing technology is recommended where the lateral connects to the main line. Top hats or interface seals may be applied remotely from inside the liner using a robot without the need to introduce a cleanout or other above ground access. Other trenchless sealing techniques include chemical grouting, lateral lining at the connection and/or up the entire lateral, or robotic placement of polymer putty. Alternatively, laterals may be opened and sealed by making a point excavation to place a new saddle connection at each lateral.

Final Inspection - As with any project, final CCTV inspection provides the documentation for the project engineer that the CIPP was properly installed. Ideally CIPP is smooth and wrinkle free throughout the length of the installation. However, CIPP cannot eliminate piping irregularities and will mirror pre-existing problems in a defective pipe being lined to eliminate I/I, exfiltration, or improve structural integrity. In addition, fins in the CIPP can occur when the pipe diameter decreases to less than the nominal diameter of the existing pipe. During the engineering and design phase of a contract, tubes are commonly specified with an undersized diameter (i.e. 4-8% undersized) to anticipate host pipe diameter changes and moderate bends. When encountering crushed pipe, PVC pipe used for point repairs, and clay pipe the host pipe diameter can decrease to the point where these measures cannot prevent fins. Fins are also unavoidable in sharp bends where the inner radius bunches going around the bend. Wrinkles such as these are cosmetic defects in an otherwise defective host pipe and prevalent in all CIPP construction. Since most all fins run along the length of the pipe they typically increase the physical properties like that of a built-in I-beam and do not affect flow. Typically fins in the CIPP are of little concern to the overall performance objectives of the rehabilitation project.

CIPP PROJECT SPECIFICATION

To insure the desired results from a CIPP rehabilitation project, proper specifications must clearly outline the objectives. With any rehabilitation project it is recommended that the collection system be evaluated as a whole and pipeline sections be segregated for repair using the appropriate rehabilitation technology(s) most suited for the stated project objectives. A project may be put out to bid with multiple technologies (i.e. CIPP, sliplining, open cut replacement, lateral lining) to achieve the desired end result. Exclusive rehabilitation with CIPP is recommended in areas where any or a combination of the following conditions may exist:

1. Suspect structural characteristics in the host pipe are manifested in the form of radial or longitudinal cracks, offset and/or displaced joints.
2. Ovality sufficient to preclude sliplining or folded and re-formed products from reaching a full round configuration consistent with ring compression support theory (see Design Section).
3. Pipes where sections are completely missing.
4. Pipe subject to highway loading in shallow or live loads.
5. Deeply buried pipe where high external hydrostatic pressure may exist.
6. Pipe with line and/or grade differentials (i.e. existing bellies in the pipe run) that may produce friction for sliplining and/or not allow folded products to reach their fully rounded state after installation.

Once it has been determined that CIPP is the proper choice for pipeline rehabilitation there are many aspects of specification that will determine the success and quality of the completed project. Prequalification factors such as threshold contractor experience, minimum installed footage, same liner size or larger, key employee resumes and local wet out facility are significant items that may be taken into account prior to bid. Contact Lanzo Lining Services for a sample specification that can be used as a template for your specific CIPP project.

ASTM SPECIFICATION

ASTM standardization is extremely important to insure consistency in materials and installation practices, while minimizing owner liability in ongoing construction work. It may take as long as five (5) years to obtain a ratified specification. After initial publication ASTM standards are kept current through a mandatory review process that is required every seven years. If there is no interest to review a standard it is dropped from publication. Standards exist for virtually every pipe rehabilitation product, including CIPP. ASTM does not purport to cover all the details of every project or installation, but does provide a valuable framework and set of guidelines that are absolutely necessary for the underground rehabilitation industry in general.

ASTM D5813 "Specification for Cured-In-Place Thermosetting Resin Sewer Pipe" covers material requirements for the resins and fabric tube materials used for CIPP. ASTM D5813 also outlines test methods for evaluating installed CIPP.

ASTM F1216 "Practice for the Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube" provides guidelines for the installation of CIPP with the direct inversion method.

ASTM F1743 "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)" is an installation standard practice for the pulled-in-place method of installation. ASTM F1743 references both ASTM F1216 and ASTM D5813 for designing and specifying CIPP.

As with any technology there are critics within and outside the CIPP industry regarding the validity of the aforementioned standard practices. Two areas that have come under extreme scrutiny are the design criteria and pre-qualifying materials for chemical resistance testing. CIPP gravity sewer design is divided into "Partially and Fully" deteriorated existing piping criteria. Based on the pipe classification, the CIPP is designed to either withstand hydrostatic loading only, or

all possible external loads that the CIPP may be exposed to. In addition, some municipalities have developed their own chemical resistance and design criteria, which is much more severe than that specified in ASTM (i.e. The California Green Book [15]). Proponents and supporters of these specifications argue that CIPP has performed admirably in the U.S. for over 40 years and has not failed as a technology because the approach taken has been conservative and aimed at long term performance for the product(s).

Lanzo Lining Services supports the more conservative approach to specification selection. With over six million (6,000,000) feet of failure free installation, primarily in fully deteriorated design basis, serves as testimony to the confidence attainable in a conservative approach.

CIPP APPLICATION GUIDELINES

Since the publication of our premier Design Guide ten (10) years ago there has been an absolute transformation within the CIPP marketplace with respect to comfort with this technology and a relative boom in the range of application for composite felt/resin liner systems.

Lanzo has remained an innovator and pioneer installer of CIPP in many cutting edge applications such as:

- I/I reduction in sanitary collection systems
- Large Diameter and Non Circular sewers, storm drains, and box culverts
- "Over the Hole" wetout and installation
- High temperature chemical concentrations and industrial sewers
- Pressure rated force main sanitary sewer transmission
- NSF 61 certified water main rehabilitation
- Green resin utilization in wetland or environmentally sensitive areas
- Air duct ventilation repair and vacuum pressure line
- Contaminated soil remediation prevention
- Flood control structure rehab
- Submerged or canal enclosure pipeline rehabilitation

CIPP has been installed by Lanzo in diameters ranging from 6" through 144".

The utilization of direct inversion, pull in place, and hand lay-up methods are application dependant but generic in terms of the design parameters presented in this guide. Additionally, both gravity and pressure rated design is presented herein, while an abundance of information has been accumulated on each of these methods available for informational or specification writing purposes by contacting Lanzo.

COMPETING TRENCHLESS PIPELINE REHABILITATION TECHNOLOGIES

In general, trenchless pipeline rehabilitation technologies have proliferated and gained extraordinary acceptance because of the changing chemical environment previously described, enforcement of the clean water regulations, inadequacies of traditional piping materials, and the rising social costs of traditional dig and replace methods. Social costs include the direct and indirect costs that will impact the community surrounding the project. These costs might include destruction of old trees, disturbance of a wetland habitat, disruption to businesses, and impact of traffic congestion on side streets as people are forced to take alternative routes. A number of experts and engineering firms have studied this more closely to develop generalized costs [16]. Pipe repair alternatives include chemical grouting, point repairs/excavation, internal robotic repairs, sectional liners, sliplining, CIPP liners, fold and form liners, and pipe bursting. Acceptance of new technologies has increased competition and pushed the cost down to the point where the cost of a trenchless repair is generally less costly than trenching, even without taking social costs into consideration.

Table 1. Generic costs of Pipeline Construction and Repair Methods [16].

Method	Cost/Inch Diameter/Foot	Type of Installation
Sliplining	$4-$6	Rehab
Grouting	$4-$6	Rehab
Cured-In-Place Pipe	$4-$8	Rehab
Pipe Bursting	$8-$10	Rehab
Over the Hole large diameter CIPP	$10-$28	Rehab
Trenching	$15-$30	Rehab or New
NSF 61 Water main CIPP rehab	$20-$30	Rehab
Sectional CIPP Liner	$50-$85	Rehab

Each method of repair has a niche where it is most applicable. These technologies are briefly reviewed with the understanding that the included summary cannot encompass the full scope of each technology.

Chemical Grouting - Chemical grouting is a technique primarily used to seal leaks in pipes or lateral connections in pipe diameters typically in the range of 6 inch to 24 inch. It has been used for years and includes material selection options such as acrylamide gel, acrylic additives, urethane gels or foam. These products are typically injected under pressure with a specialized packer that forces the liquid grout through the hole in the pipe into the surrounding soil envelope. There it polymerizes to form a solid or semi-solid gel that pervades the soil envelope serving to non-structurally seal the pipe. Grouting is economical and effective but temporary in sealing leaks and not a structural repair to a damaged pipe. The estimated effective lifetime of various grouts is an ongoing point of debate which points to a range from 3 to 7 years.

Sectional or Part Liner – Developed as a repair technique for CIPP defects, this method has seen expanded application and is perhaps "over used" to repair damaged pipe. It can be designed as a structural repair to a fully deteriorated host pipe. This method is essentially a short CIPP repair that may be furnished in lengths ranging from 3 feet to as long as necessary, depending on diameter and location of the repair. The primary issue in electing to utilize this technology is the selection of an adequate repair length. Pre video inspection reports revealing target defects do not offer insight into the underlying cause of the failure or extent of soil envelope deterioration. Consequently, a seemingly adequate repair may not prevent crack propagation outside of the limits of the sectional repair after a relatively short time. It is judicious to select a sectional repair length which takes this phenomenon into account by extending the repair to several joints in either direction beyond the target defect. Additionally, a maintenance program should exist to monitor these repairs over time as post cure shrinkage as well as other effects may cause movement of the short liner.

This method is most typically used for pipes 8 inch to 24 inch in diameter, but is available in diameters as large as 120". Fabric tubes constructed of woven and/or non-woven materials (i.e. polyester felt and/or fiberglass) are manufactured for the project and saturated with a variety of resins which have been modified for a reactive cure with low heat or UV light. The sectional liner is typically pulled into position on a carrier or packer which is then pressurized causing the short CIPP segment to expand tightly against the host pipe then allowed to cure in place.

A practical alternative to this method is an installation technique called a "blind shot" or a sectional CIPP liner section which only requires access to the pipe at one end for a starting point. Although Part Liners typically do not run manhole to manhole, this variety of sectional pipe repair offers the additional benefits of:

-
- a solid connection to a manhole-pipe interface
- a repair which is readily visible from the manhole
- the ability to line past the defect by several joints thus clearing the suspect soil envelope by a more conservative distance

Service Connection Reinstatement, Repair, Interface Seal and Lateral Lining Lanzo has become proficient in providing several technologies to repair lateral connections and lateral pipes both remotely from within the mainline, as well as, from a cleanout located at the property line. These repair technologies require specialized liner materials and equipment, but can successfully seal the lateral-mainline connection and rehabilitate the smaller lateral pipe up to the house or business. These methods require experienced field technicians with an understanding of varying host pipe materials, resin cure, remote camera and robotic equipment operation, variable temperature, flow and piping conditions to complete a successful time sensitive repair.

Different technologies exist in the marketplace which utilizes either water or air as placement media with either water, steam, or UV light for curing the resin systems. There exist several proprietary technological approaches while the end user should be cautious to insulate themselves from sole source specification which may drive cost unduly higher as they become embroiled in trade issues such as full wrap vs. lateral region adhesion, or minimum length of interface seal dimension.

An interface seal is intended to eliminate annular space or shear condition, while lateral lining serves to seal and structurally repair the lead to a determined length within the service. Although certain lateral lining technologies may be remotely launched from within the main, a cleanout is routinely necessary to insure the removal of root manifestation and mineral deposits while visually inspecting defects within the lateral to be rehabilitated. The notion that a lateral may be routinely lined without a cleanout is therefore flawed.

Robotic Repairs - This is a highly specialized technology that can also be used as a trenchless point repair method to seal cracks and leaking lateral connections. Through the use of grinding tools and epoxy resins or chemical grouts a wide variety of pipe defects can be repaired. Widespread use of this method has been hampered by the initial purchase and maintenance expense of the robotic equipment employed which also requires highly trained personnel for a small portion of the repairs typically being addressed in a comprehensive system rehabilitation project.

Repairs consist of employing a remote cutter head to ream, gouge, or machine a channel into an existing defect which then is more receptive to an epoxy which may be robotically troweled or pumped into place. Typical repairs apply to pipes in the 8-inch to 24 inch robotic equipment are repaired with these techniques.

Point Excavation for Repair - When a pipe is severely damaged or crushed it may be most cost effective to dig at that location to repair the section of pipe. This method is often used in conjunction with trenchless lining techniques to replace collapsed sections so the existing pipe may then be inspected, cleaned and subsequently lined from manhole to manhole. All sizes, shapes, and varieties of pipe have been repaired with this method to effect a conventional open cut repair.

Sliplining and Segmental Sliplining - These methods can be used to either pull or push new plastic or composite system into the existing host pipe. Traditional or "discrete" sliplining typically either pulls a high-density polyethylene (HDPE) pipe or pushes a reinforced thermoset resin (RTR) or reinforced plastic mortar (RPM) through one access pit to another. Depending on site conditions, sections of pipe of 1000 feet or more may be pulled or pushed at one time. The pull method of pipe repair is most typically used on pipe 8 inch to 24 inch in diameter, but larger sizes have been installed. In 48 inch and larger applications, segmental sliplining with thermoplastic or composite pipe can become more cost effective depending on site conditions at the entry and receiving pit along with the costs associated with bypass pumping.

Segmental sliplining is performed by lowering individual sections of pipe into an access pit and hydraulically jacking each into the host pipe towards a receiving pit while maintaining pipe flow.

Hard pipe material slipline methods are limited by the frictional forces of the slipline material against the host pipe, which will determine the shot length or allowable distance between pits.

Sliplining reduces the overall hydraulic radius significantly and may reduce the capacity of the pipe rehabilitated. Factors such as pipe joint articulation , mineral deposits, bends and line obstructions must be thoroughly investigated prior to method selection. Reinstatement of lateral connections requires external point excavations.

Pipe Bursting - Pipe bursting is a technology where the existing pipe is sheared or cracked while a new pipe is pulled behind (sliplining) a specialized bursting tool. Many types of tools have been developed with hydraulic or pneumatic bursting capability and include pulling only, pulling and pushing, and so on. This method enables the owner to actually increase the size of the existing pipe by one or more diameters and actually increase the hydraulic radius. Pipe bursting has been used to up-size 8 inch to 10 inch or 12 inch and has been used to increase pipe up to 36 inch or larger, from smaller diameters. The technique works most efficiently on brittle host pipe materials, such as clay, concrete, asbestos cement and "pit" cast iron. HDPE is most often used as the replacement pipe, but PVC, composite pipe, and even clay have been used. The limitations to this technology involve use of the bursting tools when the pipe is close to structures such as foundations or utilities that cross the line being burst. Where these structures can be point excavated, bursting can proceed without incident. Reinstatement of lateral connections requires external point excavations.

Fold and Form Lining - This process uses plastic pipe that has been folded into a "U" shape allowing it to be steam softened then pulled into the existing pipe. Using steam heat and internal pressure the liner is reshaped to meet the existing pipe. Fold and form has been attempted in diameters ranging from 6 inch to 24 inch, but is most applicable in the range of 8 inch to12 inch. HDPE and modified PVC are the piping products used for fold and form. This method is a low cost rehabilitation technology that is used where the existing pipe can provide structural support to the liner for gravity flow applications. Potential problems exist where the liner does not fully unfold, making it susceptible to collapse under external groundwater pressure. For some products the modified PVC materials are often experimental in nature without extensive long-term property research behind them. Therefore, prior to use the owner should review all products carefully. In most cases lateral connections can be reinstated by remote cutting tools, but may require point excavation and typically require grouting to guard against flow tracking through an annular space. There is no reliable "adhesion" or "mechanical bond" between a thermoplastic material and a host pipe.

Pipe Preparation - Most of the technologies listed have the common need for pre-installation inspection, cleaning, and other forms of preliminary pipe preparation. For most applications by pass pumping is of minor concern in diameters up to 15 inch. In the range of 18 inch and above by pass pumping can become a significant portion of project planning and cost. Depending on site conditions pipes greater than 48 inches may be rehabilitated during flow diversions and using techniques that minimize the reliance on by pass pumping.

Lanzo Lining Services brings experience with dig and replace, new pipe construction and multiple rehabilitation technologies while adding value to the project. The Lanzo Companies can combine construction capabilities to optimize the allocation of municipal dollars while streamlining coordination efforts on any given project.

CIPP ENGINEERING AND COMPOSITE MATERIAL PROPERTIES

Since 1993, Lanzo Lining Services representatives have actively participated in national organizations such as ASTM, NASTT, AWWA, APWA and NASSCO in an effort to assist owners, municipal and plant engineers maintain the most current material specifications. Lanzo Lining Services' objective is to provide a competitive CIPP product that will meet or exceed the EPA mandated fifty-year design life. To satisfy ASTM and municipal/industrial specifications it is critical to select tubes, resin, and catalyst products from qualified suppliers providing the highest quality materials and services. Lanzo Lining Services only uses the finest quality manufactured products and supplies from ISO 9000 certified sources. In the following sections, minimum and typical property values for the fabric and resin products are provided. In order to remain competitive while providing the highest quality CIPP; Lanzo Lining has continued to review and update the following published criteria, as the industry and job conditions necessitate.

FABRIC TUBE MATERIALS

The flexible fabric tube is one of several key elements of the CIPP process. The materials used to construct tubes must possess chemical resistance, flexibility, an ability to stretch and conform to irregular piping, and be durable to withstand the rigors of underground construction. Currently, the most commonly used fabric tube material in North America is composed of thermoplastic polyester fibers needled into a dense felt. However fabric tubes made of combinations of needled polyester and polypropylene fibers and needled polyester with various fiber reinforcements are also available. Depending on fiber orientation, liners constructed of fiberglass tubes can easily produce a flexural modulus that would exceed 1,000,000psi and flexural strength values over 15,000psi. At the time this criteria was placed in the referenced ASTM specifications the targeted material(s) were needled polyester felt and coated polyester felt. Many coatings may actually enhance the properties of a tube. Table 2 includes typical values for plain polyester felt and coated polyester felt.

Table 2. Typical tensile properties for polyester felt and plastic coated felt.

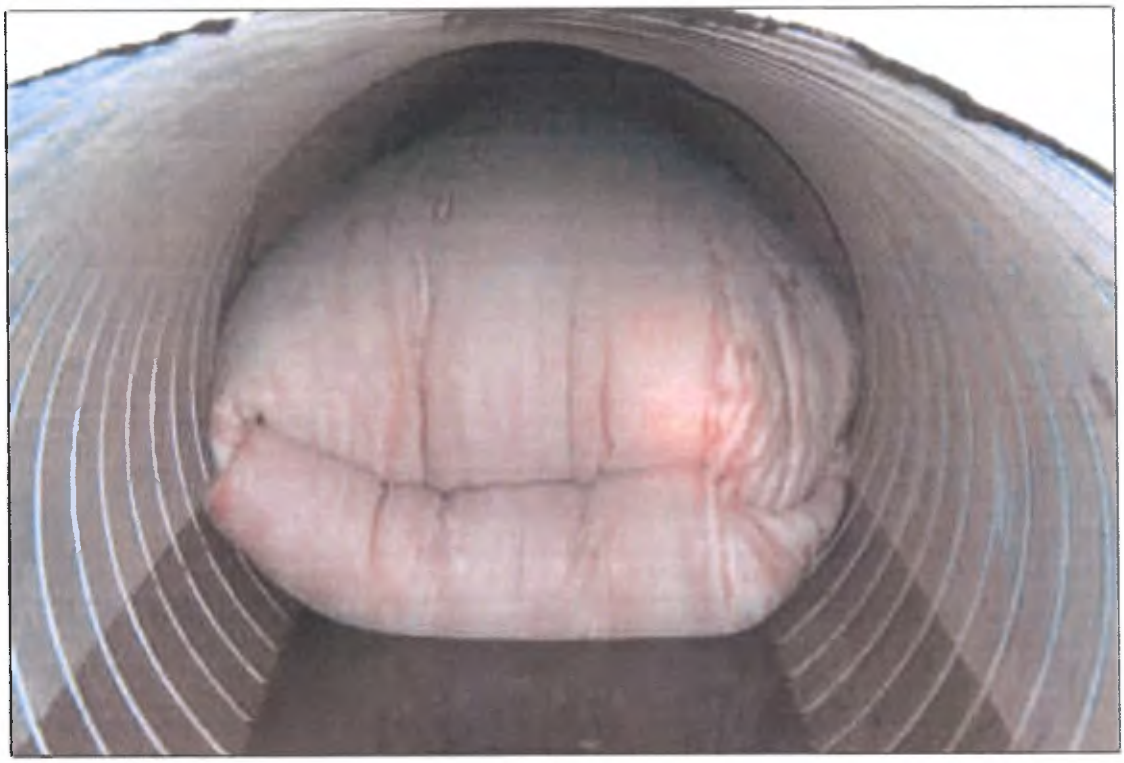
Material	% Elongation at Failure	Ultimate Tensile Strength
Felt	85-95	800-1000 psi
Plastic coated felt	70-75	1200-1500 psi

THERMOSET RESINS

Resins Overview and Properties

The thermosetting resins used for CIPP are the most important component to the short- and long-term performance of the product. First, there is a distinction between initial or short-term properties and the long-term performance that dictates the life span of a product. Short-term properties include parameters such as flexural, tensile, and compressive properties. Long-term properties include parameters such as chemical resistance, creep, and strain corrosion. Most all these parameters are important for the qualification, design, and performance of CIPP.

There are three main groups of thermoset resins used for CIPP and they consist of polyester, vinyl ester and epoxy resins. Within each of these three categories exist hundreds of combinations of products with their own characteristics that distinguish their performance. A number of papers have been published that generally review the short- and long-term performance of these three classifications of thermoset resins. In general epoxy and vinyl ester resins are higher performance products compared to polyester resins. They have higher strength, elongation, elevated thermal and chemical resistance compared to polyesters. However, not all pipe rehabilitation applications require the elevated performance of a vinyl ester or epoxy resin. The vast majority of standard gravity flow sewer pipe rehabilitated has been accomplished with polyester resins. However, since there are so many types of products within each category typical properties provided are given as a range of values that could be expected. Table 3 provides some typical properties of neat resins formulated for CIPP that have 'not' been combined with any fabrics or specialty fillers.



Frontal view of 60 inch diameter direct inversion

Finished outfall product at the headwall

Table 3. Typical neat physical properties.

Test Property	Epoxy Resin	Epoxy Vinyl Ester	Isophthalic Polyester
Flexural Modulus[1], psi	500,000-550,000	500,000-570,000	500,000-570,000
Flexural Strength, psi	15,000-25,000	15,000-25,000	10,000-18,000
Maximum Strain, %	4-7%	4-7%	3-5%
Tensile Modulus[2], psi	490,000-540,000	490,000-560,000	490,000-560,000
Tensile Strength, psi	8,000-10,000	8,000-10,000	5,000-8,000
Tensile Elongation, %	4-7%	4-7%	2-5%

1 Flexural properties determined by ASTM D790

2 Tensile properties determined by ASTM D638

Resin/Felt and Resin/Fiber Composite Properties

When the aforementioned thermoset resins are combined with the flexible fabric of a tube, material properties can be dramatically changed, as previously overviewed in the FABRIC TUBE MATERIALS section. The following discussion will focus primarily on the effects of needled polyester felt tubes on the material properties of a thermoset composite. There are several reasons for the observed effect on physical properties. First, the randomly oriented needled fibers of a felt tube are not oriented in a manner that can become load bearing. Therefore, modulus or stiffness and strength values are often reduced 30-50% compared to the neat resin properties. However, it is not as simple as it appears, since fiber types, sizes, orientation, and felt density can also affect material properties. In addition, felts made of combinations of polyester, polypropylene, and/or polyethylene fibers have varying performance due to the level of resin adhesion to the fiber(s). Polyester fibers tend to slightly solvate when exposed to styrene based resins (i.e. polyester and vinyl ester) and bond extremely well. Tubes made with a combination of polyester felt and fiberglass fibers or entirely with fiberglass can produce extremely high physical properties. By so doing, the designer can produce CIPP with a reduced wall thickness, but still perform extremely well for either external hydrostatic pressure or internal pressure applications.

The resin component of the resin/felt or resin/fiberglass composite can also be modified with fillers to effect the processing parameters and the mechanical properties of the composite. The viscosity of thermoset resins developed for CIPP are modified with specialty fillers called thixotropes. Thixotropic fillers are added at small levels (i.e. 1-3%) to increase the viscosity of the resins so that they stay in the tube fabric during processing and installation and do not drain out of the tube and into the host pipe, ground, lateral connections, etc. Thixotropes typically do not effect physical properties since they are added at such low quantities.

Other mineral fillers such as aluminum trihydrate (ATH) are also added to resin to enhance the overall material properties. Newer formulations with calcium carbonate and calcium carbonate/ATH combinations have been developed and have recently been introduced to the market. ATH and other fillers are added to significantly increase the modulus (i.e. stiffness) of the overall composite without diminishing the resins' processability, or decreasing the strength or the chemical resistance of the CIPP. Increasing the modulus of the composite can provide some cost advantages when designing CIPP and this is reviewed in the ENGINEERING DESIGN section of the manual. In addition to design advantages, resins with fillers have an increased thermal conductivity and therefore heat up more uniformly through the entire thickness of the tube which is especially helpful when working in cold climates. Fillers reduce resin and tube shrinkage during curing and cool down, which provides a tighter fit to the host pipe after the CIPP is installed. To illustrate the effects of resin/felt composite properties in Table 4 is provided with typical properties. As consistent with Table 3, these properties are generated from experimental panels made in laboratory conditions and should not be misconstrued to be typical of all installed CIPP.

Table 4. Typical property ranges for resin/felt composites consistent with CIPP construction.

Test Property	Epoxy Resin Data	Epoxy Vinyl Ester Data	Isophthalic Polyester Data	Filled Isophthalic Polyester Data
Flexural Modulus, psi	480,000-550,000	480,000-570,000	480,000-570,000	550,000-750,000
Flexural Strength, psi	10,000-12,000	10,000-12,000	7,000-9,000	7,000-8,500
Maximum Strain, %	3-5%	3-5%	2-4%	2-4%
Tensile Modulus, psi	490,000-540,000	490,000-560,000	490,000-560,000	550,000-750,000
Tensile Strength, psi	7,000-10,000	7,000-10,000	6,000-9,000	5,000-8,000
Tensile Elongation, %	2-4%	2-4%	1-3%	1-3%

Minimum Recommended Design Properties

Typical properties of neat and resin/felt composites produced in the laboratory are not typical of the product produced in the field. When all the parameters of the preparation, installation, curing, and sampling are carefully monitored and controlled the properties of installed CIPP fall within the median range of data provided in Table 4. However, there are many uncontrollable variables of an underground construction project that can negatively affect the end product. The net overall result is that variability is increased and the variability in the test data also increases. Therefore, minimum property values have been established within the industry to provide a conservative minimum value for flexural and tensile properties of installed CIPP. Table 5 provides recommended minimum design values for standard CIPP. The values in Table 5 are relatively low compared to the values of Table 4, but the median value of installed CIPP is typically 15-25% higher than minimums. However, cold weather, high groundwater, poor water or steam circulation and/or equipment failure can produce reduced properties just above the minimum standards. In effect, the majority of all CIPP installed essentially has an additional factor of safety due to the conservative design practices that have been adopted in ASTM standards. Minimum properties are given for both flexural and tensile properties, but it should be pointed out that tensile properties are only used in the design of fully deteriorated (stand-alone) internal pressure pipe.

Although not emphasized in this design guide, minimum properties using fiberglass reinforced liners might be specified with a flexural modulus that would exceed 1,000,000psi and strengths that would exceed 10,000psi for gravity flow applications. With proper fiber orientation, tensile properties can also be greatly enhanced for internal pressure applications like NSF 61 potable water pipe rehabilitation and/or sewer force mains.

Table 5. Minimum recommended design properties for CIPP.

Test Property	Epoxy Resin Data	Epoxy Vinyl Ester Data	Isophthalic Polyester Data	Filled Isophthalic Polyester Data
Flexural Modulus, psi	250,000-300,000	350,000-450,000	250,000-350,000	400,000
Flexural Strength, psi	5,500	5,500	5,500	5,500
Tensile Strength, psi	3,000-5,000	3,000-5,000	3,000-5,000	3,000-5,000

Creep Properties of Thermosetting Resins

Engineering materials of all kinds deform when placed under a load and this is a basis for careful engineering and design for any structural application. When materials such as thermoset and thermoplastic resins are subjected to low loads relative to their ultimate breaking point they will experience incremental deformation occurring over a period of time. These deformations occurring over the design life of a product is referred to as creep. Creep is affected by many factors that include the type of material being analyzed, the degree of cure (for thermoset resins), environmental conditions (temperature, chemical agents), and the amount of load applied. For the thermoset resins used for CIPP creep is an important design parameter that must be taken into account to provide an adequate factor of safety over the design life of the pipe. Loading on CIPP occurs when it is installed under the water table and uniform hydrostatic pressure pushes uniformly around the circumference of the CIPP. Additional forces can occur where CIPP is installed in unstable soil conditions and/or live loads act

on the pipe. In these cases the loads may not be uniform, but would push down on the upper half of the CIPP creating a combination of complex loading conditions.

In order to understand long-term creep performance of common resin/felt composites mechanical tests have been developed to characterize the performance of CIPP. The typical expected design life of CIPP is fifty (50) years so testing is performed in a way to estimate long-term performance and produce a safety factor that can be applied to the design of CIPP. Tests include hydrostatic buckling and three point bend tests performed under constant loading conditions. Tests are typically performed over a time period of 10,000 hours. The data is statistically fit to a line and extrapolated out to fifty (50) years for the design life of the CIPP. The reduction of stiffness due to creep is applied to the short-term flexural modulus (as given in Table 5) to estimate a long-term modulus (EL). Many confidential research projects have been conducted without publication until Louisiana Tech University carried out a research program to evaluate the long-term performance of a number of pipe lining products [17]. The results of this study have been highly controversial due to criticism over uncontrolled variables and statistical data treatment. However, this research created a basis for additional analysis and comparison between hydrostatic testing and three-point bend testing as specified in ASTM D2990 [18].

Published results of the aforementioned testing indicate factors like degree of cure, loading level, thermal and chemical environment, and type of resin and/or reinforcement will affect the amount of creep that may be experienced over the life of installed CIPP. Therefore, test results have been analyzed to develop a conservative recommendation for creep. When all conditions are set equal it is generally understood that there are differences between resin types. Therefore, the minimum recommendations in Table 6 given for the different resin categories used for CIPP are multiplied times the short-term modulus or strength to obtain the estimated EL (long-term modulus), sL (long-term flexural strength), or stL (long-term tensile strength) used for long-term CIPP design. For special applications such as pressure pipe, industrial chemical exposure, and/or elevated temperature consult Lanzo Lining for creep recommendations.

Table 6. Recommended minimum factors for creep

	Epoxy* Resin	Epoxy Vinyl Ester	Isophthalic Polyester	Filled Isophthalic Polyester
Creep Factor	0.25 - 0.6	0.5 - 0.6	0.4 - 0.5	0.4 - 0.5

*The creep factor of epoxy resins is quite variable depending on the curing agent chosen. Consult Lanzo Lining technical services for proper recommendations.

Thermal Properties of Thermoset Resins

The thermal properties of thermoset resins are measured by the heat distortion temperature (HDT). The HDT is not the only method of determining the performance of resins at elevated temperature, but is a commonly used indicator. Thermoset resins have what is called a glass transition temperature (Tg) where their properties changing from a glassy or rigid state to a softer or rubbery state. When the temperature reaches and goes beyond the Tg of a particular resin its physical properties diminish significantly. However, as temperatures approach the HDT physical properties remain fairly constant. The Tg and HDT of resins are determined by the inherent chemistry of the resin and the degree of cure. Typical HDT values are provided for the different categories of thermoset resins in Table 7. When pipe rehabilitation products will be required to perform continuously at elevated temperatures alternative resins and/or additional factors of safety may be required to compensate for the resulting reduction of stiffness and/or strength.

Table 7. Typical heat distortion temperatures (HDT) for thermoset resins used for CIPP.

	Epoxy Resin	Epoxy Vinyl Ester	Isophthalic Polyester	Filled Isophthalic Polyester
HDT	150-225F	200-245F	190-225F	190-225F

Chemical Resistance Properties of Thermosetting Resins

By the nature of the application, most CIPP will be exposed to some type of chemical environment. Since most applications involve a combination of chemicals at varying concentrations it is difficult to evaluate all the possibilities that may be necessary to define the exact performance. To simplify this analysis standard chemicals are chosen at higher than normal concentrations. Testing can also be done at elevated temperatures to accelerate the effects of these chemicals on the resin/felt composites. To date there is no defined test method for specifically evaluating CIPP composites. The standard practice currently used is to adopt a modified version of ASTM C581, which was developed for fiberglass/resin composites. By so doing, four resin/felt coupons are submerged into the chemical of interest. At intervals of 30, 90, 180 and 360 days a coupon is removed from the chemical, weighed, measured, and tested for flexural properties. At the end of one year these separate evaluations are compared to a control coupon that was not exposed to the chemical. The one aspect of this test method that can create anomalies arises when the test coupons are not uniform. In other words, all five coupons should initially have identical physical properties before the testing starts. If one or several coupons had significantly higher or lower physical properties initially, this may adversely effect of the outcome of the protocol with an anomalous data point(s). For such cases it is common to eliminate that data point from the data set and use the remaining data as an indication of the overall performance.

Table 8 provides a set of chemical resistance performance for the different types of thermoset resins used for CIPP in a number of different chemicals. This set of chemical data was performed at an elevated temperature of 120F. The one-year data was statistically fit and extrapolated out to obtain a prediction of performance at 25 years. From the data it is clear that different resin categories perform differently in groups of chemicals. Isophthalic polyester resins generally perform extremely well in acidic chemicals (i.e. sulfuric, nitric, hydrochloric acids), but perform moderately in oxidizing agents (i.e. sodium hypochlorite, potassium permanganate, hydrogen peroxide), and poorly in basic chemicals (i.e. ammonium hydroxide, sodium hydroxide). Epoxy resins generally perform extremely well in basic chemicals, but also can withstand acidic and oxidizing chemicals. Epoxy vinyl ester resins have excellent overall chemical resistance to all three categories of chemicals.

Table 9 provides and estimate of the retention of physical properties of resin/felt composites using the chemical agents specified in ASTM F1216. The data obtained in Table 9 was run at room temperature and evaluated for a period of one (1) year. Several different resin types were tested and the 1, 3, 6 and 12 month data was averaged to obtain an overall estimate of the one-year retention of physical properties. This set of tests indicates a high level of chemical resistance to all the chemicals when evaluated at the aforementioned conditions. There also appears to be no significant difference between the standard polyester and the filled polyester resins.

When specifying a resin for CIPP it is obvious one must consider the chemical environment of the application. Since most sewerage applications are acidic in nature, isophthalic polyester resins typically are adequate and work well in this environment. However, it is often difficult to predict what may be introduced into a municipal sewer or industrial piping system. For example, odor-reducing chemicals commonly used in municipal sewers could be potentially damaging to polyester resins, while not effecting epoxy or epoxy vinyl ester resins. As the environment and managing personnel change over years, common practices also change, thereby changing the requirements of the CIPP.

Large bore trenchless renovation in "tight quarters"

Table 8. Chemical Resistance of Thermoset Resins Used for CIPP. Estimated Percent Retention of Flexural Properties.

		Percent Retention of Flexural Properties					
		Epoxy Vinyl Ester		Epoxy		Isophthalic Polyester	
Chemical Tested	Flexural Property	1 Year Actual	25 Years Estimated	1 Year Actual	25 Years Estimated	1 Year Actual	25 Years Estimated
2.5% Sodium	Modulus	100	99	30	42	0	0
Hypochlorite	Strength	100+	100+	42	45	0	0
5%Hydrogen	Modulus	96	94	76	84	75	65
Peroxide	Strength	100	100	66	84	83	76
5% Potassium	Modulus	100+	100+	90	83	84	77
Permanganate	Strength	98	97	83	60	62	49
5% Sodium	Modulus	74	65	78	88	0	0
Hydroxide	Strength	79	71	75	72	0	0
5% Ammonium	Modulus	76	65	66	65	35	22
Hydroxide	Strength	72	61	64	54	38	25
25% Sulfuric	Modulus	100+	100+	93	93	92	89
Acid	Strength	97	95	90	100+	93	91
20% Hydrochloric	Modulus	100+	100+	93	89	84	78
Acid	Strength	100+	100+	99	95	79	70
5% Nitric	Modulus	100+	100+	91	85	86	79
Acid	Strength	100+	100+	100+	82	82	75

Note: 100+ indicates the curve fit would predict physical property retention greater than 100%.

Table 9. Average Chemical Resistance of Typical Thermoset Resins Evaluated for One Year Using Chemicals Specified in ASTM F1216.

		Percent Retention of Flexural Properties		
Chemical Tested	Physical Property	Epoxy Vinyl Ester	Isophthalic polyester	Filled Isophthalic Polyester
10% Sulfuric	Modulus	92	98	90
Acid	Strength	90	87	94
5% Nitric	Modulus	98	95	86
Acid	Strength	93	87	99
10% Phosphoric	Modulus	87	94	87
Acid	Strength	89	90	99
100% Gasoline	Modulus	101	98	90
	Strength	94	94	95
100% Vegetable	Modulus	102	99	95
Oil	Strength	100	94	100
Tap Water	Modulus	92	95	85
	Strength	90	85	99
0.1% Detergent	Modulus	110	94	90
	Strength	108	90	94
0.1% Soap	Modulus	99	93	85
	Strength	95	89	98

CIPP installation at Joe Louis Arena – Home of the Detroit Red Wings

Rehabilitation of 900 feet of 72-inch sanitary trunk sewer at "The Joe"

STRUCTURAL DESIGN OF CIPP

In the previous sections of this Engineering Design Manual ASTM specifications F1216 and F1743 have been reviewed and the design equations utilized in this manual will conform to the requirements of these specifications. Alternative designs for CIPP have merits and potentially offer more accurate predictions of performance. However, it is not the purpose of this Design Manual to advocate or implement the use of these alternative design equations until they have been accepted and adopted by specifying organizations such as ASTM. In order to provide a basis for theses design models a review of the development of the design theory used in the ASTM standards will be discussed. To put these theories into perspective an overview of some recently introduced modeling alternatives will also be discussed in this manual.

DESIGN BACKGROUND

The objective of buried pipe design evolves around the ability to develop a set of equations that can take forces of ground water, soil loading and other pressures such as live loads into consideration. Through practical experience and scientific study it was determined that cylindrical structures such as tubes or pipe failed by buckling when exposed to an external load. Some of the earliest proven buckling theories published were carried out by Timoshenko and others in the early 1900's [19]. This work focused on buckling behavior of thin wall tubes. These equations were subsequently modified to take into account long tubes having a practical thickness consistent with the building materials available at the time. One of the first practical applications of this work was the successful development of the first submarines. The unrestrained buckling equation that was developed for long thin tubes is given as follows:

$$Pw = \frac{2 E t^3}{(1 - v^2) D_m^3} \qquad (1)$$

where,

Pw	=	Hydrostatic water pressure
E	=	Modulus of elasticity of the pipe
t	=	Pipe wall thickness
v	=	Poisson's ratio, typically = 0.3
D_m	=	Mean pipe diameter (Do - t)
Do	=	Mean outer CIPP diameter

In the 1940's Spangler published work that was conducted on flexible piping systems[20]. This work was the basis by which pipe stiffness of flexible pipes was derived. The measurement of pipe stiffness has been standardized with ASTM D2412[21] and is determined at a pipe deflection of 5%. This is a relatively simple test and is performed on free standing, unsupported pipe placed between two parallel plates that are pressed towards each other at a controlled rate. Spangler's also developed a model for the deflection of buried flexible pipe that took into account factors such as dead load forces, pipe bedding, and soil modulus[20].

Work by these early pioneering engineers was extremely important in laying the foundation that is the basis of the design equations used for CIPP. However, it is important to understand that there is very little similarity between the loading experienced by installed CIPP and that of buried rigid or flexible pipe. CIPP is installed into existing pipe that has typically been buried for many years. As such, the soil has long since consolidated and the soil pipe system is typically very stable. Therefore, installed CIPP is supported by the soil pipe system and subsequent pipe deflections can be expected to be minimal. When CIPP is installed into an existing pipe the surrounding pipe provides constrained ring support to the CIPP under the influence of uniform hydrostatic water pressure. When CIPP is exposed to this type of loading the CIPP is under compression. If the load increases to a critical level the CIPP will eventually deform and fail by buckling. Hydrostatic buckling experiments carried out by Aggerwal and Cooper[22], Lo and Zhang[23], and Kleweno[24] have clearly demonstrated practical ranges of the enhancement that can be obtained by the support

provided by the host pipe. These studies demonstrated that supported CIPP can buckle at pressures that are seven to fifteen times greater than that of unrestrained CIPP. In order to account for this support in the development of buckling equations used in the design of CIPP this phenomenon was characterized as an enhancement factor and assigned the variable "K". The enhancement factor is the ratio between the restrained buckling pressure and the unrestrained buckling pressure. By applying a statistical treatment of the data generated by Aggerwal and Cooper the value of K was assigned a value of seven (7). In other words, there is high statistical confidence that the restrained buckling pressure will be at least seven times greater than the unrestrained buckling pressure. By applying the enhancement factor and appropriate safety factors to the buckling equation attributed to Timeshenko, CIPP can be designed to easily withstand the hydrostatic forces that are prevalent around the pipe. In most practical applications, CIPP is installed in conditions where the hydrostatic pressure is significantly less than the critical buckling pressure. As such CIPP failure may still occur, but would occur over a very long period of time. This type of long-term buckling failure occurs as a result of plastic creep deformation. Materials such as thermoset and thermoplastic resins will undergo slight deformations over time when exposed to a constant load, such as hydrostatic water pressure. Given enough pressure and a long enough period of time, the CIPP can deform to the extent that it will produce catastrophic failure by buckling. In order to take the long term effects of creep into account the modulus of elasticity in the buckling equation attributed to Timeshenko was modified to a long-term modulus. In addition, a safety factor and correction for pipe ovality was also added to obtain the restrained buckling equation. By substituting the dimension ratio (DR) for the mean diameter and rearranging, the equation reduces as given below:

$$Pw = \frac{2KE_L}{(1 - v^2)} \frac{1}{(DR - 1)^3} \frac{C}{N} \quad (2)$$

where, E_L = Long-term modulus of elasticity of the pipe material

K = Enhancement factor, typically $K = 7$

DR = Do/t, Do = mean outside diameter of the CIPP

N = Safety factor

C = Ovality correction factor (See Appendix Table 12)

$$C = [Domin/(Domax)^2]^3 = [(1 - q/100) / (1 + q/100)^2]^3 = (r/re)^3 \quad (3)$$

$$q = 100 \times \frac{(D - Dmin)}{D}, \text{ or } 100 \times \frac{(Dmax - D)}{D} \quad (4)$$

where, C = Ovality reduction factor

q = Percentage of ovality of the original pipe

D = Inside diameter of the original pipe

$Dmin$ = Minimum inside diameter of the original pipe

$Dmax$ = Maximum inside diameter of the original pipe

The effects of long-term hydrostatic buckling of installed CIPP was studied by the Trenchless Technology Center (TTC) at Louisiana Tech University by Guice in 1994[17]. The study carried out by the TTC was an investigation into the long-term structural performance comparing the critical buckling behavior of several pipe rehabilitation systems (i.e. five cured-in-place pipe (CIPP) and one PVC fold and form (FNF)) from a number of commercial product manufacturers. These pipe rehabilitation products were installed in sections of round steel pipe that were sealed with gaskets on the ends.. The annular space between the steel pipe and the liner were pressurized with water at a number of different pressures and monitored over time as the products creeped, deformed, and eventually failed by buckling. Although the report was extensive the data produced had significant scatter and has been the subject of many subsequent papers

that questioned the inability to control experimental variables. Subsequent reports and presentations (McAlpine, 1996[25], 1996[26]) have pointed out the flaws of the testing program. These flaws include: 1) testing carried out in perfectly round steel pipe, 2) the CIPP was manufactured above ground under highly controlled conditions, 3) tested under controlled temperature and humidity conditions, 4) no influence of chemicals typically found in sanitary sewer conditions, and 5) lack of detailed statistical analysis. In recent years long-term tests have been extensively analyzed in an attempt to develop experimental protocols that can carefully control variables for long- and short-term hydrostatic buckling. In addition, there has been considerable research to define the relationship between EL and K, and/or to develop alternative buckling models that correlate more closely with data. The model developed by Glock[27] has gained considerable support (Guice & Li, [28], Schrock & Gumbel, [29]) as a more accurately representing existing data. New models being proposed are refinements that can represent pipe imperfections (Moore[30]) and ovality (Omara[31])) more accurately. With all the potential problems pointed out by a number of authors regarding the modified buckling equation that is currently used in ASTM F1216 and ASTM F1743, this equation appears to be providing a conservative design basis for pipe lining systems as evidenced by the lack of failures over the 30+ years of its use.

Since there is currently no single design equation that can be used for all the different conditions that must be taken into account for the proper design of CIPP it is necessary to divide these conditions into different groups. For both gravity flow and internal pressure design equations have been divided into categories of "partially deteriorated" and "fully deteriorated" conditions of the existing pipe to be rehabilitated. These piping conditions are defined as follows:

Partially Deteriorated Piping Condition

A partially deteriorated gravity flow pipe is one in which the existing pipe may have displaced joints, cracks or corrosion, but is structurally able to support all soil and surface loads. In this case the existing pipe is intended to provide structural support over the full circumference of the CIPP. When assuming a pipe is partially deteriorated, the CIPP will be designed to withstand uniform hydrostatic pressure over the full circumference of the CIPP. In addition, as a conservative approach, this design does not assume that the CIPP is attached to the existing pipe in any way.

A partially deteriorated pressure pipe is one in which the existing pipe may also have minor corrosion, leaking joints, and/or small holes, and should be free of any longitudinal cracks. In this case the existing pipe is assumed to be able to withstand the specified internal design pressure over the expected lifetime of the pipe. When assuming a pressure pipe is partially deteriorated, it is assumed that the CIPP will conform tightly against the host pipe everywhere (i.e. in bends or diameter changes, etc.) and uses the strength of the existing pipe to support the stresses. The thickness of the CIPP can be compensated to span small holes or leaking joints, but will not be of sufficient thickness to withstand design pressures. In addition, if the partially deteriorated pressure pipe is assumed to be leaking the designer must also be aware of external hydrostatic pressure to insure that the minimum CIPP thickness is sufficient to withstand these forces over the design life of the product.

Fully Deteriorated Piping Condition

A fully deteriorated gravity flow pipe is one in which the existing pipe has insufficient strength to support all soil and surface loads. A fully deteriorated pipe is characterized by severe corrosion, missing pipe, crushed pipe, longitudinal cracks, and severely deformed pipe. When assuming a pipe is fully deteriorated, the CIPP is designed as a pipe able to withstand all hydrostatic, soil, and live loads that may exist in the CIPP-soil system with adequate soil support.

An alternative strategy for fully deteriorated gravity flow pipes is available to the designer in areas where there are isolated sections of missing or severely offset pipe that would otherwise cause it to be classified as fully deteriorated. In these areas it may be possible to carry out point repairs, and rehabilitate the pipe as a partially deteriorated classification. However, each situation must be considered separately.

A fully deteriorated pressure pipe is one in which the existing pipe has failed and/or has insufficient strength to operate at specified design pressures. A pipe may also be classified as fully deteriorated if it is determined that it will not be able to withstand design pressures at some point during the expected lifetime. A fully deteriorated pressure pipe is characterized by significant loss of wall thickness due to severe corrosion, large holes, missing sections of pipe, and leaking longitudinal cracks. When assuming a pipe is fully deteriorated, the CIPP is designed as a stand alone pipe able to withstand all internal pressure. In addition, the designer must also be aware that fully deteriorated CIPP pressure pipe must be capable of withstanding external hydrostatic pressure.

PARTIALLY DETERIORATED GRAVITY FLOW CIPP DESIGN

When rehabilitating existing pipe that has been classified as partially deteriorated in a gravity flow condition the restrained buckling condition applies. In this case the classical buckling equation that has been described previously is re-arranged to solve for CIPP thickness as follows:

$$t = \frac{Do}{\left(\frac{2KE_LC}{PwN(1-v^2)}\right)^{1/3}+1} \qquad (5)$$

where,
- Do = Mean outer CIPP diameter, inches
- K = Enhancement factor, typically K = 7
- E_L = Long-term modulus of elasticity of the pipe material
- C = Ovality correction factor (See Appendix Table 12)
- Pw = External water pressure measured above the pipe invert (See Appendix Table 13)
- N = Safety factor, typically N = 1.5 - 2.0
- v = Poisson's ratio, typically v = 0.3

For partially deteriorated design conditions where the groundwater is below the invert of the pipe the hydrostatic pressure is equal to zero and the restrained buckling equation cannot be used to calculate CIPP thickness. For this special design case the calculated thickness of the CIPP must be equal to or greater than that which will produce a maximum dimension ratio of DR = 100. When this special design condition exists, CIPP thickness is determined by the following equation:

$$t = Do/100 \qquad (6)$$

When designing for circular partially deteriorated pipe the CIPP is under constant compressive hoop stresses. If the existing pipe is out of round or has localized ovalization, bending moment forces may predominate on the CIPP. For this special case the CIPP must be checked to insure that the bending forces do not exceed the long-term flexural strength of the CIPP. To make this determination the bending stresses on the CIPP are determined by the following equation:

$$\frac{S}{PwN} = [1.5q/100\,(1 + q/100)DR^2] - [0.5(1 + q/100)DR] \qquad (7)$$

where q is defined by Equation 4 and the other parameters have been defined previously.

Partially Deteriorated Design Example

Determine the minimum wall thickness required of the following piping condition:

1) Existing pipe classification = Partially deteriorated

2) Mean outer CIPP diameter (Do) = 24 inches

3) Minimum pipe diameter (Dmin) = 23.1 inches
4) External water above invert = 8 feet
5) Minimum CIPP modulus (E) = 350,000 psi
6) Minimum CIPP strength (s) = 5,500 psi
7) Long-term modulus (E_L) = 175,000 psi
8) Long-term strength (s_L) = 2750 psi

A. Determine hydrostatic pressure acting on CIPP

P = 8 ft x 0.433 psi/ft water = 3.46 psi

B. Calculate the pipe ovality

Determine q using Equation 4.

q = 100(24 - 23.1)/24 = 3.75%

Determine ovality reduction factor using Equation 3

$C = [(1 - 3.75/100)/(1 + 3.75/100)^2]^3 = 0.715$

C. Determine minimum CIPP design thickness using buckling Equation 5

$$t = \frac{24}{\left(\frac{2(7)175{,}000(.715)}{(3.46)2(1-.32)}\right)^{1/3} + 1} = 0.36 \text{ inches}$$

D. Because the pipe is out of round, bending stresses must be calculated to insure they do not exceed the long-term flexural strength of the CIPP

Determine S using Equation 7

DR = Do/t = 24/0.36 = 66.6

$S/(3.46)2 = [1.5(3.75/100)(1 + 3.75/100)66.6^2] - [0.5(1 + 3.75/100)66.6]$

S = 1552.2 psi

E. The minimum CIPP design thickness is 0.36 inches because the bending stresses are less than the long-term CIPP flexural strength. However, if the bending stresses had exceeded the long-term flexural strength then this equation would control the design. In this case solving for the proper thickness can be accomplished by trial and error. Start by choosing dimension ratios (DR) that are smaller than previously used until the bending stress is less than the long-term flexural strength of the CIPP.

FULLY DETERIORATED GRAVITY FLOW CIPP DESIGN

When rehabilitating existing pipe that has been classified as fully deteriorated in a gravity flow condition ASTM F1216 and ASTM F1743 specifies the use of a design equation from AWWA C950 that has been modified by adding the ovality reduction factor, and the consideration of long-term effects due to creep. In this case the modified AWWA C950 equation from ASTM F1216 has been re-arranged to solve for CIPP thickness as follows:

$$t = .721\ Do \left(\frac{(NP_t)^2}{CE_L RwB'E'}\right)^{1/3} \quad (8)$$

where, P_t = Total pressure due to water, soil and live load acting on pipe, psi
Rw = Buoyancy factor, dimensionless
B' = Empirical coefficient of elastic support, dimensionless
E' = Modulus of elasticity of adjacent soils or soil reaction, psi

The CIPP designed by the modified AWWA C950 formula is required to have a minimum stiffness (EI/Do3) which is 50% of the specification. The AWWA C950 specification calls for EI/Do3 to be equal to 0.186 and 50% of this value is 0.093. In the following equation this means that pipe designed with a flexural modulus of elasticity E = 350,000 psi would have a dimension ratio equal to 67 for fully deteriorated pipe. If the CIPP stiffness is too low, the wall thickness must be increased accordingly to insure that the following design condition is met:

$$EI/Do^3 = E/12(DR)^3 \geq 0.093 \quad (9)$$

where, E = Flexural modulus of elasticity of the CIPP, psi
I = Moment of inertia, in^4, $in = t^3/12$

When designing fully deteriorated CIPP where the existing pipe is out of round or the CIPP may have localized ovalization, bending moment forces may predominate on the CIPP. For this special case of the fully deteriorated design the CIPP must be checked to insure that the bending forces do not exceed the long-term flexural strength of the CIPP. To make this determination the bending stresses on the CIPP are determined by modifying Equation 7 and substituting total pressure (Pt) to produce the following equation:

$$\frac{S_L}{P_t N} = [1.5q/100\,(1 + q/100)DR^2] - [0.5(1 + q/100)DR] \quad (10)$$

where q is defined by Equation 4 and the other parameters have been defined previously.

Total External Pressure on CIPP

Several new parameters are introduced for the design of fully deteriorated gravity flow pipe. This manual is intended to provide simplistic explanations of these design parameters that have not been provided in ASTM F1216 or other design guides currently available. When determining fully deteriorated designs all loads acting on the CIPP must be estimated to determine the total pressure (Pt). This is accomplished by estimating the contribution of each individual load and adding them together. The total load is typically made up of hydrostatic water pressure (Pw'), buoyancy corrected soil load (Ps), superimposed or live loads (PL), and other loads such a vacuum (Pv). Loading due to vacuum is a special case and will not be handled here. Consult Lanzo Lining Services for recommendations related to vacuum loading. The total pressure acting on the pipe can be represented as follows:

$$P = Pw' + Ps + P_L + Pv \quad (11)$$

Hydrostatic Water and Soil Loads

Initially, groundwater and soil heights must be determined or estimated to begin the design process. For the fully deteriorated design condition be careful to note that groundwater and soil heights are determined from the top of the pipe and not the invert. The hydrostatic pressure is determined as follows:

$$Pw' = Hw\ (.433 psi/ft\ water) \quad (12)$$

where, Hw = Water height above the top of the pipe, ft

The contribution related to soil loading involves many different parameters. The soil prism loading pressure is determined as follows:

$$P_S = wH_sR_w/144in^2/ft^2 \quad (13)$$

where, w = Soil density, lb/ft^3 (See Table 14 for soil types and densities)
H_s = Soil height above top of pipe, ft.
R_w = Water buoyancy factor, dimensionless

$$R_w = 1 - 0.33(H_w/H_s) \geq 0.67 \quad (14)$$

Other related design parameters are the modulus of soil reaction or elastic support (E') and the coefficient of elastic support (B'). The modulus of soil reaction values used for CIPP design should typically represent stable undisturbed soils that would have E' values in the range of 700 to 3000 psi. Most typically a value of 700 psi is recommended for unknown soil conditions. Where the pipe is buried deep and the soil condition is stable values of 1000 to 1500 psi may be applicable. In areas known to have weak and unstable native soils a value of 200 psi may be appropriate. The coefficient of elastic support (B') is determined with the following relationship:

$$B' = 1/(1 + 4e^{-0.065H_s}) \quad (15)$$

Superimposed or Live Loads

For the fully deteriorated design condition dynamic live load pressures occur frequently and are a standard design condition for the parameter PL. Live loads may be classified as either concentrated or distributed, depending on the soil pipe conditions and the depth the pipe is buried. In some cases the live load may be characterized by impact factors. Impact loading is generally only applicable for pipes that are relatively shallow (i.e. 2-5 ft). A number of maximum live load conditions have bee studied and recommended for pipe buried beneath highways, railways, and airport runways. The generally accepted guidelines for determining these live loading conditions are provided by the ASSHTO Standard Specifications for Highway Bridges[32], HS-20-44 highway loading, American Railway Engineers Association (AREA) Cooper E-80 loading, and the Federal Aviation Agency criteria. The most frequently encountered design condition is that for pipes buried under active roads or highways. For highway HS-20 loading the live load becomes insignificant beyond seven feet of soil height cover over the top of the pipe. Live load pressures (PL) associated with the aforementioned piping conditions are given in Table 18.

Fully Deteriorated Design Example

Determine the minimum wall thickness required of the following piping condition:

1) Existing pipe classification	=	Fully deteriorated
2) Mean outer CIPP diameter (Do)	=	48 inches
3) Minimum pipe diameter (Dmin)	=	47.04 inches
4) External water above pipe (Hw)	=	8 feet
5) Depth of soil cover above pipe (Hs)	=	15 feet
6) Type of soil	=	Ordinary Clay ($120lb/ft^3$)
7) Soil Modulus (E's)	=	700 psi
8) Live load	=	Live load HS-20
9) Minimum CIPP flexural modulus (E)	=	350,000 psi
10) Minimum CIPP flexural strength (s)	=	5,500 psi
11) Long-term modulus (E_L)	=	175,000 psi
12) Long-term strength (S_L)	=	2750 psi

A. Determine the total load

Hydrostatic water pressure

$Pw = 0.433(Hw) = .433psi/ft(8ft) = 3.46$ psi

Soil load

$Ps = wHsRw/144in^2/ft^2$

$Rw = 1 - 0.33(Hw/Hs) \geq 0.67 = 1 - 0.33(8ft/15ft) = 0.824$ which is > 0.67

Ordinary clay soil density = $120lb/ft^3$

$Ps = 120lb/ft^3(15ft)0.824/144in^2/ft^2 = 10.3$ psi

The soil pressure can also be determined by multiplying the Buoyancy Correction Factor (Rw) times the Soil Prism Pressure give in Table 17.

$Ps = 0.824(12.5) = 10.3$ psi

Live load (P_L) (Table 18) ~ 0 psi

Total pressure load applied to the CIPP

$P_t = 3.46$ psi + 10.3 psi = 13.76

B. Calculate coefficient of elastic support

$B' = 1/(1 + 4e^{-0.065Hs})$

$B' = 1/(1 + 4e^{-0.065}(15ft)) = 0.40$ (Table 16)

C. Calculate pipe ovality using Equation 4

$q = 100(48 - 47.04)/48 = 2.0\%$

Determine ovality reduction factor using Equation 3

$C = [(1 - 2.29/100)/(1 + 2.29/100)^2]^3 = 0.84$ (Table 12)

D. Determine the minimum CIPP thickness for buckling

$$t = .721\ Do\left(\frac{(NP_t)^2}{CE_L RwB'E'}\right)^{1/3} = .721(48)\left(\frac{(2.0(13.76))^2}{(.84)(175{,}000)(.824)(.4)(700)}\right)^{1/3}$$

$t = 0.975$ inch

E. Check for minimum pipe stiffness

$DR = 48/0.975 = 49.2$

$350{,}000/12(49.2)^3 = .26 \geq 0.093$

F. Check for pressure limited due to bending stresses (Equation 10)

$S_L = 13.76(2)[1.5(2)/100(1 + 2.0/100)48^2] - [0.5(1 + 2/100)48]]$

$S_L = 1920$ psi

G. The calculated bending stress (i.e. 1,920psi) is less than the estimated long-term bending strength of the resin (i.e. 2,750psi) so bending stress does not control the design thickness for this example.

Therefore, the final design thickness for the CIPP is:

$t = .975$ inch

PARTIALLY DETERIORATED INTERNAL PRESSURE PIPE

When designing for internal pressure, it is critical to obtain a proper evaluation of the condition of the pipe being evaluated. Secondary to this is the requirement to understand the proper operating pressure. The third consideration for the design of pressure pipe is an understanding of test pressures, surge pressures and/or water hammer that may significantly exceed the standard operating or test pressures of the pipe. In addition, the project engineer and contractor must be aware that pipe requiring heavy cleaning may change the condition of the pipe from a partially to a fully deteriorated condition. After cleaning it is recommended that pipe classified as partially deteriorated be tested for the operating or test pressure to verify the condition of the pipe prior to lining. If the pipe is able to maintain the specified pressure then it can be classified as partially deteriorated without question. However, this may not always be possible due to the presence of small holes in the pipe that will not allow it to maintain pressure. When the condition of the pipe and/or the operating parameter is not well defined, it is recommended that the pipe be classified as fully deteriorated. Pressure pipe presents a higher risk application of CIPP and it is recommended that the contractor have experience in this area of technology to insure success[33].

The partially deteriorated design equation for internal pressure pipe given in ASTM F1216 was derived with the assumption that the CIPP acts like a uniformly pressurized round flat plate with fixed edges covering an existing hole in the pipe. The CIPP is designed with the assumption that the aforementioned condition prevails and that bending stresses at and around the hole (if one exists) control the design thickness. This design assumption is more conservative than that of a square or rectangular plate.

The equation given in ASTM F1216 has been incorrectly derived with the term DR-1 in the derivation instead of the correct term DR. Although it may be argued that the difference is negligible to the outcome of the calculated thickness, the technically correct derivation will be advocated for use in this engineering design guide. The technically correct derivation for pressure acting on a flat circular plate covering a hole is given below. This equation has been rearranged to solve for CIPP thickness:

$$t = \frac{Do}{[5.33/Pi\ (Do/Dh)^2(S_L/N)]^{0.5} + 1} \qquad (16)$$

where,
- Do = Mean outer CIPP diameter, inches
- Pi = Internal pipe pressure, psi
- Dh = Hole diameter in the pipe, inches
- S_L = Long-term flexural bending strength for the CIPP, psi
- N = Safety factor, N = 2 minimum

In order for the circular flat plate design condition to be valid the following criteria must be met. If this condition is not met then the CIPP cannot be considered a circular flat plate and ring tension or hoop stress will dominate. For this condition the internal pressure condition is designed as a fully deteriorated internal pressure pipe.

$$Dh/Do \leq 1.83(t/Do)^{0.5} \qquad (17)$$

The variables used in Equation 17 have been previously defined.

Once the CIPP thickness has been calculated this value must be compared with the thickness calculated from Equation 5 to confirm that external hydrostatic water pressure does not dominate the design condition. The larger thickness is then selected for the design. Since design Equation 17 is conservative it may at times lead to a greater CIPP thickness than if the CIPP is evaluated in ring tension as an unrestrained, stand-alone pipe. Any internal pressure pipe application is higher risk so it is recommended that a Lanzo Lining Services representative be contacted for assistance in pressure pipe design assistance.

Partially Deteriorated Internal Pressure Pipe Design Example

1) Determine the CIPP thickness for the following piping conditions:

2) Existing pipe classification	=	Partially deteriorated
3) Existing pipe inner diameter (D)	=	15 inches
4) Existing pipe maximum diameter (Dmax)	=	15.2 inches
5) Internal pressure (Pi)	=	80 psi
6) External water (Hw)	=	5 ft above top of pipe
7) Maximum pipe hole diameter (Dh)	=	1 inch
8) Minimum CIPP flexural modulus (E)	=	350,000 psi
9) Minimum CIPP flexural strength (s)	=	5,500 psi
10) Minimum long-term modulus (E_L)	=	175,000 psi
11) Minimum long-term strength (S_L)	=	2,750 psi
12) Minimum long-term tensile strength (S_{tL})	=	1,750 psi

A. Determine the pressure pipe thickness using Equation 16.

$$Do = \frac{D + Dmax}{2} = \frac{15.0 + 15.2}{2}$$

Do = 15.1 inches

$$t = \frac{15.1}{[5.33/80(15.1/1.0)^2(2{,}750/2.0)]^{1/2} + 1}$$

t = 0.10 inches

B. Check thickness with Equation 17.

$1/15.1 \leq 1.83(0.1/15.1)^{1/2}$

$0.066 \leq 0.149$

The condition of Equation 17 is met

C. Check the thickness for external pressure using Equation 5.

$q = 100(15.2 - 15.0)/15.0 = 1.33\%$

$C = [(1 - 1.33/100)/(1 + 1.33/100)^2]^3 = 0.89$

$Pw = 5(.433) = 2.2psi$

t = 0.18 inches

The thickness for external pressure is greater than that required for internal pressure and the DR = 84, which is less than 100, as specified in Equation 6.

D. Since the pipe is slightly out of round, the bending stresses must be checked using Equation 7.

$S_L = 2.2(2.0)[[1.5(.0133)(1 + .0133)84^2] - [0.5(1 + .0133)84]]$

$S_L = 440$, which is less than the long-term flexural strength of the CIPP. Therefore, the final CIPP thickness is t = 0.18 inches.

FULLY DETERIORATED INTERNAL PRESSURE PIPE

As discussed previously, it is critical to understand the physical conditions of the pipe and the operating parameters of the system when designing for the fully deteriorated pressure condition. This pipe classification assumes the existing pipe has no capability to hold any of the pressure and the CIPP must be designed of a proper thickness to hold all internal and external pressure.

For the design of pressure pipes it may assumed that pipes are either thick or thin walled cylinders with uniform pipe wall thickness. Internal pressure produces an internal ring tension loading condition and tensile strength of the resin/fabric matrix used to construct the CIPP is important to the design. As reviewed in the Materials section of the Engineering Design Guide, high performance resins such as vinyl esters and epoxy resins are recommended for pressure applications due to their high tensile strength and elongation properties. Contact Lanzo Lining technical services for recommendations concerning the design and materials selection for pressure pipe.

The design equation for fully deteriorated pressure pipe given in ASTM F1216 assumes pressure pipe is a thick walled cylinder as given below:

$$Pi = \frac{2S_{tL}}{(DR-2)\,N} \qquad (18)$$

The equation for a thin walled cylinder is given as follows:

$$Pi = \frac{2S_{tL}}{(DR-1)\,N} \qquad (19)$$

When rearranged to solve for thickness Equation 19 becomes:

$$t = \frac{Do}{[(2S_{tL}/PiN) + 1]} \qquad (20)$$

The variables used in Equation 20 have previously been defined.

Although the differences are relatively small, the solution for a thin walled cylinder is a more conservative approach than ASTM F1216. Therefore, design Equation 20 for a thin walled pressure cylinder will be used for fully deteriorated pressure pipe. When the pressure pipe is underground the CIPP thickness for internal pressure should be checked against Equations 8 and 9 for fully deteriorated gravity flow pipe. The greatest thickness is chosen for the pressure pipe.

Fully Deteriorated Internal Pressure Pipe Design Example

Determine the CIPP thickness for the following pipe design conditions:

1) Existing pipe classification	=	Fully deteriorated
2) Existing pipe Inner diameter (D)	=	15 inches
3) Existing pipe maximum diameter (Dmax)	=	15.2 inches
4) Internal pressure (Pi)	=	80 psi
5) External water (Hw)	=	8 ft above top of pipe
6) Soil height (Hs)	=	15 ft above top of pipe
7) Soil type	=	Ordinary Clay (120lb/ft3)
8) Soil modulus (E')	=	700 psi
9) Minimum CIPP flexural modulus (E)	=	350,000 psi
10) Minimum CIPP flexural strength (s)	=	5,500 psi
11) Minimum long-term modulus (EL)	=	175,000 psi
12) Minimum long-term strength (sL)	=	2,750 psi
13) Minimum long-term tensile strength (stL)	=	1,750 psi

A. Determine the CIPP thickness using Equation 20.

Do = 15.1 (From previous example)

t = 15.1/[(2(1750)/80(2)) + 1] = 0.66 inches

B. Check the CIPP thickness against the fully deteriorated gravity flow design condition for external buckling (Equation 8).

Determine the total pressure

Pt = Pw + Ps + PL = 3.46 + 10.3 + 0 (see previous Fully Deteriorated example)

Pt = 13.76

Determine pipe ovality (see previous example)

q = 1.33% (Equation 4)

C = 0.89 (Equation 3, Table 12)

Determine CIPP thickness using Equation 8.

Rw = 0.824 (Table 15, see previous example)

B' = 0.40 (Table 16)

$$t = .721Do\left(\frac{[(NP_i)^2]}{CE_L RwB'E'}\right)^{1/3} = .721(15.1)\left(\frac{((2.0)(13.76))^2}{(.89)(175{,}000)(.824)(.4)(700)}\right)^{1/3}$$

t = 0.30 inch

Since 0.30 in ≤ 0.66 inch internal pressure dominates the design.

C. Check the CIPP thickness for minimum pipe stiffness using Equation 9.

DR = 15.1/0.66 = 22.9

$350{,}000/12(22.9)^3 \geq 0.093$

$2.43 \geq 0.093$

D. Since the pipe is slightly out of round, the bending stresses must be checked using Equation 10.

$S_L = 13.76(2.0)[[1.5(1.33)/100(1+1.33/100)22.9^2] + [0.5(1+1.33/100)22.9]]$

S_L = 612 psi, which is less than 2750psi

E. All checks indicate that internal pressure dominates the design of this fully deteriorated pressure pipe and the specified thickness is t = 0.66 inches.

HYDRAULIC DESIGN OF CIPP

GRAVITY FLOW

The installation of CIPP typically improves the flow characteristics of the pipe being rehabilitated. Flow is improved because the inner surface of CIPP is extremely smooth and continuous, without any joints or discontinuities that create friction to flow. Typically the Manning equation is used to predict flow in gravity or open channel piping conditions as follows:

$$Q = VA = \frac{1.486\, AR^{2/3}\, S^{1/2}}{n} \qquad (21)$$

where, Q = Flow rate, cfs
V = Velocity, fps
A = Flow Area
n = Manning coefficient of roughness (see Table 10)
R = Hydraulic radius, ft = A/P
P = Wetted perimeter of flow, ft
S = Slope of grade line, ft(slope)/ft(pipe)

When the pipe is circular and the flow is full as in a surcharged situation the Manning equation may be modified to the following form:

$$Q = \frac{0.463\, D^{8/3}\, S^{1/2}}{n} \qquad (22)$$

where, D = pipe internal diameter, ft.

For circular pipe flowing full the Manning equation can be abbreviated to produce an easy comparison of flow capacity between CIPP and different piping materials as given below:

$$\%\ \text{Flow Capacity} = \frac{Q_{CIPP} \times 100}{Q_{exist}} = \frac{n_{exist}}{n_{CIPP}} \left(\frac{D_{CIPP}}{D_{exist}}\right)^{8/3} \times 100 \qquad (23)$$

Manning coefficients provide a relative comparison of the resistance to flow for different types of pipe and coefficients for several piping materials have been provided in Table 10. There is a large variation in the coefficients for different materials and even variation for the same piping product because these coefficients are dependent on the condition of the pipe evaluated. A conservative average Manning coefficient for CIPP in relatively smooth concrete, clay, or steel pipe is an 'n' of 0.010. However, this coefficient might be subject to change over time as slime and/or debris build up in uncleaned pipe over time.

Gravity Flow Design Example

Problem: Determine the change in flow capacity when a circular 24 inch concrete pipe is flowing full and is lined with a 12 mm thick CIPP.

1. **Select Manning coefficients for the piping materials (Table 10).**
   a) **n' for CIPP = 0.010**
   b) **'n' for concrete = 0.015**
2. **Determine inside pipe diameters.**
   a) **Existing concrete pipe D = 24 inches**
   b) **New CIPP D = 24 - 2(12/25.4) = 23.1 inches**
3. **Determine increased flow capacity using Equation 23.**

$$\% \text{ Flow Capacity} = \frac{0.015}{0.10}\left(\frac{23.1}{24.0}\right)^{8/3} \times 100 = 135\%$$

Therefore, it was determined that the CIPP increased the flow of the pipe approximately 135% compared to the existing concrete pipe. This increase in flow was realized even though the inside diameter of the CIPP was slightly smaller than the existing concrete pipe.

PRESSURE FLOW

For pressure flow the Hazen-Williams equation is commonly utilized for determining the flow rate of the pipe. For pressure flow CIPP also increases the flow capacity of a pipe because of the inherent smoothness of the inner surface. The Hazen-Williams equation is given as follows:

$$Q = 1.318\, C\, R^{0.63}\, S^{0.54}\, A \qquad (24)$$

where,

Q	=	**Flow rate, cfs**
C	=	**Hazen-Williams coefficient (see Table 11)**
R	=	**Hydraulic radius, ft = A/P**
A	=	**Flow area, ft^2**
P	=	**Wetted perimeter of flow, ft**
S	=	**Slope of grade line, ft(slope)/ft(pipe)**

As shown previously, the Hazen-Williams equation can be simplified to provide a comparison of flow capacity between CIPP and the existing pipe as follows:

$$\% \text{ Flow Capacity} = \frac{Q_{CIPP}}{Q_{exist}} \times 100 = \frac{C_{CIPP}}{C_{exist}}\left(\frac{D_{CIPP}}{D_{exist}}\right)^{8/3} \times 100 \qquad (25)$$

The Hazen-Williams coefficients for different piping materials, or age of materials are provided in Table 11. Determination of flow capacities of CIPP in a pressure application relative to other existing piping materials is calculated in the same manner as given in the gravity flow design example.

APPENDIX

Table 10. Manning Coefficients for Typical Piping Materials.

Pipe Material	Manning 'n' Coefficient	Recommended Manning 'n'
Cured-In-Place Pipe	0.009 - 0.012	0.010
Vitrified Clay	0.013 - 0.017	0.013
Concrete	0.013 - 0.017	0.015
Corrugated Metal	0.019 - 0.030	0.025
Brick	0.015 - 0.017	0.016

Table 11. Hazen-Williams Coefficients for Typical Piping Materials.

Pipe Material/Condition	Recommended Hazen-Williams 'C' Coefficient
Cured-In-Place Pipe	140
New steel or ductile iron (less than 1 year old)	120
Cement lined new steel or ductile iron	140
Steel (2 years old)	120
Steel (10 years old)	100
Cast Iron (5 years old)	120
Cast Iron (18 years old)	100
Tuberculated Steel or Cast Iron	80

Table 12. Ovality reduction factor, C.

$C = [Domin/(Domax)^2]^3$

Percent Ovality	1	2	3	4	5	6	7	8	9	10
Reduction Factor, C	0.91	0.84	0.76	0.70	0.64	0.59	0.54	0.49	0.45	0.41

Easement installation of subdivision sewer rehab

Subaqueous installation of CIPP into storm drain

Table 13. Partially Deteriorated Gravity Flow CIPP Design Thickness.

CIPP Thickness (mm) for each Pipe Diameter (Inches) at the given Depth (feet)

Water Depth	Water Pressure	6	8	10	12	15	18	21	24	27	30	36	42	48	54	60	66	72
1	0.44	1.1	1.5	1.8	2.2	2.8	3.3	3.9	4.4	5.0	5.5	6.6	7.7	8.8	9.9	11.0	12.1	13.2
2	0.87	1.4	1.8	2.3	2.8	3.5	4.2	4.8	5.5	6.2	6.9	8.3	9.7	11.1	12.5	13.8	15.2	16.6
3	1.30	1.6	2.1	2.6	3.2	3.9	4.7	5.5	6.3	7.1	7.9	9.5	11.1	12.6	14.2	15.8	17.4	19.0
4	1.73	1.7	2.3	2.9	3.5	4.3	5.2	6.1	6.9	7.8	8.7	10.4	12.2	13.9	15.6	17.4	19.1	20.8
5	2.17	1.9	2.5	3.1	3.7	4.7	5.6	6.5	7.5	8.4	9.4	11.2	13.1	15.0	16.8	18.7	20.6	22.4
6	2.60	2.0	2.6	3.3	4.0	5.0	6.0	6.9	7.9	8.9	9.9	11.9	13.9	15.9	17.9	19.9	21.8	23.8
7	3.03	2.1	2.8	3.5	4.2	5.2	6.3	7.3	8.4	9.4	10.4	12.5	14.6	16.7	18.8	20.9	23.0	25.1
8	3.46	2.2	2.9	3.6	4.4	5.5	6.5	7.6	8.7	9.8	10.9	13.1	15.3	17.4	19.6	21.8	24.0	26.2
9	3.90	2.3	3.0	3.8	4.5	5.7	6.8	7.9	9.1	10.2	11.3	13.6	15.9	18.1	20.4	22.7	25.0	27.2
10	4.33	2.3	3.1	3.9	4.7	5.9	7.0	8.2	9.4	10.6	11.7	14.1	16.4	18.8	21.1	23.5	25.8	28.2
11	4.76	2.4	3.2	4.0	4.8	6.1	7.3	8.5	9.7	10.9	12.1	14.5	17.0	19.4	21.8	24.2	26.6	29.1
12	5.20	2.5	3.3	4.2	5.0	6.2	7.5	8.7	10.0	11.2	12.5	15.0	17.5	19.9	22.4	24.9	27.4	29.9
13	5.63	2.6	3.4	4.3	5.1	6.4	7.7	9.0	10.2	11.5	12.8	15.4	17.9	20.5	23.0	25.6	28.1	30.7
14	6.06	2.6	3.5	4.4	5.2	6.6	7.9	9.2	10.5	11.8	13.1	15.7	18.3	21.0	23.6	26.2	28.8	31.5
15	6.50	2.7	3.6	4.5	5.4	6.7	8.0	9.4	10.7	12.1	13.4	16.1	18.8	21.5	24.1	26.8	29.5	32.2
16	6.93	2.7	3.7	4.6	5.5	6.8	8.2	9.6	11.0	12.3	13.7	16.4	19.2	21.9	24.6	27.4	30.1	32.9
17	7.36	2.8	3.7	4.7	5.6	7.0	8.4	9.8	11.2	12.6	14.0	16.8	19.6	22.3	25.1	27.9	30.7	33.5
18	7.79	2.8	3.8	4.7	5.7	7.1	8.5	10.0	11.4	12.8	14.2	17.1	19.9	22.8	25.6	28.5	31.3	34.1
19	8.23	2.9	3.9	4.8	5.8	7.2	8.7	10.1	11.6	13.0	14.5	17.4	20.3	23.2	26.1	29.0	31.9	34.8
20	8.66	2.9	3.9	4.9	5.9	7.4	8.8	10.3	11.8	13.3	14.7	17.7	20.6	23.6	26.5	29.5	32.4	35.4
Minimum Practical Thickness		4.5	6.0	6.0	7.5	9.0	10.5	10.5	12.0	12.0	13.5	15.0	16.5	18.0	21.0	24.0	27.0	28.5

For determining the CIPP thickness in Table 13 the following variables were utilized in the calculations: E_L = 175,000 psi, S_L = 2750 psi, 2% Ovality, Safety Factor = 2.0, Enhancement Factor K = 7.0, Poisson's Ratio = 0.3

Table 14. Soil Types and Densities.

Soil Type	Density, w (lb/ft3)
Sand & Gravel	110
Saturated Topsoil	115
Ordinary Clay	120
Saturated Clay	130

Table 15. Water Buoyancy Factor, Rw.

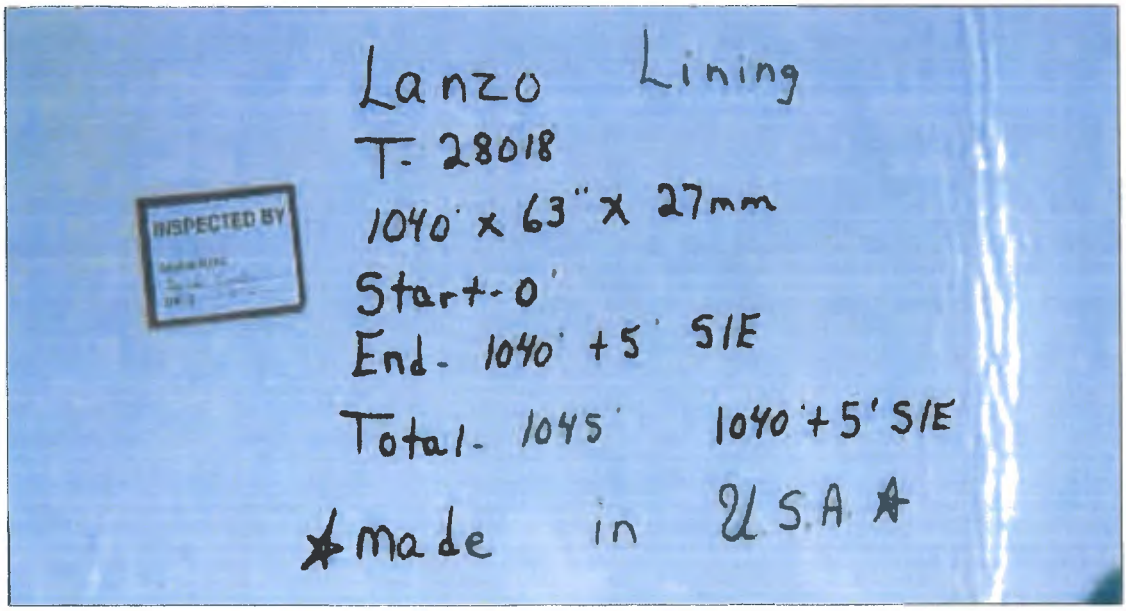
$Rw = 1 - 0.33(Hw/Hs) \geq 0.67$

Ratio Hw/Hs	Factor Rw
0	1.00
0.05	0.98
0.1	0.97
0.15	0.95
0.20	0.93
0.25	0.92
0.30	0.90
0.35	0.88
0.40	0.87
0.45	0.85
0.50	0.84
0.55	0.82
0.60	0.80
0.65	0.79
0.70	0.77
0.75	0.75
0.80	0.74
0.85	0.72
0.90	0.70
0.95	0.69
1.00	0.67

Table 16. Coefficient of Elastic Support, B'

$B' = 1/(1 + 4e^{-0.065Hs})$

Soil Height Hs, ft	Elastic Support B'
0	0.2
1	0.21
2	0.22
3	0.23
4	0.24
5	0.26
6	0.27
7	0.28
8	0.30
9	0.31
10	0.32
11	0.34
12	0.35
13	0.37
14	0.38
15	0.40
16	0.41
17	0.43
18	0.45
19	0.46
20	0.48
22	0.51
24	0.54
26	0.58
28	0.61
30	0.64



All materials are rigorously inspected for quality while Lanzo Lining Services emphasizes materials "Made in America"

Table 17. Soil Prism Pressure as a Function of Water or Soil Height and Soil Density.

		Soil Prism Pressure, psi Soil Density, w, lbs/ft³				
Height of Water, Hw or Soil, Hs, ft	Hydrostatic Pressure Pw', psi	100 lbs/ft³	110 lbs/ft³	115 lbs/ft³	120 lbs/ft³	130 lbs/ft³
1	0.43	0.7	0.8	0.8	0.8	0.9
2	0.87	1.4	1.5	1.6	1.7	1.8
3	1.30	2.1	2.3	2.4	2.5	2.7
4	1.73	2.8	3.1	3.2	3.3	3.6
5	2.17	3.5	3.8	4.0	4.2	4.5
6	2.60	4.2	4.6	4.8	5.0	5.4
7	3.03	4.9	5.3	5.4	5.8	6.3
8	3.46	5.6	6.1	6.4	6.7	7.2
9	3.90	6.3	6.9	7.2	7.5	8.1
10	4.33	6.9	7.6	8.0	8.3	9.0
11	4.76	7.6	8.4	8.8	9.2	9.9
12	5.20	8.3	9.2	9.6	10.0	10.8
13	5.63	9.0	9.9	10.4	10.8	11.7
14	6.06	9.7	10.7	11.2	11.7	12.6
15	6.50	10.4	11.5	12.0	12.5	13.5
16	6.93	11.1	12.2	12.7	13.3	14.4
17	7.37	11.8	13.0	13.6	14.2	15.3
18	7.79	12.5	13.8	14.4	15.0	16.3
19	8.23	13.2	14.5	15.1	15.8	17.2
20	8.66	13.9	15.3	16.0	16.7	18.1
22	9.53	15.3	16.8	17.5	18.3	19.9
24	10.4	16.7	18.3	19.2	20.0	21.7
26	11.3	18.1	19.9	20.8	21.7	23.5
28	12.1	19.4	21.4	22.3	23.3	25.3
30	13.0	20.8	22.9	24.0	25.0	27.1

Trenchless CIPP rehabilitation of a pipe running under a busy highway during rush hour traffic

Table 18. Live load Pressure and Impact Factors for Surface Load Impact.

Soil Height	Highway HS-20		Railway E-80		Airport	
Hs	Load, psi	Impact	Load, psi	Impact	Load, psi	Impact
0-1	>15.1	0.3	N/A	0.4	N/A	0.5
1	15.1	0.3	N/A	0.4	N/A	0.5
2	10.9	0.2	26.4	0.36	13.2	**
3	5.3	0	23.6	0.28	12.3	**
4	2.2	0	18.4	0.24	11.3	**
5	1.7	0	16.7	0.2	10.1	**
6	1.3	0	15.6	0.16	8.8	**
7	1.1	0	12.2	0.12	7.9	**
8	1.0	0	11.1	0.08	6.9	**
9	*	0	9.4	0.04	6.5	**
10	*	0	7.6	0	6.1	**
12	*	0	5.6	0	4.7	
15	*	0	4.2	0	2.5	

*Insignificant, less that 1.0psi

**Consult FAA requirements for ground conditions

Table 19. Fully Deteriorated Gravity Flow Condition for High Groundwater at Grade.

CIPP Thickness (mm) for each Pipe Diameter (Inches) at the given Depth (feet)

Soil Depth	Water Depth	6	8	10	12	15	18	21	24	27	30	36	42	48	54	60	66	72
6	6	2.5	3.0	3.7	4.5	5.6	6.7	7.9	9.0	10.1	11.2	13.5	15.7	17.9	20.2	22.4	24.7	26.9
8	8	2.5	3.2	4.0	4.7	5.9	7.0	8.1	9.2	10.2	11.3	13.5	15.7	17.9	20.2	22.4	24.7	26.9
10	10	2.5	3.3	4.1	5.0	6.1	7.7	8.8	10.0	11.3	12.4	14.6	16.9	19.0	21.2	23.5	25.9	28.2
12	12	2.8	3.7	4.6	5.5	7.1	8.4	9.7	11.0	12.3	13.7	16.1	18.5	21.1	23.4	25.8	28.0	30.2
16	16	3.2	4.2	5.3	6.3	8.0	9.6	11.1	12.6	14.1	15.6	18.5	21.4	24.3	27.1	29.9	32.6	35.2
20	20	3.5	4.7	5.8	7.0	8.9	10.6	12.3	14.0	15.6	17.3	20.6	23.8	27.0	30.3	33.4	36.5	39.5
25	25	3.9	5.2	6.4	7.7	9.8	11.7	13.6	15.4	17.3	19.1	22.8	26.5	30.1	33.6	37.2	40.7	44.2
30	30	4.2	5.6	7.0	8.4	10.6	12.6	14.7	16.7	18.7	20.8	24.8	28.8	32.7	36.6	40.5	44.3	48.2
Minimum Practical Thickness		4.5	6.0	6.0	7.5	9.0	10.5	10.5	12.0	12.0	13.5	15.0	16.5	18.0	21.0	24.0	27.0	28.5

For determining the thickness of the CIPP in Table 19 the following variables were used: E_L = 175,000 psi, S_L = 2750 psi, 2% Ovality, Safety Factor = 2.0, Soil Density = 120 lb/ft^3, Soil Modulus = 1000 psi, HS-20 Highway Loading at shallow depths

APPENDIX

Table 20. Fully Deteriorated Gravity Flow Condition for Groundwater at 50% of Soil Depth.

CIPP Thickness (mm) for each Pipe Diameter (Inches) at the given Depth (feet)

Soil Depth	Water Depth	6	8	10	12	15	18	21	24	27	30	36	42	48	54	60	66	72
6	3	2.5	3.0	3.7	4.5	5.6	6.7	7.9	9.0	10.1	11.2	13.5	15.7	17.9	20.2	22.4	24.7	26.9
8	4	2.5	3.1	3.7	4.5	5.6	6.7	7.9	9.0	10.1	11.2	13.5	15.7	17.9	20.2	22.4	24.7	26.9
10	5	2.5	3.3	4.0	4.7	5.7	6.8	7.9	9.0	10.1	11.2	13.5	15.7	17.9	20.2	22.4	24.7	26.9
12	6	2.7	3.5	4.3	5.1	6.3	7.4	8.6	9.7	10.8	12.1	14.3	16.4	18.7	20.7	22.9	24.9	26.9
16	8	3.0	3.9	4.8	5.7	7.1	8.4	9.8	11.1	12.4	13.7	16.3	19.0	21.5	23.9	26.4	28.8	31.2
20	10	3.3	4.3	5.3	6.3	7.8	9.3	10.8	12.3	13.8	15.3	18.2	21.1	23.9	26.8	29.5	32.3	35.0
25	12.5	3.6	4.7	5.8	6.9	8.6	10.3	11.9	13.6	15.2	16.9	20.1	23.3	26.5	29.7	32.8	36.0	39.0
30	15	3.8	5.0	6.3	7.5	9.3	11.1	12.9	14.7	16.5	18.3	21.8	25.4	28.9	32.3	35.7	39.1	42.5
Minimum Practical Thickness		4.5	6.0	6.0	7.5	9.0	10.5	10.5	12.0	12.0	13.5	15.0	16.5	18.0	21.0	24.0	27.0	28.5

For determining the thickness of the CIPP in Table 19 the following variables were used: E_L = 175,000 psi, S_L = 2750 psi, 2% Ovality, Safety Factor = 2.0, Soil Density = 120 lb/ft^3, Soil Modulus = 1000 psi, HS-20 Highway Loading at shallow depths

Lanzo Lining Services crew preparing liner for direct inversion installation of CIPP

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Clarifier pressure pipe rehabilitation at WWTP

Quality controlled tube impregnation at one of Lanzo Lining Services' state of the art wet out facilities

The Lanzo Companies bring forty-five years of heavy construction experience in addition to over 6,000,000 feet of installed cured-in-place pipe lining experience. Our goal at Lanzo is to provide safe, cost-effective, on-time, and high quality construction services. We hold the highest level of ethics and are committed to ensuring the safety of our employees and the convenience of the people within the communities we service.

LANZO
Lining Services, Inc.

Our mission is to deliver safe, environmentally friendly and low impact trenchless construction services on time at or below budget.

LANZO LINING SERVICES

Deerfield Beach, Florida office

125 SE 5th Court
Deerfield Beach, FL 33441
Phone: (954) 973-9700
Fax: (954) 974-3894

Roseville, Michigan office

28135 Groesbeck Highway
Roseville, Michigan 48066
Phone: (586) 775-5819
Fax: (586) 775-2328

Website: www.lanzo.net

Please direct all technical questions to Fred Tingberg, Jr. (fredt@lanzo.org)

Clarifier pressure pipe rehabilitation at WWTP

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DUNS# 808382642

CAGE# 60B14

NAICS CODES

237110 – Water and Sewer Line and Related Structures
325211 – Plastic Material and Resin Manufacturing
326122 – Plastic Pipe and Pipe Fitting Manufacturing
562998 – All Other Miscellaneous Waste Management Services

CERTIFICATIONS

Federal/National:
- SBE – Small Business Enterprise

State/Regional:
- FDOT Prequalified
- MDOT Prequalified

AFFILIATIONS

North American Society for Trenchless Technology - NASTT
National Association of Sewer Service Companies - NASSCO
Water Environment Federation – WEFTEC
American Water Works Association – AWWA
American Public Works Association – APWA
The Construction Underground – TCU
Michigan Infrastructure and Transportation Association – MITA
Northeast Superintendent Association – NESA
American Society for Testing and Materials - ASTM

REFERENCE DOCUMENTS

ASTM F1216 – Standard practice for rehabilitation of existing pipelines and conduits by the inversion and curing of a resin-impregnated tube.

ASTM F1743 - Standard practice for the rehabilitation of existing pipelines and conduits by the pulled-in-place installation of cured-in-place thermosetting resin pipe (CIPP).

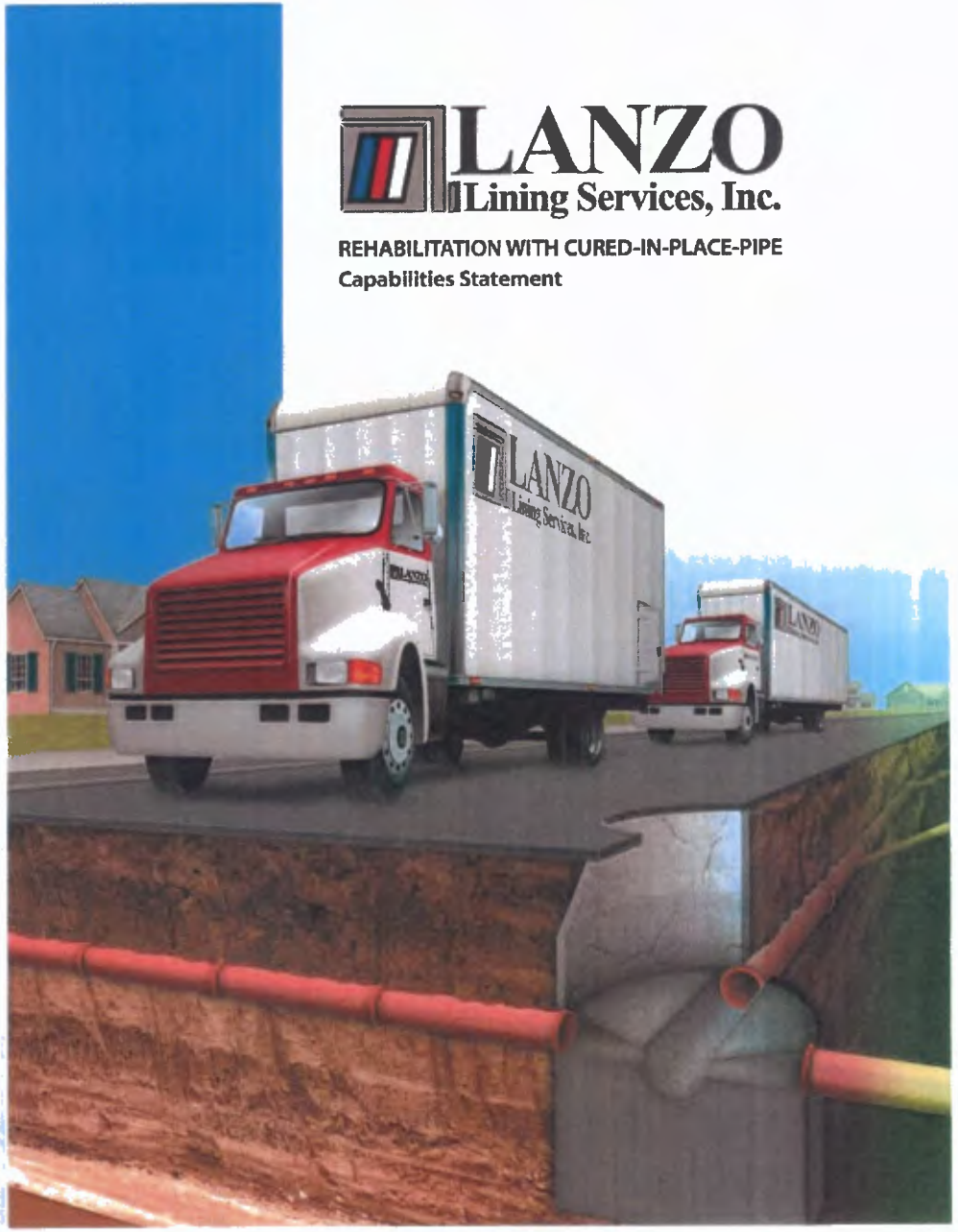
ASTM D5813 - Standard specification for cured-in-place thermosetting resin sewer pipe.

ASTM C581 - Standard practice for determining chemical resistance of thermosetting resins used in glass fiber reinforced structures, intended for liquid service.

ASTM D790 - Test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.

LANZO
Lining Services, Inc.

REHABILITATION WITH CURED-IN-PLACE-PIPE
Capabilities Statement



Lanzo Lining Services was formed in 1993 to provide a more cost-effective alternative to replacing failed pipelines using the cured-in-place pipe method (CIPP). This technology gives project owners the option to use one of the most advanced trenchless technologies to successfully rehabilitate pipelines. Lanzo Lining has over seven (7) million feet of CIPP throughout Florida, Michigan, as well as other regions within the United States and Canada. Installations have ranged in size from 4" to 144".

Lanzo Lining Services is among a handful of companies qualified to use a cured-in-place pipelining technology to rehabilitate deteriorated pipelines.

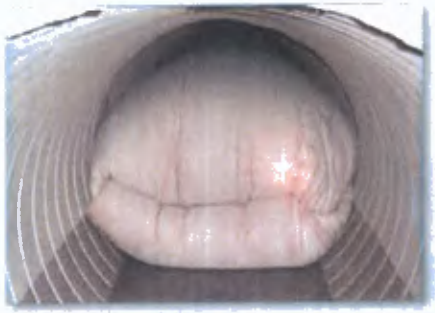
Lanzo Lining Services customers are finding the benefits of cured-in-place pipelining to regain structural integrity and reduce infiltration, inflow and exfiltration at lower cost, in less time, and with fewer inconveniences to the owner and respective communities.

Lanzo Lining Services provides high quality, cost effective and on time results while meeting all Federal, State and Municipal regulations. We hold the highest level of ethics and are committed to ensuring the safety of our employees along with the convenience and safety of the people within the communities we service.

At Lanzo Lining Services we value our employees and the residents of the communities in which we serve. Lanzo Lining Services has been leading competitor in the CIPP industry for over 17 years, originating in Pompano Beach, Florida, with offices in Deerfield Beach and Roseville, Michigan. Lanzo Lining Services is an equal opportunity employer employing a highly diverse staff of over 100 people which provides a full range of CIPP services and contracting capabilities.

SERVICES OFFERED BY LANZO LINING

- Sewer Cleaning
- Internal video inspection "CCTV"
- Manhole to manhole CIPP lining meeting ASTM F1216 & F1743.
- Trenchless Storm Sewer Rehabilitation
- Trenchless Sanitary Sewer Rehabilitation
- Lateral reinstatement and sealing
- Lateral Lining
- Manhole verification and repair
- Trenchless Forcemain rehabilitation
- Watermain Lining meeting NSF61
- Fully Integrated wet out facility in Pompano Beach, Florida
- Fully Integrated wet out facility in Roseville, Michigan
- QA/QC including Third party testing of liner runs installed
- 50 year service life expectancy
- 5 year warranty for all materials and workmanship
- Lanzo Citiliner - mobile wet out facility using non-styrenated "GREEN" Epoxy resins
- ISO 9002 Materials and Suppliers



Frontal view of 60 inch diameter direct inversion

Finished outfall product at the headwall

Our service is the daily solution of problems and pursuit of a quality installation. This is not simply the installation of a product but rather the accomplishment of a complete sequence of events ranging from site inspection, pipe preparation, delivery of resin impregnated felt tubes from "wet out" to installation, utility reinstatement and job site cleanup with minimal disruption to the surrounding community is the approach to every phase of the CIPP project.

PRECONSTRUCTION PHASE

– prior to commencing work, a pre-construction meeting shall be held to submit and review the following:

- Work schedule, including anticipated start and completion date.
- Maintenance of traffic plan
- Material certification and other submittals
- Material safety data sheets
- Engineering calculations for liner thickness design
- By-pass pumping plan
- Sub-contracting
- Certificate of insurance submitted

CONSTRUCTION PHASE

- Inspection
- Remove all debris and televise the pipe prior to lining
- Set up approved MOT and/or lane closures
- Dewatering and by-pass pumping
- Point repair to remove obstruction prior to pipe renovation
- Tube preparation, installation, curing and cool down
- Lateral reinstatement and liner terminations
- Final inspection

POST CONSTRUCTION

- Submit pre-installation videos and sewer logs of line segments
- Submit post-installation videos and sewer logs of the completed CIPP and reinstated laterals
- Submit structural test data from an independent third party testing lab
- Submit installed CIPP thickness measurements from an independent third party testing lab

Environmentally friendly "Green Resin Formulations"

Lanzo Lining Services has remained an innovator and pioneer installer of CIPP as trenchless pipeline rehabilitation technologies have gained extraordinary acceptance due to the changing chemical environment along with enforcement of clean water regulations. Lanzo Lining has experience in many cutting edge applications such as:

- Large diameter & non-circular storm drains
- Over the hole wet out and installation
- Pressure rated force main sanitary sewer
- NSF 61 certified water main rehabilitation
- Green resin utilization in wetland or environmentally sensitive areas
- Submerged or canal enclosure pipeline rehabilitation
- Sanitary sewer collection systems
- High temperature chemical concentrations and industrial sewers
- Air duct ventilation repair & vacuum pressure line

LANZO
TRENCHLESS TECHNOLOGIES

Delivering innovative trenchless technology solutions to rehabilitate the world's diverse infrastructure

CIPP REFERENCE SPECIFICATION

This CIPP Reference Specification serves as only a guideline and is not intended to encompass the requirements of every municipality or industrial application. However, the points put forth in this document have been used successfully to specify and complete CIPP projects.

First, it is the recommendation of Lanzo Trenchless Technologies that an overall project be evaluated, specified and bid with the unique underground construction technologies separated. By so doing, the strengths and economics of each technology can properly be utilized for the best final result on any given project. Once it has been determined by the project engineer that a project be completed with trenchless underground technologies to minimize disruption to the surrounding community and businesses, the next task involves specification development for advertising and bidding the project. In any given large project there may be sections of pipe best rehabilitated with sliplining or segmental sliplining, fold and form, CIPP and/or other technologies. When this is the case, separate specifications should be developed and the project bid accordingly. For example, bidding slipling, fold and form and CIPP together would typically not allow the end user to have a fold and form or CIPP project because of cost considerations. In addition, the community would not have a project devoid of digging and disruption.

When determining how and under what circumstances CIPP should be specified there are a number of factors to consider. The exclusive use of CIPP in areas where any or a combination of the following conditions may prevail:

1. Suspect structural characteristics in the host pipe where axial, radial, or longitudinal cracks, joint offsets, or shear conditions exist.
2. Pipe ovality sufficient to preclude other products from reaching its full round configuration which is required in the design of this product with ring compression theory.
3. Pipe where line and/or grade differentials may preclude other products from becoming fully rounded (i.e. lines with existing bellies, etc.).
4. Pipe where segments of pipe may be missing.
5. Pipe subject to highway loading in shallow depths where live loading is present or in deep bury locations where soil prism loading is possible.
6. Pipes under State Roads or under roads requiring FDOT maintenance. Typical common concerns of a project include traffic control, by-pass pumping, lateral reinstatement, and chemical grouting of reinstated lateral connections.

LANZO TRENCHLESS TECHNOLOGIES

Delivering innovative trenchless technology solutions to rehabilitate the world's diverse infrastructure

SUGGESTED SPECIFICATIONS FOR CURED-IN-PLACE PIPE (CIPP)
AS RECOMMENDED BY LANZO TRENCHLESS TECHOLOGIES

1. INTENT AND DESCRIPTION

1.1 The intent of this specification is to provide a recommended set of guidelines for the reconstruction of pipelines and conduits through the use of cured-in-place pipe (CIPP). In this specification recommended references, prequalification requirements, materials, pre- and post-installation inspection tests have been provided. The process generally consists of inserting a resin impregnated fabric tube into an existing pipe or conduit, expanding the tube against the existing pipe, and curing the tube to form a pipe within a pipe. The tube my be inserted into the pipe by direct inversion or pulling in place. Curing is accomplished by either circulating heated water or steam or ambient temperature air or water to affect the desired cure throughout the pipe from access point to access point.

Although the Contractor my have an approved or licensed process, no material changes or design changes shall be undertaken unless approved by the Agency specifying the project.

2. CONTRACTOR PREQUALIFICATION EXPERIENCE

2.1 The process must be proven through previous successful installations of CIPP rehabilitation projects on lines of 8" or larger in the United States within the last five years. The footage total for these projects shall be a minimum of 1,000,000 lineal feet. Additionally the Contractor shall submit a minimum of 50,000 lf of the size specified or larger to demonstrate competence with the magnitude of the project being constructed. Experience records shall be submitted with submittals according to the guidelines of the specifying agency. Contractors using sub-contractors shall submit information about the sub-contractor (i.e. name, experience records, jobs which the general and sub-contractor have worked jointly, etc.).

3. REFERENCE DOCUMENTS

3.1 ASTM F1216 - Standard Practice for rehabilitation of existing pipelines and conduits by the inversion and curing of a resin-impregnated tube.

3.2 ASTM F1743 - Standard practice for the rehabilitation of existing pipelines and conduits by the pulled-in-place installation of cured-in-place thermosetting resin pipe (CIPP).

3.3 ASTM D5813 - Standard specification for cured-in-place thermosetting resin sewer pipe.

3.4 ASTM C581 - Standard practice for determining chemical resistance of thermosetting resins used in glass fiber reinforced structures, intended for liquid service.

3.5 ASTM D790 - Test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.

3.6 Plans, drawing and profiles of lines to be rehabilitated are included, as available. Videotapes may also be available for review. It is the Contractor's responsibility to visit the site and investigate the project, as necessary, for preparation of any proposal.

3.7 In the event of a conflict, documents shall have the following priorities: (1) Specifications for CIPP, (2) General conditions, (3) ASTM F1216, F1743, and D5813 (as appropriate).

4. PREBID PREQUALIFICATION SUBMITTALS

4.1 Submittals shall be made according to the guidelines of the Agency

4.2 Resin

4.2.1 Submit technical data sheets showing physical properties of the products modified for the CIPP process.

4.2.2 Submit one year chemical resistance tests of flexural properties and weight change evaluations that have been carried out with the submitted resin(s) and the fabric tube material(s) to be used on the project. The edges or surfaces of the test specimens shall not be sealed or coated unless it can be conclusively proven that these modifications can be successfully completed in the field and that these product modifications will remain intact throughout the expected life of the product. The chemicals evaluated should be consistent with those specified in ASTM F1216 and/or ASTM D5813. These tests shall be run in a manner consistent with ASTM C581 with flexural property and weight change data available at intervals of 1, 3, 6 and 12 months to establish a trend of product performance. Tests should be carried out by an accredited lab and preferably through an independent third party lab.

4.2.3 At any point in the project, the specifying agency may request dated certificates of analysis for each delivery of resin during the project to confirm that the specified resin is being used on the given project.

4.3 Tube Materials

4.3.1 Submit technical data sheets showing that the physical properties of the tube materials meet the requirements of ASTM D5813.

4.3.2 Submit tabular summary of calculated sewer segment design thickness and recommended dry tube thickness for each installation. Dry tube thickness shall exceed calculated design thickness for all cases.

5. POST-INSTALLATION SUBMITTALS

5.1 Submit pre-installation tapes of the line segments being rehabilitated in a format specified by the agency (i.e. full pipe circumference, resolution, color, etc.).

5.2 Submit post-installation tapes of the completed CIPP and reinstated laterals in a format specified by the agency.

5.3 Submit flexural property test data from an independent third party testing lab of each line segment installed.

5.4 Submit installed CIPP thickness measurements from an independent third party testing lab of each line segment installed.

6. MATERIALS

6.1 Flexible Tube

6.1.1 The flexible tube shall be manufactured and fabricated under quality-controlled conditions set by the process manufacturer. The tube shall be manufactured of a size that when installed it will fit snuggly to the internal circumference of the pipe or conduit being rehabilitated and have minimal wrinkling.

6.1.2 The tube thickness shall also be specified such that the installed thickness meets the requirements of the specifying agency.

6.1.3 The tube length shall be manufactured such that it will span the entire length of the access points. When the product is installed between manholes, the CIPP shall extend beyond and seal the end of each manhole.

6.1.4 The specified tube material shall have a minimum tensile strength in the longitudinal and transverse directions as specified in ASTM D5813.

6.2 Resin

6.2.1 Provide a liquid thermosetting resin that will properly saturate the tube without draining out and will produce a properly cured pipe, which is resistant to abrasion and the effluent passing through the CIPP.

6.2.2 The approved polyester resin shall be made by a reaction of isophthalic/terathalic acid, maleic anhydride, and a glycol characterized by reactive unsaturation located along the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/promoters to produce cross-linked copolymer matrices. Use of recycled polyethylene terephthalic (PET)

6.2.3 resins shall not be allowed. In addition, only branched glycol chemistry shall be allowed in the composition of the polyester resin.

6.2.4 The approved vinyl ester shall be made by a reaction of epoxy resin with methacrylic acid and characterized by reactive unsaturation located in terminal positions of the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/opromoters to produce cross-linked copolymer matrices.

6.2.5 The approved epoxy resin shall be made by a reaction of bisphenol A and epichlorhydrin producing glycidyl ether reactive sites at the terminal positions of the molecular chain. This resin is cross-linked with the reactive equivalent of a curing agent suitable for the CIPP process.

6.3 Minimum physical properties

6.3.1 The minimum physical properties of the installed CIPP shall meet the following requirements.

Property	**Reference**	**Minimum**
Flexural Modulus	ASTM D790	250,000 psi
Flexural Strength	ASTM D790	4,500 psi

7. PRECONSTRUCTION CONFERENCE

7.1 After the contract is awarded and prior to commencing work, the Contractor will attend a pre-construction meeting with the Agency. At the meeting it is recommended that the work schedule, traffic controls, materials and other submittals, major sub-contractors, by-pass pumping plan, and certificates of insurance be submitted at that time.

8. TRAFFIC CONTROL

8.1 A traffic control plan shall include detailed diagrams showing the location of all traffic control devices and the length of time for all lane closures, as well as location of any flaggers, as necessary. One lane of traffic in each direction must be maintained at all times, and local streets may only be closed with prior approval of the Traffic Engineer.

8.2 A written method of handling traffic for each different phase of the project shall be submitted and include both vehicular and pedestrian traffic.

8.3 The name and number of the Contractor representative responsible for traffic control shall be made available to solve traffic problems at each job site location.

9. PERMITS

9.1 Depending on the project and location, there may be a number of required permits that must be obtained prior to commencement of the work. An example of permits that might be required include projects within State Highway right of ways, water permits, industrial waste permits, etc.

10. PUMPING AND BY-PASS PUMPING

10.1 The contractor shall submit a written plan at the preconstruction conference outlining the by-pass pumping scheme. The plan shall describe in writing and with diagrams the logistics of by-passing each pipe segment to be rehabilitated. Typically the Contractor or Sub-Contractor will provide the pumps for a given project. The by-pass shall be designed to handle peak flows with additional capacity in the event of a rainstorm. The by-pass shall be watertight and not leak. The plan should address contingencies in the event of a major rainfall or equipment malfunction.

11. CLEANING OF SEWER LINES

11.1 The Contractor, when required, shall remove all internal debris out of the pipe prior to installing the CIPP. The Contractor shall be responsible for disposing of all the debris in accordance with Agency requirements. Any hazardous waste encountered during a project, unless otherwise specified , is considered a changed condition.

12. PATENTS

12.1 The Contractor shall warrant and hold harmless the Agency against all claims for patent infringement and any loss thereof.

Reference

Applied Felts Letter

APPLIED FELTS

March 21st, 2020

To Whom It May Concern

Background

Applied Felts Inc. is a fully owned subsidiary of Applied Felts Ltd, part of the Rawson Group, a large non-woven textiles company. The Rawson Group was a key developer of CIPP technology beginning in 1974 and was the sole supplier of coated felt materials worldwide until the late 1980s. Applied Felts has produced inversion tube installed by qualified and certified installers operating in more than 30 countries. Millions of Linear Feet of Applied Felts' products have been in successful service over the past years within the State of Florida.

Lanzo is a fully owned certified installer of Applied Felts. Lanzo was a key developer of CIPP technology beginning in 1993 and was a major provider of CIPP technology in many forms while suiting applications ranging from Gravity Sewer to Storm to Pressure Pipe to NSF certified Watermain.

We can certify that **Lanzo Companies** is an approved installer and has installed over 4,000,000 LF in wastewater collection systems within the past 5 years. Furthermore, Lanzo has installed more than 15,000,000 linear feet of liners throughout the United States and Canada, of which 5,000,000 linear feet has been successfully installed in the South Eastern States of USA, all adhering to ASTM 1216-03.

Lanzo has installed quantities of AF liners as follows:

More than **6,000,000 LF** if sanitary sewer in the 8 to 18-inch range.

More than **450,000 LF of sanitary** sewer equal or greater than the size of 36-inch pipe

More than **150,000 LF of sanitary** sewer equal or greater than the size of 60-inch pipe

More than **850,000 LF of STORM** sewer between the sizes of 12" and 144-inch pipe

Applied Felts provides engineering support and technical assistance to its installers. Physical testing of tensile and flexural strengths is performed with many different resin systems to insure compatibility.

Specifications

Applied Felts lining materials are made of polyester needle felt with the outside layer of the tube coated with polyester polyurethane. Multiple layers of felt are constructed together to provide a wide range of liner thickness.

Quality Control & Assurance

Applied Felts, Inc. is a certified ISO 9002 manufacturer, and all materials are tested to ensure suitability to the various field applications. Each liner is typically tested in 28 different ways. Detailed traceable test data is available for any particular liner.

David Fletcher
Applied Felts

Applied Felts, Inc. 450 College Drive, Martinsville, VA 24112, Tel: (276) 650-1904, Fax (276) 650-1970 E-mail: appliedfelts@embarqmail.com

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Completed Projects List Past 5 Years

Lanzo Trenchless Technologies North
Completed Projects

Lanzo Job #	Project Name	Scope	Owner	Year	Pipe Dia
707	Town of Lantana Piggy Back	CIPP	Town of Lantana	2017	8-27"
702	Lauderdale-By-The-Sea Piggy Back	CIPP	Lauderdale-By-The-Sea	2016	8"-27"
701	Imperial Golf HOA Storm Sewer Lining & Rehab	CIPP	Imperial Golf Estates HOA	2016	8"-27"
699	City of Delray Bch Reclaim Water Expansion Area 12B	CIPP	City of Delray Beach	2016	8"-27"
698	Palm Springs Sussex Kent Park SS	CIPP	Village of Palm Springs	2016	8"
697	Miami Beach Palm & Hibiscus	CIPP	Miami Beach	2016	8"
693	City of Lake Worth,FL	CIPP	Lake Worth	2015	8"-27"
692	Town of Jupiter Island Gravity Sewer	CIPP	Jupiter Florida	2015	8-27"
691	Port St.Lucie Sewer Lining & Laterals	CIPP	Port St. Lucie	2015	8"-27"
690	Highpoint 5 Storm	CIPP	High Point of Delray Sec 5	2015	8"-27"
689	Travelers Resort Dade City	CIPP	Travelers Rest Resort Inc	2015	8"-27"
688	Ft. Lauderdale Annual	CIPP	City of Ft. Lauderdale	2015-2016	8"-15"
687	Turkecy Creek Storm Drain 2	CIPP	Turkey Creek HOA	2015	18",24", 30"
686	Miami Beach Environaste SS Rehab	CIPP	Miami Beach	2015	8"-27"
685	Seacoast Utility Authority Annual	CIPP	Seacoast Utility Authority	2015-2016	8"- 18"
684	FDOT E5T27 Volusia County	CIPP	FDOT	2015	15"-48"
683	City of Hollywood Annual I&I 2015	CIPP	City of Hollywood	2015-2016	8"-48"
682	SR 70 FDOT/ Johnson Davis	CIPP	FDOT	2015	8"
681	SR 715 Culvert Repair, Vac Vision	CIPP	FDOT	2015	8"
680	Miami Beach DB Sunset Harbour	CIPP	Miami Beach	2014	8"
LN2053	Macomb Element Arm Interceptor/Manhole Rehab	CIPP	Macomb County Public Works	2015	
LN2041	Bay City 2014 Critical Sewer Relining Project	CIPP	Bay City, City of	2014	8" - 20"
LN2035	Macomb County Lakeshore Interceptor	CIPP	Macomb County	2015	42"
679	Eastpointe HOA	CIPP	HOA	2014	15",24", 30"
678	FDOT T3423 US 98 VacVision	CIPP	FDOT	2014	8"-27"
677	Maitland T94-T002	CIPP	HOA	2015	8"
676	Miami Aviation	CIPP	Miami Dade County	2014	8"-10"
675	Johnson Davis- Boynton Beach	CIPP	FDOT	2014	30"-48"
673	City of Stuart-Boca Piggy Back	CIPP	City of Stuart	2014	16"
672	Capital Circle-Vac Vision	CIPP	Leon County	2014	36"
671	Port St. Lucie Storm	CIPP	City of Port St. lucie	2014	30"
670	Port of Miami Tunnel Project	CIPP	Port of Miami	2014	8"
669	Palm Beach County Annual CIPP	CIPP	Palm Beach County Water Utilities	2014-2015	8"-21"
668	Pinellas County Annual	CIPP	Pinellas County	2014	8"-30"
LN2032	Bloomfield Township Wing Lake	CIPP	Bloomfield Township	2014	8"-15"
665	Highpoint 54in Storm	CIPP	Highpoint 5	2014	54"
664	Hinterland Boca Pump Station	CIPP	City of Boca Raton	2014	8"
663	Brevard County	CIPP	Brevard County Florida	2013	71" X 47"
661	Turkecy Creek Storm Drain	CIPP	Turkey Creek HOA	2014	18"-42"
LN2033	Stark County Sanitary Engineers	CIPP	Stark County Ohio	2012	42"
660	City of Tampa Annual I&I Contract	CIPP	City of Tampa	2014	8"-30"
660	Tampa 2014 Annual I & I	CIPP	City of Tampa	2015	8"-30"
659	Boca Hills	CIPP	City of Boca Raton	2013	8"
658	FDOT-E5T07(Orlando)	CIPP	FDOT	2014	15"-60"
655	Miami Beach, Cadillac Hotel Drainage Rehab (GT McDonald)	CIPP	GT McDonald Enterprises	2013	12"
654	City of Hollywood Taft Street 60"	CIPP	City of Hollywood	2014	60"
653	West Palm Beach FPL Danella	CIPP	FPL	2013	12"
LN2027	Western Township Utility Authority	CIPP	WTUA	2014	48"
652	South Martin Regional Utility Annual	CIPP	Town of Jupiter Island	2013	8"
651	FDOT T7320 Pinellas County (APAC SE)	CIPP	FDOT	2013	8" to 24"
650	Miami Beach Venetian Islands Improvements	CIPP	City of Miami Beach	2013	8"
LN2025	City of Taylor-2012 Sanitary Sewer Rehab Program	CIPP	City of Taylor	2013	8"-12"
647	Lake Worth 7th Ave Sewer Rehab	CIPP	City of Lake Worth	2013	10" to 21"
646	Broward NCNIP BP#11 (Gianetti Contracting)	CIPP	Broward County	2013	8"
645	FDOT Southeastern Engineering 94th St Outfall	CIPP	FDOT	2013	36"
LN2020	US Steel-Jug Island	CIPP	US Steel	2013	48"
644	Imperial Golf Estates	CIPP	Imperial Golf Estate	2013	15" to 18"
642	Broward Pine Island Rd for Flow Tech	CIPP	Broward County, FL	2013	18"
641	Highland Beach Storm	CIPP	Town of Highland Beach	2013	12"
639	FDOT Volusia County	CIPP	FDOT	2013	15" to 48"
638	APAC SR 580 Pinellas	CIPP	FDOT	2013	18"
637	FDOT Winter Springs (ONAS Corp)	CIPP	FDOT	2013	18" to 48"
LN2019	City of Grand Rapids CIPP Various Locations	CIPP	City of Grand Rapids	2013	8"-36"
636	Evans Park Mount Dora	CIPP	City of Mount Dora	2012	30"
635	Ranger Construction SR 710 Beeline Hwy	CIPP	FDOT	2012	8"
634	Hillsborough County - Barrington Dr (Vac Vision)	CIPP	Hillsborough County	2012	8"
633	Belle Glade WUD 10-062R (Hinterland)	CIPP	Palm Beach County	2012	8" to 27"
632	Hallandale Beach	CIPP	Hallandale Beach, FL	2012	8" to 15"
631	Lake Nona Publix	CIPP	Lake Nona Land Company	2012	18" to 48"
629	FDOT SR 70 - Johson-Davis	CIPP	FDOT	2012	18" to 30"
626	FDOT Orange County SR 551	CIPP	FDOT	2012	18" to 24"
625	FDOT E7HR00 (Vac Vision)	CIPP	FDOT	2012	42"
623	Waneta Place Storm Drain Rehabilitation	CIPP	Sarasota County	2012	36"
622	Town of Bay Harbor Islands	CIPP	Town of Bay Harbor Islands	2012	8"
619	Village By The Bay Drainage Repairs	CIPP	Village By The Bay Condo Assoc	2012	15" to 24"
617	APAC-Southeast SR 64	CIPP	FDOT	2012	36"
616	Rockline Vac Systems	CIPP		2012	15" to 36"
613	Lauderdale-by-the-Sea	CIPP	Lauderdale-by-the-Sea	2012	8" to 12"
611	Port St. Lucie Autozone Prima Vista	CIPP	Port St. Lucie	2012	6" to 8"
609	Macomb County Culvert Repair	CIPP	Macomb County	2012	12"
608	Macomb Community College Center Campus (Proline Asphalt)	CIPP	Clinton Township	2012	6"
606	Imperial Golf Estates	CIPP	Imperial Golf Estate	2012	24"
604	City of Tampa, Junction Chamber #2 Effluent Pipes Rehab	CIPP	City of Tampa	2012	90" to 96"
602	Seacoast Utility Authority Annual	CIPP	Seacoast Utility Authority	2012	8" to 24"
601	Kerby Road Interceptor	CIPP	Village Grosse Point Farms	2012	54"
600	North Atlantic Drive	CIPP	Town of Lantana	2012	18"
599	D. Mancini & Sons - Miami Beach	CIPP	City of Miami Beach	2012	8"-12"
598	City of Hollywood I & I Improvements	CIPP	City of Hollywood	2012	8" to 48"
597	Hollywood Academy of Art & Science	CIPP	City of Hollywood	2012	12"
596	Harbour Ridge Culvert Improvements	CIPP	Palm City	2012	18" to 24"
595	City of Lake Worth, FL	CIPP	City of Lake Worth	2012	21"
594	West Bloomfield I & I Reduction Program	CIPP	Oakland County Water Resources	2012	8" to 27"
592	City of Hollywood, FL Emergency 48" FM	CIPP	City of Hollywood	2012	48"
591	Town of Lake Clarke Shores, South Service Area - Phase II	CIPP	Palm Beach County	2012	8" to 27"
589	Soil and Materials Engineers - St John's, MI	CIPP	City of St. John's	2012	24"
588	Village of Grosse Point Shores (Claireview Drive)	CIPP	Village of Grosse Pointe Shores	2012	8" to 27"

Qualifications

Qualifications

Safety

Lanzo strives to place safety as its number one Core Value.

Safety First

- At Lanzo; we are committed to be Safe for our Customers, for each other, and for the communities in which we serve.
- We are all entitled to go to a workplace where we can expect to return safely to our families after our workday.
- No Job is that important, no reward great enough to risk ourselves or each other.
- Safety is attitude, awareness, and commitment to best practices.

From 2014 to current Lanzo has not received any OSHA violations or Safety Citations and Penalties.

We can provide if required our Corporate Safety Manual if required. We also on all project develop and maintain job specific as well as site specific safety plans.

Warranty

Lanzo Trenchless Technologies offers a FIVE (5) YEAR warranty for all materials and workmanship.

Having over twenty (25) years' experience with testing methods described in this RFP, we feel comfortable that exceeding the performance anticipated with methods presently being utilized by Lanzo should be easily demonstrated. The service life expectancy for materials and resins being utilized on this project is fifty (50) years.

Our standard approach to warranty is that should there be a problem, we would quickly implement a repair as needed. The negatives that emanate from not satisfying the client in this regard, as it pertains to both ongoing work as well as reference value outweigh the cost of the repair. We have installed more than fifteen million (15,000,000) feet of this rehabilitation type of which five million (5,000,000) lineal feet of CIPP rehabilitation has been performed without failure within The State of Michigan.

Should we utilize any subcontractor to perform ancillary tasks such as Manhole Coatings, MOT or bypass we would extend our warranty to their portion of the work as well.

Key Personnel Resumes

Several essential key individuals will be assigned to the project and designated as the project team leaders. The leaders will have direct oversight and management of all project functions as well as the remaining project personnel, who are equally important and just as qualified in their respective positions. The team leaders will also be responsible to maintain the deliverables and ensure continual project compliance with: (but not limited to)

- OSHA, MIOSHA and all general industry standard safety laws, rules, regulations, guidelines, policies, procedures and processes
- The intended scope of services and project specifications
- Quality Assurance and Quality Control Program
- City, State, and Federal guidelines, policies, and procedures
- Design standards and objectives
- Project team communication
- Schedule requirements and objectives
- Cost control measures
- Project reporting
- Document control
- Project punch list
- Project closeout

LANZO COMPANIES
Building and restoring sustainable infrastructure to support the needs of our communities

SAL D'Alessandro

Trenchless Superintendent

QUALIFICATIONS

Mr. D'Alessandro has eight years of experience in the lining industry. He possesses specific experience with all the different phases of trenchless rehabilitation of existing utility systems. Sal reviews all wall thickness calculations and evaluations as to materials utilized for each CIPP Liner installation. On projects he reviews measured analysis of time requirements for bypass requirements, pit locations and placement technology to be utilized. He is also manages the day to day communication with our third party testing facility and facilitates the sending of samples and the review of reports that are returned.

EXPERIENCE

Sal is experienced, working as a field supervisor, and project coordinator. Sal has managed a variety of municipal, industrial and private projects. He has worked on various projects with diameters and sizes of CIPP liners ranging from 4" to 108". Sal is experienced with both circular and non-circular pipelines, pressure lines, water-mains, as well as force-mains.

COMPLETED PROJECTS

Lauderdale-By-The-Sea Piggy Back – Cost $630,198.50

Imperial Golf HOA Storm Sewer Lining & Rehab - $34,602.00

City of Delray Beach Reclaim Water Expansion Area 12B – Cost $68,680.00

Palm Beach Sussex Kent Park Sanitary Sewer – Cost $181,858.00

Highpoint 5 Storm Sewer Rehab – Cost $84,240.00

Traveler's Resort Dade City – Cost $67,160.00

Fort Lauderdale Annual – Cost $1,571,795.00

Turkey Creek Storm Drain 2 – Cost $152,464.00

LICENSES/CERTIFICATES/QUALIFICATIONS

First Aid & CPR Certified

Advanced Confined Space Training and Rescue

40-Hour Hazwoper

PACP Certified

LANZO COMPANIES

Building and restoring sustainable infrastructure to support the needs of our communities

John D'Alessandro

Trenchless Senior Project Manager

QUALIFICATIONS

Mr. D'Alessandro has forty years of experience in the lining industry. He possesses specific experience with all the different phases of trenchless rehabilitation of existing utility systems. John reviews all wall thickness calculations and evaluations as to materials utilized for each CIPP Liner installation. He is experienced in the management and implementation of quality control measures to insure the highest quality product in every project he is involved in.

EXPERIENCE

Lanzo Construction Co., Florida, Pompano Beach, FL **1980-1993**

Project Manager & Estimator

Project Manager for Florida structural Division, direct involvement with all treatment facilities and pump station contracts for Florida, North Carolina and Michigan operations.

Telcon, Inc. **1993-2005**

Owner

- Utility contractor performing water, sewer and drainage throughout central and southeast Florida public and private sector. Complete site work including utilities, pavement and earthwork.
- Worked directly for FPL and Southern Bell installing concrete duct banks, residential URD and cable, high voltage pipe type transmission and fiber optic cable installation.
- Project experience includes heavy civil pipe installations, sewage pumping stations and treatment plants, earthwork, paving, power and communication utilities,. manhole and utility pipeline rehabilitations. Bore and jacking, Micro tunneling and directional boring.

Lanzo Construction Co., Florida, Pompano Beach, FL **1980-1993**

Cheif Estimator & General Manager

- Utility Company specializing in Rehabilitating Sanitary, Drainage Water and Force main by CIPP (cured in place pipe).
- Responsible for all national bidding and procurement projects.
- Project Manager for all current contracts held in the State of Florida.
- MacDill Air Force Base, Tampa, Florida project. 17,000 lf 14" to 54" CIPP of storm drainage system GPR (Ground penetrating radar) survey. Structure rehabilitation with epoxy coatings and exterior pipeline grouting from surface.
- City of Atlanta, Georgia Watershed Contract 4, 90,000 lf of CIPP 8" to 24" gravity sewer, point repairs, pipe bursting, manhole rehabilitation and related restoration.
- City of Hollywood, Florida, 13,000 lf 48" and 9,000 lf 36" Gravity CIPP, major bypass pumping, manhole rehabilitation, sanitary lateral CIPP.
- Miami Dade Water and Sewer, Annual Contract CIPP of 8" through 21" Sanitary Sewers, 145,000'lf
- City of Ft. Lauderdale Florida, various contracts, combined 175,000 lf 8" to 15" CIPP rehabilitation. 500 each lateral linings and manhole cementitious coatings.
- City of Petersburg, Florida, annual contract for CIPP rehabilitation of mainline sanitary, laterals and manholes.55,000'lf
- Clinton Township, Michigan, 9500 lf 36"gravity sewer rehabilitation and manhole cementitious coatings with related grouting and bypass pumping.

LANZO COMPANIES
Building and restoring sustainable infrastructure to support the needs of our communities

Saul Rivera

Lining Foreman

Qualifications:

Mr. Rivera has over 14 years of experience as a Project Superintendent in the Lining Division. He possesses specific experience with all the different phases of trenchless rehabilitation of existing utility systems. On projects he reviews measured analysis of time requirements cleaning and preparing the pipeline for lining. He has experience in the local and private sector of the rehabilitation industry. He has the experience at the local and regional level for large scale projects.

COMPLETED PROJECTS / EXPERIENCE

Lanzo Trenchless Technologies, Inc. — **March 2020 - Present**

Ric-Man Construction, Inc. — **March 2016 – March, 2020**

Kenny Construction Company — **May 2012 - March 2016**

- City of Evanston Large Diameter Sewer Rehabilitation - City of Evanston Utilities Department
- Upper Des Plaines Intercepting Sewer 20B Rehabilitation, NSA - Metropolitan Water Reclamation District of Greater Chicago
- Term Agreement for Sewer Lining: North, North, Central, South and Far South Areas - City of Chicago, Department of Water Management
- Tollgate 2013 Interceptor Rehabilitation – WSU Project - City of Aurora, IL
- Arizona Forest Hwy 39 Mt. Lemmon Drainage – WSU Project - Pima County DOT, AZ
- East 88th Avenue CIPP Project – WSU Project - South Adams County Water and Sanitation District
- Fiscal Year 2013 Sewer Lining Projects - Board of Public Utilities, Cheyenne Wyoming
- Alma 2012 Sanitary Sewer Improvements Phase 2 - City of Alma, Kansas
- Exposition Interceptor Rehabilitation - City of Aurora, Colorado

Spinello Companies — **2008-2012**

- Herring Run Sewer Rehab - City of Baltimore, Maryland
- 2010 Sanitary Trunk Sewer Rehabilitation - RMWWA, Flemington, Maryland
- 2010 Sanitary Sewer Interceptor Rehabilitation - City of Annapolis, Maryland
- 2009 East/West Sanitary Sewer Interceptor Rehabilitation - City of Sugar Land, Texas

Lanzo Lining — **2006 - 2008**

- 2009 Storm Drain Lining - Harbor Ridge Yacht and Country Club, Port Saint Lucie, Florida
- 2008 Lining of 54" Storm Drain by Cured-In-Place Pipe - Mac Dill Airforce Base, Tampa Bay, Florida
- 2008 Pinellas County Sewer Rehab - Pinellas County, Tampa Bay, Florida
- Sanitary Sewer Rehabilitation - City of Destin Florida
- Rehabilitation of Sanitary Sewers - Pt Saint Lucy, Florida
- Annual Contract CIPP Rehabilitation - Miami Dade Water and Sewer Dept.

LANZO COMPANIES

Building and restoring sustainable infrastructure to support the needs of our communities

LICENSES/CERTIFICATES/QUALIFICATIONS

- Certification for Confined Space Entry
- Certified with FDOT for M.O.T.
- Certification for CPR/Medical First Aid
- OSHA 30-Hour Construction Safety Certificate
- Basic Plus First Aid/CPR/AED
- Class A CDL with hazmat and tanker endorsement
- NUCA Confined Space Entry Program
- Nassco/PACP!X

Joe Solomon

Cutting Crew Foreman

Qualifications:

Mr. Solomon areas of expertise consist of CIPP Rehabilitation and sewer cleaning. In his role as Cutting Foreman he will be organizing, scheduling crews and is responsible for the CIPP Cutting crew. He can perform all phase of rehabilitation from CCTV & cleaning sewers, wet-out of CIPP liners, and the installation of CIPP liners (steam & hot water). He is also well versed in post CCTV and preparation of submittals at the completion of installation.

Certifications and Education:

PACP Certified

OSHA 10-hr Construction Training

Telehandler (Forklift)

Confined Space Training

Project Experience:

WRC — Farmington Hills

Oakland Macomb Interceptor Drain — Contract 6 -

City of Battle Creek 2016-022B — 2015 Sanitary Sewer Interceptor Rehabilitation -

Macomb Element and Sterling Heights Arm Interceptor and Manhole Rehabilitation

Stark County P-567 CIPP Lining, Plain Township Project

City of Dearborn Heights — CO 11

DWS-899 Detroit Emergency Sanitary Sewer Repair

Paul Torres, Jr.

Project Manager/Proposed Project Superintendent

Qualifications:

Mr. Torres provides clear communication between the owner's representatives who make the decisions and our men with boots on the ground who build the work and is essential to the successful delivery of projects in the State of Michigan. He possesses specific experience in the construction of sewer rehabilitation projects. He has experience at the local and regional level for large-scale projects requiring the coordination of various construction disciplines. He is knowledgeable in public sector construction needs.

LICENSES/CERTIFICATES/QUALIFICATIONS

First Aid & CPR Certified

Advanced Confined Space Training and Rescue

40-Hour Hazwoper

PACP Certified

COMPLETED PROJECTS

WRC - Farmington Hills

Oakland Macomb Interceptor Drain ® Contract 6

Oakland Macomb Interceptor Drain - Contract 5B

Macomb Element and Sterling Heights Arm Interceptor and Manhole Rehabilitation

City of Dearborn Heights - CO 11

Alejandro Godinez

Lining Crew Foreman

QUALIFICATIONS

Mr. Godinez is results-driven Lining Foreman with a total of 12 years' experience in the construction industry. Areas of expertise consist of underground construction and sewer cleaning. His leadership has provided a good conduit of communication and he works well with management and non-management personnel, with strength in developing trusting, loyal relationships with customers, suppliers and workforce. In his role as Lining Foreman he will be organizing, scheduling crews and assist with the performing of all phases of CCTV and cleaning operations, responsible for expediting and prepping all sewers for CIPP installation. Alejandro is responsible for the CIPP inversion lining crew. He can perform all phase of construction from CCTV & cleaning sewers, wet-out of CIPP liners, and the installation of CIPP liners (steam & hot water) consisting of pipe sizes 8" through 96".

COMPLETED PROJECTS

Oakland Macomb Interceptor Drain – Contract 6

Oakland Macomb Interceptor Drain – Contract 5B

Macomb Element and Sterling Heights Arm Interceptor and Manhole Rehabilitation

WRC Framington Hills

Stark County P-567 CIPP Lining, Plain Township Project

DWS-899 Detroit Emergency Sanitary Sewer Repair

LICENSES/CERTIFICATES/QUALIFICATIONS

First Aid & CPR Certified

Advanced Confined Space Training and Rescue

40-Hour Hazwoper

PACP Certified

Darrell James

Lining Foreman

Qualifications:

Mr. James areas of expertise consist of CIPP Inversion Water, Steam, Lateral launching and ILS. In his role as Cutting Foreman he will be organizing, scheduling crews and is responsible for the CIPP Cutting crew. He can perform all phase of rehabilitation from CCTV & cleaning sewers, wet-out of CIPP liners, and the installation of CIPP liners (steam & hot water). He is also well versed in post CCTV and preparation of submittals at the completion of installation.

Certifications and Education:

Bachelor of Arts in Administration of Justice - Howard University, Washington DC

Experience:

Inland Water Pollution Control – Detroit, MI

Project Manager / CIPP Foreman

- Managed contractual CIPP rehabilitation projects
- Managed crews in installation of large and small diameter CIPP utilizing water and steam processes
- Bypass pump set up, monitoring and maintenance
- Coordinating training and development of lining personnel

Insituform Technologies Inc. – Detroit, MI

CIPP Foreman

- Managed installation of large and small diameter CIPP utilizing water steam and ILS
- Supervised a team of 5 maintaining a safe work culture and environment meeting critical deadlines
- Maintained the operation and repair of all field equipment
- Climbed large diameter pipe to reinstate laterals

Licenses/Certification:

First Aid & CPR Certified

Advanced Confined Space Training and Rescue

40-Hour Hazwoper

PACP Certified

Qualifications

Equipment Condition

Lanzo has a long history of maintaining our own equipment of fleet vehicles, heavy trucks, heavy equipment and cranes as you can see by our extensive equipment list, that control over our own destiny is the only way to insure continued success. Our maintenance program is a well-oiled machine which includes ample staff such as the Equipment Managers, Diesel Mechanics, Parts Runners, Welders, Fuel Truck Driver, and Low Boy Drivers. Our in-house maintenance and service includes two fully equipped indoor shops with overhead 10 ton cranes, on site bulk storage of fluids, spare parts stock, and fleet maintenance software and tracking system. Our Diesel Mechanics are completely mobile and provide maintenance and repair services to our heavy equipment in the field. This maintenance program in conjunction with our ability to mobilize spare heavy equipment with our Low Boy Tractor Trailer insure that down time due to equipment failure is minimized. TV Trucks and Vactor Trucks that require specialized maintenance and care in cold environments are handled and repaired by specialized and trained mechanics who are familiar with their operations and maintenance needs. This ensures that they are available for operations at all times. We also have winter storage of vehicles that allow us to keep them available and ready even in adverse conditions.

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Equipment List

Year	Make	Model	Description	Serial #
			FLEET TRUCKS	
2015	LINCOLN	Navigator	LINCOLN NAVIGATOR	5LMJJ2HT6FEJ08459
2003	FORD	Expedition	FORD EXPEDITION	1FMRU15W33LA22233
2010	LINCOLN	Navigator	LINCOLN NAVIGATOR	5LMJJ2H57AEJ02843
2014	LAND ROVER	RANGE ROVER	RANGE ROVER SPORT	SALGS2TF1EA196237
2016	FORD	ESCAPE	FORD ESCAPE	1FMCU9G99GUB34580
2016	FORD	F-150	FORD F-150 PICKUP	1FTFX1EGXGFB68575
2016	GMC	YUKON	DENALI XL 4WD	1GKS2HKJ5GR354517
1999	FORD	F250	FORD F-250	1FTNX20F3XEE44732
2004	FORD	F250 Super Cab	FORD F-250 SUPERCAB IN SERVICE PER MARK B 1/11/2017	1FTNX21P54ED43680
2015	FORD	F-250 XL	FORD F-250 XL PICK-UP	1FT7X2A64FEC76377
2015	FORD	F-250 XL	F-250 XL SUPERCAB	1FT7X2A69FEC50163
2012	GMC	SIERRA CREW	GMC SIERRA CREW 4X4	1GT121C89CF221815
2013	FORD	ESCAPE	FORD ESCAPE	1FMCU0GX2DUA46444
2003	FORD	F250	FORD F-250 PICK-UP TRUCK	1FTSX31PX3ED38076
2015	FORD	F-250 XL	FORD-250XL 4X4 SUPERCAB	1FT7X2B60FED03797
2008	FORD	F-350	FORD F-350	1FTWX31R28EA51258
2016	FORD	F 250 XL	FORD F-250XL	1FT7X2A66GEA23448
2015	FORD	F-250 XLT	FORD F-250 XLT	1FT7X2A64FED50008
2015	FORD	F150	FORD F150	1FTEX1E8XFFB60303
2015	FORD	F250	FORD F250	1FT7X2B68FED37700
2013	FORD	F-250	FORD F250	1FT7W2B65DEB13607
2013	FORD	F-250	FORD 250	1FT7W2B61DEB15760
			HEAVY TRUCKS	
2010	INTERNATIONAL	7500 SBA 6X4	VACTOR 2115-824 PLUS (VAC S/N 10-03V-12092)	1HTWNAZT3AJ190342
1997	INTERNATIONAL	4700	INTL FLATBED BOILER	1HTSCAAN2VH496110
1997	INTERNATIONAL	4700	INTL FLATBED BOILER	1HTSCAAN4VH496111
2001	FORD	F550	F-550 CHASSIS ARIES TV	1FDAF56F21EB80514
2001	FORD	F550	F-550 CHASSIS ARIES TV	1FDAF56F51EB80538
2012	FREIGHTLINER	F3CC170 SPRINTER	FREIGHTLINER TV/CUTTER VAN	WDPPF4CC6C9520609
1991	INTERNATIONAL	4700	INTL 4700 REFRIGERATOR TRUCK	1HTSCNDNXMH320973
2015	ARIES	TR2000	TR2000 TRACTOR, 6-15IN PIPE KIT / FRAME SPREADER	TR2000-15016248
2002	AEROCAP	Hi-Cube	T V Hi-Cube TV Truck	1FDXE45S72HA53473

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
1998	INTERNATIONAL	4900	22' Reefer Truck Tool Truck	1HTSDAAN7WH538043
1998	INTERNATIONAL	4900	22' Reefer Truck Tool Truck	1HTSDAAN4WH538047
2006	FORD	F550	F-550 CHASSIS ARIES TV	1FDAF56P46ED91584
2011	INTERNATIONAL	7400 6X4	RS CITYLINER TYPE 800 - IN SERVICE MAY 2016	1HTWGAZR5BJ356392
2008	FORD	S-DTY F-750	Rush Steam Unit	3FRXF75H78V644136
2008	FORD	F-750 / RSU 000	Rush Steam Unit	3FRXF75H58V644135
2009	VACTOR		VACTOR-7600 SFA 6X4 (VACTOR S/N 08-07V-11295)	1HTWXSBT99J086217
2015	KENTWORTH	T800	BOILER TRUCK/RUSH HEATER WITH WORK PLATFORM	1NKDL40X5FJ426720
2015	KENTWORTH	T800	BOILER TRUCK/RUSH HEATER WITH WORK PLATFORM	1NKDL40X7FJ426721
2007	PETERBILT	340	BOOM TRUCK W/NATIONAL 900A 26 TON BOOM TRUCK	2NPRLZ0X17M732773
2017	INTERNATIONAL	DURASTAR	INTERNATIONAL 26' REEFER TRUCK - LEASE #I-8650	3HAMMMMN9HL501949
2017	INTERNATIONAL	DURASTAR	INTERNATIONAL 26' REEFER TRUCK - LEASE #I-8651	3HAMMMMN5L501950
2015	KENWORTH VACTOR	T800	VACTOR 2115 - MI VACTOR	1NKDL40X2FJ431616
2016	EMAGINEERED SOLUTIONS		12" SHOOTER WITH SLIDE GATE	ESI-S12RB-U-5127-N
2016	EMAGINEERED SOLUTIONS		12" SHOOTER WITH SLIDE GATE	ESI-S12RB-U-5128-N
2016	FORD	F550	16' HIC TV CUTTER CCTV INSPECTION SYSTEM	1FDUF5GT9GEA60770
2012	NISSAN	NV3500	CUES HD TV TRUCK 2 CRAWLERS AND 2 CAMERA	1N6AF0LY3CN108007
2017	INTERNATIONAL	DURASTAR	INTERNATIONAL 26' REEFER TRUCK	3HAMMMMN9HL501949
2017	INTERNATIONAL	DURASTAR	INTERNATIONAL 26' REEFER TRUCK	3HAMMMMN5L501950
2017	INTERNATIONAL	4300	INTERNATIONAL 26' REEFER TRUCK	1HTMMMMN4JH526141
2015	INTERNATIONAL	4300	26' REFRIGERATED TRUCK	3HAMMMMN6FL744194
2016	FREIGHTLINER	2115-824P100A	VACTOR 21158254 PLUS 1	1FVHG3CYY9GHHD7620
2017	FREIGHTLINER	800HPRECOTK80	TRUCK MOUNTED JET UNIT	1FVACXDT6HHHM2321
2015			747 TRAILER JET 40 GP	1S9KU2128FD381467
1989	FORD	AEROMAX	WATER TRUCK	1FTYS95X9KVA52417
1995	GMC	TOP KICK	TOPKICK VAN	1GDL7H1J1SJ515287
2006	FORD		MECHANIC TRUCK	3FRWF65F76V315275
2000	KENWORTH	LOWBOY TRATOR	EQUIPMENT LEASE	1XKDD60X3YJ861656
TRAILERS				
2003	SEWER EQUIP. CO		Gate Easement Machine (White)	5FLRP12173B145145
2005	TRIPLE CROWN	5X10 Utility Trailer	5X10 Utility Trailer 3K GVW	1NXU5X10551010395
1996	CARGO EXPRESS		CARGO INVERSION UNIT TRAILER	ICE09614119960098

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
1996	BEAVER		BEAVER CUTTER	1UK500F20T1019012
1995	SRECO	MD HV1800	SRECO HV1800 JET TRAILER	4H5W31729SL952004
1996	O'BRIEN	700JP	O'BRIEN 600GAL JET TRAILER	99644817296041080
2002			LARGE SEWER TRANSPORTER-ARIES	YT02012204
2004	HOTKICK		HOTKICK HEATER UNIT OM-148 LATERAL LINING	01470
2004	HOTKICK		HOTKICK HEATER UNIT OM-148 LATERAL LINING	01493
2004			MAX LINER GUN LATERAL LINING	LG001001
2004	SOEHNLE		SOEHNLE DIGITAL SCALE LATERAL LINING	7755
2004			VACUUM PUMP LATERAL LINING	LG000043
2004			HAND CALIBRATION ROLLER LATERAL LINING	KR000001
2006	BLACKROCK	TRAILER	BLACKROCK UTILITY TRAILER 8000HD	2SWUW11A96S044474
2007	INGERSOLLR	P185WIR	INGERSOLLR AIR COMPRESSOR	343329/NOVIN0200661278
2000	O'BRIEN	JET TRAILER	O'BRIEN JET TRAILER	1Z93PJ2E8YL119086
2005	SRECO	350 JET TRAILER	MODEL 350 TRAILER JET - 300 GALLON	2374 (CHASSIS VIN#2435)
1970	GREAT DANE		DROP DECK TRAILER	43611
1999	RITE	750-WO	RITE WATER HEATING BOILER BOX	26868
1999	RITE	750-WO	RITE WATER HEATING BOILER BOX	26887
2006	MQ POWER	DCA45SSIU3C	MQ POWER 36KW DIESEL GENERATOR	3774786
	60" SCAFFOLD	HOMEMADE	60" HOMEMADE SCAFFLOLD	N/A
2006	WE HAUL		TANDEM AXLE TRAILER	5NHUWE6266N057057
			MIS GROUT & CCT EQUIPTMENT GROUT SYSTEM	
2000	SRECO	JETTER	JETTER TRAILER - 600gal TANK	4H5W31726YL002661
2006	ROYAL CARGO	RSTCH 8.5X20TA3	ROYAL CARGO TRAILER	5LABE202X6M012980
2005	PACE AMERICAN	LM714TA2	PACE AMERICAN TRAILER - SAFETY TRAILER	4FPUB14235G092534
2006	SULLAIR	210HDPQ	SULLAIR 210HDPQ AIR COMPRESSER	152104
2006	SULLAIR	210HDPQ	SULLAIR 210HDPQ AIR COMPRESSER	152096
2015	PACE AMERICAN	CS7X14TA	PACE AMERICAN TRAILER - SAFETY TRAILER	53BPTEA20FU013501
1992			48' REFRIGERATED TRAILER-WHITE	IDTV61Z22NA206931
1978			COPCO FLATBED TRAILER 45' X 96"	15389
			SECA EASEMENT TRAILER	6524
1998	UTILITY	VS2R-48/162/102	48' REFRIGERATED TRAILER	1UYVS2480WM689603
2004	UTILITY	ALUM 48/162/102	48' INSULATED REEFER TRAILER	1UYVS24814M232702
2015	INTERNATIONAL	4300	26' REFRIGERATED TRUCK - IDEALEASE OF MIAMI U# I-8609	3HAMMMMN6FL744194
2016	YONGQIANG	4X8 UTILITY TRAILER	48X96 FOLDING TRAILER	L4WC1H811GA093989

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
2017	PACE AMERICAN	JV85X20TE3	PACE AMERICAN TRAILER - TOOL TRAILER	53BPTEB26HU023578
2016	GT EXPRESS	T1022275-10P	PERMALINER 22' TRAILER / F-10 TOP GUN EQUIPMENT	5GLBE2221GC000482
			SMALL EQUIPMENT	
2015	CUES	KANGAROO	CUES KANGAROO POWER CUTTER - UNIT#218	
2015	CUES	KANGAROO	CUES KANGAROO POWER CUTTER - UNIT#218	
2015	CUES	KANGAROO	CUES KANGAROO POWER CUTTER - UNIT#218	
2015	CUES	KANGAROO	CUES KANGAROO POWER CUTTER - UNIT#218	
2013	HAMMERHEAD	HG20	HAMMERHEAD HG20 WINCH	1E9WD1423CC196266
2013	HAMMERHEAD	HG20	HAMMERHEAD HG20 WINCH	1E9WD1429CC196241
2014	HAMMERHEAD	HG5	HAMMERHEAD HG5 WINCH	1E9WE07199C196158
2014	HAMMERHEAD	HG12	HAMMERHEAD HG12 WINCH	1E9WC1424EL196317
2015	HAMMERHEAD	HG12	HAMMERHEAD HG12 WINCH	1E9WC1421EC196299
2014	CIPP	8 - 18 BASIC	CIPP SVC MODEL 8-18 AIR INVERTER / SHOOTER	
1994	TAYLOR	TE155S	TAYLOR FORKLIFT TE155S	S-B5-21221
2001	TAYLOR	THD610	TAYLOR FORKLIFT THD610	29911
2010	NISSAN	CFU50LP	NISSAN FORKLIFT	CU1F2-9Q0942
1998			CAT 938 F WHEEL LOADER w/gp Bucket	1KM01745
2015	NozzTeq	LJ300C	24" TORQUE MULTI PURPOSE CUTTER	
2004			Rotating Chain Cutter 8"-16" Pipes	10.200R
2005	ENZ	EU10200RS	Rotating Chain Cutter 8"-16" Pipes	
2009	TURBO II	CHAIN CUTTER	FLEXIBLE 6" - 12" CHAIN CUTTER	P/N 1-0403
	SUPER CUTTER	PLUS 200	SUPER CUTTER PLUS 200 CHAIN CUTTER	200151-C
	BEAVER CUTTER	B-165	BEAVER CUTTER B-165	BDO 8206
			BEAVER CUTTER B-165	BDO 8106
			BEAVER CUTTER B-165	BF 09311
			BEAVER CUTTER B112 MINI	MF 02811
	BOWMAN	DOMINATOR 4-30	BOWMAN DOMINATOR 4-30 CUTTER	CD-1-06-06-0-0-4 PENN
			CUES CAMERA (PAN & TILT)	069
			CUES CAMERA (STRAIGHTLINE)	070
			CUES CAMERA (PAN & TILT)	078
			CUES CAMERA (PAN & TILT)	010
2004			"LETS" LATERAL CAMERA	04101801
2005	ARIES	PE-2600	Color Pan & Tilt Camera	05091101
2005	FLOW-TEK	LJ300C	8"21" Lumberjack 300 Series	
2007	NozzTeq	LJ300C	8"21" Lumberjack 300 Series	

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
2007	ARIES	SEEKER	SELF LEVELING CAMERA W/200' PUSH ROD	SK3200
2015	PROTEUS	MINI CAM	PROTEUS INSPECTION SYSTEM BY MINICAM	PCU-0121
	ARIES	TITAN TR7000	TITAN TR7000 LARGE 4 WHEEL TRACTOR	LOCATE SERIAL # 2016 !!!
2016	KOHLER	CH 1000	9085 PRESSURE WASHER 7000PSI	16-11216
2016	CHEMGROUT	708354-7112	TRAILER MOUNT AIR POWERED GROUT MACHINE W/DBL HOPPER	16131225002C6GH
1999			36 X 60 DOME HEAD PLUG	
2012	CHIPPING UNIT	HOMEMADE	ALUMINUM CHIPPING UNIT - (MOBILE UNIT TO UNIT)	
			RIDGID 23717 DRAIN CLEANER	Mod # 23717
1997			STANLEY HYDRAULIC UNIT-PORTABLE	640
2000			HYD.POWER UNIT W/PUMP10209	7907
	HOMEMADE 15' PORTABLE	PINCH ROLLERS	OVER-THE-HOLE ROLLER & CONVEYOR	
	COMMERCILA ICE		INDUSTRIAL ICE MACHINE	
2006	INGERSOL RAND	PD20A-AAP-STT	2" Diaphragm Vacuum Pump - 3/4 HP Motor	HO316 417
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2015	UNICO COMNMERICAL	SLED FABRICATION	PIPE ACCESS SLED CART	HOME MADE NO S/N
2016	TITAN	SERIES 160 INCH	PORTABLE WET-OUT CONVEYOR W/RESIN MIXING SYSTEM	N/A
1997			SULLAIR 185 DPG AIR COMPRESSOR	004-124324
1997			SULLAIR 185 DPG AIR COMPRESSOR	004-124331
2007	SULLAIR	185 DPQ	SULLAIR 185 DPG AIR COMPRESSOR	200705160129
			PROSCOUT COLOR CAMERA	03021801
	HONDA	WB20X/WB30X	Honda 2" Water Pump	1259219
2007	ROL-AIR	7722HK28	8hp Gas Compressor (Honda) w/Regulator	07071549
	GENERAL	GPS	BLOWER - GP8	H30671
			VIPER TURBO GAS FOAM GENERATOR	004-152096
2006	ALLEGRO	9504	Manhole Blower (Electric Motor)	1899
1994			4-INCH THOMPSON PUMP / TRAILER MTD.	NOVINO200076813
1996			6-INCH THOMPSON VAC-ASST PUMP	TPM41011J1566V393

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
2006	ALLEGRO	9504	Manhole Blower (Electric Motor)	1898
2006	GENERAL	GP8	Manhole Blower (BRIGGS & STRATTEN Engine)	050830YA
1999	ALLEGRO		ALLEGRO MANHOLE BLOWER 9505	56282
2005	GENERAL	GP8H	Manhole Blower (Honda Engine)	33832
2001			4" TRASH PUMP	33606
2001			4" TRASH PUMP	28525
2002			4" TRASH PUMP	36991
2002			PARTNER K-700 CUT OFF SAW	023400291
2005	HONDA	WT40X	4" Trash Pump (Honda)	WT40XK2 GX340K1
2005	MULTIQUIP	QP3TH	3" Trash Pump (Honda)	3TH-5255
2006	MULTIQUIP	QP3TH	3" Trash Pump (Honda)	3TH-5212
2006	MULTIQUIP	QP4TH	4" Trash Pump (Honda)	4TH-0370
2006	MULTIQUIP	QP4TH	4" Trash Pump (Honda)	4TH-0709
2005	HONDA	WB20X	2" Water Pump (Honda)	GCAAT-1529760
2007	HONDA	WT30X	3" Trash Pump (Honda) IN SVC NOV 2011	1122831
2007	HONDA	WT40X	4" Trash Pump (Honda)	1106081
2007	MULTIQUIP	QP3TH MQ	3" Trash Pump	11899
	HONDA	WT40X	4" TRASH PUMP - ATTACHED UNIT 225	
2008	KUBOTA	SEP-21.0	INDUSTRIAL GENERATOR - ATTACHED TO U#212	0235531/002
	WACKER	PT3A	3' PUMP, ENG PA2X/GBJT S/N 10865244	112114063
2008	HONDA	WT30X	3" TRASH PUMP	1122942
2008	TSURUMI	EPT3100HA	4" PUMP	03166
2008	HONDA	WB20XT	2" Water Pump (Honda) / REPLACES UNIT #941	CBNT-1067306
	HONDA	EB5000X	HONDA GENERATOR	GC05-3872817
2010	HONDA	WT40X	4" TRASH PUMP	1114990
2010	HONDA	WT40X	4" TRASH PUMP	1114993
2010	HONDA	WT40X	4" TRASH PUMP	1111670
2011	GORMAN R	14C1-GX30	4" GAS TRASH PUMP	1482897
	GORMAN RUPP	PA4A60-4045DSH	4" DIESEL SELF=PRIME PUMP	1284077
			BROWNIES THIRD LUNG-C260X	
2004			ALUMINUM SHOOTER FOR CIPP	
2006	POWER PRO	3500	GENERATOR - 3500	ENG #HY168FB/B2017299
2006	MULTIQUIP	QP3TH	4" Trash Pump (Honda)	3TH-8710
2006	POWER PRO	3500	GENERATOR - 3500	ENG #HY168FB/B2017370
	NORTH STAR	13000 PPG	GENERAOR (HONDA ENGINE)	8050059

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
2006	HONDA	EM2500	GENERATOR - (Honda)	ENG #GC02-5669839
2007	STIHL	MS200T	14" CHAIN SAW	164677109
2007	SCHONSTEDT	GA-5Z-CX	METAL DETECTOR - REBAR LOCATOR	235068
2007	STIHL	TS400	Cut off Saw	166644774
2007	STIHL	TS-400	CUT OFF SAW	166477798
2007	*MSA*	SOLARIS	MULTIGAS DETECTOR (P/N10047226)	A5-76789
2007	*MSA*	SOLARIS	MULTIGAS DETECTOR (P/N10047226)	A5-76788
2007	*MSA*	SOLARIS	MULTIGAS DETECTOR (P/N10047226)	A5-74599
2006	*MSA*	SOLARIS	MULTIGAS DETECTOR (P/N10047226)	A5-45079
2006	*MSA*	SOLARIS	MULTIGAS DETECTOR (P/N10047226)	A5-45083
2008	STIHL	TS420	TS420 STIHL SAW	168695551
2008		PPT265	26CC POWER PRUNER/POLE SAW	11006153
2008	STIHL	TS420	14" CUTQUIK SAW	168392018C
2010			AIR IMPACT WRENCH 11IN	
2009	RKI	GX-2001 (N)	MULTIGAS DETECTOR (RED)	8X3020450
2010	RKI	GX-2001 (N)	MULTIGAS DETECTOR (RED)	9Y4020012
2016	IT-RD62-78314	ROCK DRILL	IT-RD62-78314 ROCK DRILL 7/8 X 3-1/4 30LB	N/A
2016	IT-RD62-78314	ROCK DRILL	IT-RD62-78314 ROCK DRILL 7/8 X 3-1/4 30LB	N/A
2011	*MSA*	ALTAIR 4X	ALTAIR 4X MULTIGAS DETECTOR	
2012	*MSA*	ALTAIR 4X	ALTAIR 4X MULTIGAS DETECTOR	138298
2012	*MSA*	ALTAIR 4X	ALTAIR 4X MULTIGAS DETECTOR	138299
2016	SUNITEC/SPITZNAS	CS213350010	HAND HELD CORE DRILL, WET PNUEMATIC 3.8HP	16121
2016	SUNITEC/SPITZNAS	CS213350010	HAND HELD CORE DRILL, WET PNUEMATIC 3.8HP	16122
2016	SUNITEC/SPITZNAS	CS213350010	HAND HELD CORE DRILL, WET PNUEMATIC 3.8HP	PENDING 8-17-16
2012	ECKO	*AIR MOVER*	Reversible 8" Confined Space Blower with Hose	0003576
2012	FRENCH CREEK	*TP7*	7' Adjustable Aluminum Tripod	19176
2012	FRENCH CREEK	R50G	3 Way Rescue Unit	19045
2012	FRENCH CREEK	MW50G	Work Winch	19077
2016	WACKER	PUMP PTS4V	4" TRASH PUMP W/VANGUARD (GAS ENGINE)	20280919
2016	WACKER	PUMP PTS4V	4" TRASH PUMP W/VANGUARD (GAS ENGINE)	20280918
2016	WACKER	PUMP PTS4V	4" TRASH PUMP W/VANGUARD (GAS ENGINE)	20280916
2016	WACKER	PUMP PTS4V	4" TRASH PUMP W/VANGUARD (GAS ENGINE)	20280917
2016	SOLER & PALAU	CTB42	INDUSTRIAL TUBULAR CENTRIFUGAL BLOWER	SN579371-1
2016	SOLER & PALAU	CTB42	INDUSTRIAL TUBULAR CENTRIFUGAL BLOWER	SN579371-2
	TSURUMI	GOMAR	4" TRASH PUMP - P.K.12	1017682

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
	TSURUMI	GCARK	3" TRASH PUMP - WKT2	1005083
	TSURUMI	GCO1	2" TRASH PUMP - TE250HA WKTZ	4357811
	TITAN		3" TRASH PUMP ON WHEELS	196L55/43550P
2012	HONDA	WB20X	2" CENTRIFUGAL PUMP - HONDA GX120	WABT-1650759
	HONDA	GX270	HONDA 4500W ELECTRIC GENERATOR	GCALK-1040111
	HONDA	GX270	HONDA 4500W ELECTRIC GENERATOR	GCALK-1040115
	MAKITA	DCS-6401	MAKITA CHAIN SAW	508847562
	STIHL	STIHC-039	STIHL CHAIN SAW	1127-021-0800
	POULAN PRO	PP4218A	42CC POULAN CHAIN SAW	13296N200425-1
	STIHL	MS290	STIHL CHAIN SAW	287250125
	SEWER PLUG		24"X48" SEWER PLUG WITH "4 FLOW THRU AND 24" SLEEVE	
	SEWER PLUG		24"X48" SEWER PLUG WITH "4 FLOW THRU AND 24" SLEEVE	
	SEWER PLUG		24"X48" SEWER PLUG WITH "4 FLOW THRU AND 24" SLEEVE	
	SEWER PLUG		36"X60" SEWER PLUG WITH 36" SLEEVE	
2016	HONDA	EU2000	HONDA GENERATOR - 2K WATT	EACT-1392652
2016	HONDA	EU2000	HONDA GENERATOR - 2K WATT	EACT-1336892
2016	TEMPAIR	C-2000	PORTABLE FILTRATION UNIT 115V	12649
2016	TEMPAIR	C-2000	PORTABLE FILTRATION UNIT 115V	12834
	PRAMAC	S-6000	6000 KW GENERATOR	PWS0150336B
2016	TSURUMI		2" TRASH PUMP - W/GX160 HONDA	18176
2016	LANDA	HD40AGEB	COLD WATER BELT DRIVEN POWER WASHER 4000PSI	11072770-100135Q
2015	TORPEDO HEATER		OIL FIRED TORPEDO HEATER - 170,000 BTUH	3VE51
2016	THOMPSON	PUMP SER #6JSVEE-022	6" VAC ASSISTED HIGH PRESS PUMP TRAILER MOUNTED	TRLR SER #1T9PH1415GP634223
2016	RYOBI	RY903600	RYOBI 3600 GENERATOR	DB16233D030366
	PLUNGE CUT	890	CONCRETE CHAIN SAW	14186
	DOMEHEAD	2/1/2017	6" X 10" DOMEHEAD PLUG	
	DOMEHEAD	2/1/2017	12" X 18' DOMEHEAD PLUG	
	6" FLOW THROUGH	2/1/2017	10" X 16" - 6" FLOW THROUGH PLUG	
	6" FLOW THROUGH	2/1/2017	20" X 40" - 6" FLOW THROUGH PLUG	
	DOMEHEAD	2/1/2017	24" X 48" DOMEHEAD PLUG'S @ 3PCS	
	DOMEHEAD	2/1/2017	48" X 32" DOMEHEAD PLUG	
	4" FLOW THROUGH	2/1/2017	12" X 18' - 4" FLOW TROUGH PLUG	
	4" FLOW THROUGH	2/1/2017	10" X 16" - 4" FLOW THROUGH PLUG	
	2" FLOW THROUGH	2/1/2017	8" - 2" FLOW THROUGH W/HIGH PRESSURE PLUG	
	2" FLOW THROUGH	2/1/2017	24" - 2" FLOW THROUGH W/HIGH PRESSURE PLUG	

LANZO TRENCHLESS TECHNOLOGIES

Qualifications

Year	Make	Model	Description	Serial #
	DOMEHEAD	2/1/2017	20" X 36" DOMEHEAD PLUGS @ 2PCS	
	2" FLOW THROUGH	2/1/2017	15" X 30" - 2" FLOW THROUGH PLUG	
	4" FLOW THROUGH	2/1/2017	8" X 12" - 4" FLOW THROUGH PLUG	
	6" FLOW THROUGH	2/1/2017	12" X 18" - 6" FLOW THROUGH PLUG	
SAFETY TOOLS				
2016	SCBA AIRHAWK II	AIRHAWK II 4500	SELF CONTAINED BREATHING APPARATUS	MULTIPLE
2015	OdaLog RT	H2S	OdaLog WIRELESS H2S LOGGER W/ OdaStat-G SOFTWARE	MULTIPLE
2015			COMMUNICATION SYSTEM - OMID 5B	MULTIPLE

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

2 of 8

1. Sewer Televising and Cleaning References
(Must be completed and submitted with Bid for consideration)

List sewer cleaning and televising projects of sewers equal to or greater than 36 inches in size that total (together) over 100,000 lineal feet with the lengths of the individual segments over 1,000 feet in the past 7 years and provide references. Also, list a minimum of 3 projects that include the cleaning and televising of the sanitary siphon sewers equal to or greater than 24 inches in size in the past 7 years and provide references. The Contractor shall have also worked a minimum of three projects in similar environmentally sensitive areas in the past 7 years.

Firm's Name: _____

Role on Project: _____

1.1. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

1.2. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

1.3. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

1.4. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

1.5. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

1.6. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

1.7. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

5 of 8

2. Sewer CIPP Lining References
(Must be completed and submitted with Bid for consideration)

List sewer CIPP lining projects of sewers equal to or greater than 36 inches in diameter that total (together) over 10,000 lineal feet in northern states and/or Canada in the past 7 years and over 1,000,000 feet of lining in general over the past 7 years, and provide references. Also, provide safety record for the past 7 years as an attachment.

Firm's Name: _____

Role on Project: _____

2.1. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

2.2. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

2.3. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

2.4. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

DETAILED SPECIFICATION
FOR
CONTRACTOR QUALIFICATIONS

3. Onsite Superintendent/Foreman
(Must be completed and submitted with Bid for consideration)

List name of onsite superintendent/foreman and list a minimum of 3 projects of similar complexity totaling 10,000 lineal feet of CIPP lining in sanitary sewers greater than 24 inches in diameter that they have supervised in the past 7 years and provide references.

Superintendent/Foreman Name: _____

3.1. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

3.2. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

3.3. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

3.4. Client's Name: _____

Address: _____

Contact Name: _____ Contact Phone: _____

Type of Work: _____

_____

_____

_____

Year Work Performed: _____ Work Amount ($): _____

DETAILED SPECIFICATION
FOR
PROJECT SCHEDULE

DESCRIPTION

Examination of Plans, Specifications, and Work Site: Bidders shall carefully examine the Bid Form, plans, specifications and the work site until the Bidder is satisfied as to all local conditions affecting the contract and the detailed requirements of construction. The submission of the bid shall be considered prima facie evidence that the Bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and all requirements of the contract.

The entire work under this Contract shall be completed in accordance with, and subject to, the scheduling requirements as outlined below, and all other requirements of the Contract Documents.

1. The Contractor shall begin the work of this project on or before **December 15, 2020**, and only upon receipt of the fully executed Contract and Notice to Proceed. Appropriate time extensions shall be granted if the Notice to Proceed is delayed beyond this date.

2. The entirety of work under this Contract, including but not limited to sanitary sewer inspection, cleaning, televising, and rehabilitation (cured-in-place pipe [CIPP] lining); manhole rehabilitation; the removal of any and all traffic control devices; and the installation/maintenance of the needed temporary soil erosion and sedimentation control devices, shall be completed by the Final Completion date of **May 31, 2021**.

The Contractor is expected to be furnished with two (2) copies of the Contract, for his/her execution, on or before **October 30, 2020**. The Contractor shall properly execute both copies of the Contract and return them, with the required Bonds and Insurance Certificate, to the City within ten (10) days. The Contractor shall not begin the work before the applicable date(s) as describes herein without approval from the Project Engineer, and in no case before the receipt of the fully executed Contract. City Council approval is expected on **November 16, 2020**.

Time is of the essence in the performance of the work of this contract. The Contractor is expected to mobilize sufficient personnel and equipment and work throughout all authorized hours to complete the project within the specified time/date of this Contract. Should the Contractor demonstrate that work must occur on Sundays in order to maintain the project schedule, they may do so between the hours of 9:00 a.m. and 5:00 p.m. with prior approval from the City. The Contractor will submit authorization requests for any Sunday work a minimum of three working days in advance of the day of the proposed work. There will be no additional compensation due to the Contractor for work performed on Sundays.

Prior to the start of any construction, the Contractor shall submit a detailed progress schedule of work for the Engineer's review and approval. Work shall not start until a schedule is approved in writing by the Engineer. The Contractor shall update the approved work schedule upon request by the Engineer and present it to the Engineer within seven days of said request.

The City's decision to delete locations, add locations, change the limits of construction limits at any locations, or, the City's contribution to a delay of the construction at any one location shall not entitle the Contractor to receive additional compensation for work on any other location(s), nor shall it relieve the Contractor of any responsibilities for completion of work on any other location(s).

DETAILED SPECIFICATION
FOR
PROJECT SCHEDULE

2 of 2

The Engineer may delay or stop the work due to threatening weather conditions. The Contractor shall not be compensated for unused materials or downtime due to rain, or the threat of rain. The Contractor is solely responsible for repairing all damages to the work and to the site, including road infrastructures, road subgrades, and any adjacent properties, which are caused as a result of working in the rain.

The Contractor shall not work in the dark except as approved by the Engineer and only when lighting for night work is provided as detailed elsewhere in this contract. The Engineer may stop the work, or may require the Contractor to defer certain work to another day, if, in the Engineer's opinion, the work cannot be completed within the remaining daylight hours, or if inadequate daylight is present to either properly perform or inspect the work. The Contractor will not be compensated for unused materials or downtime, when delays or work stoppages are directed by the Engineer for darkness and/or inadequate remaining daylight reasons. The Contractor is solely responsible for repairing all damages to the work and to the site, including road infrastructures, road subgrades, and any adjacent properties, which are caused as a result of working in the dark.

No work shall be performed or lane closures permitted during the holiday periods, as defined by the Engineer.

Failure to complete all work as specified herein within the times specified herein, including time extensions granted thereto as determined by the Engineer, shall entitle the City to deduct from the payments due the Contractor, **$500.00** in Liquidated Damages, and not as a penalty, for delays in the completion of the work for each and every calendar day beyond any "Complete Work" date for each location, and beyond the overall project completion date as required by this Detailed Specification.

Liquidated Damages will be assessed until the required work is completed in the current construction season. If, with the Engineer's approval, work is extended beyond seasonal limitations, the assessment of Liquidated Damages will be discontinued until the work is resumed in the following construction season.

If the work required by this construction contract is not completed by the specified date(s) including any extensions of time granted thereto, at the sole discretion of the City of Ann Arbor, this Contract may be terminated with no additional compensation due to the Contractor, and the Contractor may be forbidden to bid on future City of Ann Arbor projects for a period of at least three (3) years. If the Engineer elects to terminate the Contract, contract items paid for on a Lump Sum basis shall be paid up to a maximum percentage equal to the percentage of the contract work that has been completed.

DETAILED SPECIFICATION
FOR
COORDINATION AND COOPERATION WITH OTHERS
AND
WORK BY OTHERS

1 of 1

The Contractor is reminded as to the requirements of article 104.07 of the 2012 edition of the MDOT Standard Specifications, "Cooperation by the Contractor."

The Contractor shall directly coordinate his/her work with individual City Departments/Divisions/Units.

No additional compensation will be paid to the Contractor, and no adjustments to contract unit prices will be made, due to delays and/or the failure of others in the performance of their work, nor for delays due to the encountering of existing utilities that are, or are not, shown on the Plans.

The following Utility Owners, and others not listed specifically, may have overhead and/or underground facilities located within the Right-of-Way/Public Easements:

The City of Ann Arbor
University of Michigan (UM)
Michigan Department of Transportation (MDOT)
AT&T
Comcast
DTE Energy - Detroit Edison Company (Edison)
DTE Energy - Michigan Consolidated Gas Company (Michcon)
Fiber Link Inc.
Light Core (Century Tel)
MCI Communications
Windstream Communications

On all projects:

"3 Working Days before you Dig - Call MISS DIG - Toll Free" Phone No. 1-800-482-7171.

The Owners of public or private utilities which will not interfere with the completed project and which do not present a hazard to the public or an extraordinary hazard to the Contractor's operations will not be required to move their facilities on or from the street right-of-way.

During the life of this contract, other public authorities and utility companies may be performing work within or adjacent to the project limits, including, but not limited to; construction of adjacent projects, underground utility work, permanent signing and traffic signals work, traffic control improvements, street maintenance and snow removal, etc. The Contractor shall cooperate and coordinate construction activities with these agencies in accordance with Article 104.08 of the 2012 edition of the MDOT Standard Specifications for Construction.

Stoppages created solely by the operations of the utility companies which delay utility revisions on any portion of this project may be considered as a basis of claim for an extension of time for project completion.

Costs for this work will not be paid for separately, but shall be included in the bid price of the Contract Item "General Conditions."

DETAILED SPECIFICATION
FOR
MAINTENANCE OF TRAFFIC

DESCRIPTION

Traffic shall be maintained in accordance with the City of Ann Arbor Public Services Department Standard Specifications and as specified in Sections 104.11, 812, and 922 of the Michigan Department of Transportation (MDOT) 2012 Standard Specifications for Construction, the 2011 Michigan Manual of Uniform Traffic Control Devices (MMUTCD), and as described herein.

The Contractor shall furnish, erect, maintain and, upon completion of the work, remove all traffic control devices and barricade lights as required on the project for the safety and protection of local traffic. This includes, but is not limited to, temporary advance, regulatory, and warning signs; barricades and channelizing devices at intersections and on streets where traffic is to be maintained; barricades at the ends of the project and at right-of-way lines of intersecting streets, and traffic control devices for moving construction operations.

MATERIALS

The materials and equipment shall meet the requirements specified in the corresponding sections of the MDOT 2012 Standard Specifications for Construction and the 2011 MMUTCD.

Maintenance of Local Traffic

Unless otherwise indicated on the plans, all side roads shall not be closed to through traffic except during construction operations of short duration and only upon written approval of the Engineer.

Local access shall be maintained at all times for emergency vehicles, refuse pick-up, mail delivery, school buses, and ingress/egress to public and private properties.

Contractor must accommodate the safe access to the residential buildings and businesses located within construction area.

Driveways shall not be blocked for extended periods of time unless arrangements can be made with the affected property owner(s). When it becomes necessary to temporarily block driveways, the Contractor shall notify the affected property owners in advance to coordinate the work and allow sufficient time for vehicles to vacate from properties. It may be necessary to allow for vehicles to temporarily park in the roadway at locations that do not interfere with the Contractor's work. During these periods the owners of the respective vehicles must be available to, with proper notice, move their vehicles if it becomes necessary to accommodate the work.

At times, when it becomes necessary to temporarily obstruct local traffic during the performance of the work, the Contractor shall provide traffic regulator control in conformance with Chapter 6E of the MMUTCD, Sections 6E.01 thru 6E.08. A minimum of two traffic regulators are required. The cost of traffic regulator control shall be included in the contract pay item "Minor Traffic Control, Modified, Maximum $50,000".

A lane-closure permit shall be obtained by the Contractor from the Engineering Department, at least 48 hours in advance of any proposed lane or street closing.

DETAILED SPECIFICATION
FOR
MAINTENANCE OF TRAFFIC

2 of 2

No lane closures shall be permitted during the Independence Day and Labor Day holiday periods, as defined by the Engineer.

The hours of work on all Local streets are 7:00 a.m. to 8:00 p.m., Monday through Saturday, or as specified on the lane-closure permit. No equipment will be allowed in the street before or after these hours. Local streets may only be closed to through traffic (local access only) with written authorization of the Engineer. Work must be completed each day such that all streets are re-opened to through traffic by 8:00 p.m. unless otherwise specified, directed, or authorized in writing by the Engineer. All major changes in traffic control shall be made either between 9:30 a.m. and 3:30 p.m. or between 7:00 p.m. and 6:30 a.m. in order to minimize interference with rush-hour traffic. All traffic controls must be in-place and ready for traffic each day by 6:30 a.m. and 3:30 p.m.

The Contractor shall temporarily cover conflicting traffic and/or parking signs when directed by the Engineer.

The Contractor shall use quantities of dust palliative, maintenance aggregate, and cold patching/HMA mixtures for use as temporary base, surfacing, and dust control at utility crossings, side roads and driveways (wherever required to maintain traffic), and where directed by the Engineer to maintain local access. The cost for the use of dust palliative, maintenance aggregate, cold patch and/or hot mix asphalt 36A mixture, as required and directed by the Engineer for maintenance of traffic and local access, shall be included in contract pay item "General Conditions," and it will not be paid for separately.

The work of maintaining and relocating existing warning, regulatory and/or guide signs; and of removing, salvaging and reinstalling existing signs and supports is included in the bid price for the contract pay item “Minor Traffic Control, Modified, Maximum $_50,000_”.

Mailboxes and newspaper boxes that are in the way of the construction shall be removed and reset immediately in a temporary location approved by the Engineer. Mail and paper delivery shall not be interrupted during the construction. Upon completion of the construction, all mailboxes and newspaper boxes, including their supports, shall be repositioned in their permanent locations as approved by the Engineer. This work shall be included the contract unit price for the contract pay item “General Conditions,” and it will not be paid for separately.

The Contractor shall perform the work of this Contract while maintaining traffic in accordance with the Contract Documents as specified herein. No traffic shall be allowed on newly placed asphalt surfaces until rolling has been satisfactorily completed and the surface has cooled sufficiently to prevent damage from traffic. This is to be accomplished by flag persons and by relocating traffic control devices to prevent traffic from entering the work area until such time that it can be safely maintained without damaging the new construction. The Contractor shall provide traffic regulators in sufficient number to maintain traffic as described herein, and to keep traffic off sections being surfaced, and provide for safe travel at all times as directed by the Engineer.

The Contractor shall furnish, erect, maintain, and upon completion of the work, remove any and all traffic control devices utilized on the project.

Each pressure distributor, paver and roller shall be equipped with at least one approved flasher light which shall be mounted on the equipment so as to give a warning signal ahead and behind.

DETAILED SPECIFICATION
FOR
CONSTRUCTION SEQUENCING

1 of 1

The Contractor must submit a detailed progress schedule at the Pre-construction meeting which is to be approved by the Engineer. Unless an alternative sequence is requested by the Contractor and approved in writing by the Engineer, the work shall be performed in the order as shown on the schedule. This outline does not detail the full range of materials and processes needed to complete the work under this Contract. At each location the Contractor shall:

1. Install the required temporary traffic control devices in accordance with the construction plans, as detailed in the specifications, and as directed by the Engineer.
2. Install the soil erosion control measures in accordance with the plans and as directed by the Engineer.
3. Obtain approval for, set up, and activate by-pass pumping.
4. Clean & videotape sewer to be lined.
5. Construct the proposed sewer lining. The new sewer shall be tested in accordance with the plans and specifications.
6. After all the new sewer has passed the required testing, the contractor shall open all service leads. Service leads shall not be out of service for more than 12 hours.
7. Deactivate and breakdown by-pass pumping equipment.
8. Perform final cleanup and restoration in accordance with the Contract documents.
9. Remove temporary soil erosion and sedimentation control measures.
10. Remove all temporary traffic control devices.

Reference the plans for additional construction sequencing requirements.

DETAILED SPECIFICATION
FOR
HOURS OF WORK

a. General Restrictions.- Hours of work shall be as stated in the Ann Arbor City Code Title IX, Chapter 119, Page 9.363, Monday through Saturday, between the hours of 7:00 a.m. and 8:00 p.m.

b. Exceptions.- During installation of the cured-in-place pipe (CIPP) lining, the Contractor may choose, in some cases, to perform nighttime work to facilitate construction during the inversion and curing processes. Additional requirements regarding this work are contained in Detailed Specification "CIPP Sewer Lining" and elsewhere in the Contract Documents. The Contractor shall include this work in their progress schedule, notify, and submit a request to the Engineer for permission to perform the nighttime CIPP work a minimum of 5 working days prior to beginning the work.

Maintenance of the sewer flow control may also require working outside the allowable hours of work ("off-hour" work). The Contractor shall provide anticipated off-hour work as part of their Sewer Flow Control Plan submittal(s) as contained in the Detailed Specification for "Sewer Flow Control."

Additional work restrictions are contained in the Detailed Specifications for "Project Schedule," "Maintenance of Traffic," "Working Space," "Construction Sequencing," and elsewhere in the Contract Documents. These work restrictions shall take precedence over the General Restrictions and Exceptions listed above.

The Contractor shall only perform work at night or on Sundays as required by the Contract Documents, unless there is a special need and the work is approved by the Engineer. All requests to work during off-hours shall be included in the Contractor's progress schedule and submitted to the Engineer for approval a minimum of 5 working days prior to beginning the work.

c. Noise Control. - All noise generated by construction activities shall not exceed 71 decibels (dBA) beyond the property line of the property on which the work is being conducted between 7:00 a.m. and 8:00 p.m., Monday through Saturday. The Contractor shall provide screening, noise absorption, and level II sound attenuation as required on equipment to meet the noise limitations set herein. Any "off-hour" work will require a temporary exemption from the City of Ann Arbor City Administrator. A temporary exemption may be granted in accordance with each respective entities' code of ordinance.

d. Method of Payment.- The costs of night work, whether required by the Contract Documents or requested by the Contractor, shall not be paid for separately, but shall be considered included in the cost of the affected contract pay items.

DETAILED SPECIFICATION
FOR
WORKING IN THE RAIN

Portions of the work to be performed under this contract are weather sensitive. Contractor shall be responsible for coordinating and scheduling their work in anticipation of the weather.

Sewer flow control must cease during wet weather conditions. Wet weather conditions are as defined in Detailed Specification "Sewer Flow Control."

In the event of a wet weather event, Contractor shall remove plugs installed for sanitary flow diversion. Plugs shall be reinstalled upon cessation of the wet weather event and as approved by the Engineer.

The Contractor shall not be compensated for the time and/or effort spent removing the temporary flow diversion plugs and the lateral bypass pumping system or for unused materials or downtime caused as a result of a wet weather event. The Contractor is solely responsible for repairing all damage to the work and to the site, including road infrastructure, road subgrades, underground utilities, any adjacent properties, and the like, which are damaged as a result of working in the rain or working in areas that are wet from recent precipitation.

The only exception to the above is as indicated in Detailed Specification "Extension of Time, Additional Compensation."

The costs of complying with this requirement shall not be paid for separately, but shall be considered included in the cost of the affected contract pay items.

DETAILED SPECIFICATION
FOR
EXTENSION OF TIME, ADDITIONAL COMPENSATION

The Contractor shall notify the Engineer of their intent to submit a claim for additional compensation or an extension of time in accordance with the requirements of Section 104.10 of the 2012 edition of the Michigan Department of Transportation (MDOT) Standard Specifications for Construction. Failure to do so may be a basis for not approving the request for additional compensation or extension of time. The notification will allow the Engineer an opportunity to influence, keep records, and monitor the work.

Extensions of time will not be authorized due to delays caused by, or stemming from, the weather for the period between November 14th and April 16th unless any of the following conditions are present:

1. Air temperature (as measured from a thermometer provided, maintained, and installed by the Contractor in a location on the worksite, as mutually agreed upon between the Contractor and the Engineer) is below 15ºF for a period of time longer than 48 consecutive hours.

2. Accumulations of snow in excess of 12 inches occur in any 24 hour period.

3. Freezing rain in excess of 1/4-inch occur in any 24 hour period.

4. Wet weather event, as defined in Detailed Specification "Sewer Flow Control" requiring the temporary removal of flow diversion plugs and lateral bypass pumping system.

Should the above mentioned weather conditions occur, and the Contractor requests an extension of contract time, the time extension shall only be for the realized delay to the controlling work operation.

The above weather delays shall not be considered as a basis for additional compensation on this project. The only exception shall be that if the temporary removal of the flow diversion plugs and lateral bypass pumping system occurred after the sewers had been cleaned, televised, prepped for lining, and approved by the Engineer for lining before the sewers were lined. In such an event, the Contractor may request compensation for the re-cleaning and re-televising of the affected pipes only. The re-cleaning must first be approved by the Engineer prior to the work beginning. No compensation shall be provided for the removal and re-installation of the plugs.

In addition, if delays resulting from air temperature, snow accumulation, and/or freezing rain occur and the Contractor has their bypass pumping system in place and operational, the Contractor shall still be responsible to continuously protect and maintain in operation the complete sewer flow control system. Expenses related to maintaining the bypass pumping system shall not be considered to be additional costs or extra expenses during an authorized extension of time due to these weather-related time extensions.

The Contractor shall anticipate underground utility complications arising from the proposed utility work, unknown and/or fragile utilities, and utilities requiring investigation and or relocation. These utilities may be shown on the Drawings, correctly or incorrectly, or not at all, and may delay a controlling operation.

Additional compensation is defined as additional work, extra work, upward unit price adjustments, payments for down time, and the like.

DETAILED SPECIFICATION
FOR
ITEM #200 – GENERAL CONDITIONS, MODIFIED, MAXIMUM $100,000

1 of 2

DESCRIPTION

This item shall include all work described and required by the Plans and Specifications for which no item of work is listed in the Bid Form, including but not limited to:

- Scheduling and organization of all work, subcontractors, suppliers, testing, inspection, surveying, and staking
- Coordination of, and cooperation with, other contractors, agencies, departments, and utilities
- Protection and maintenance of Utilities
- Placing, maintaining, and removing all soil erosion and sedimentation controls, including stone inlets filers (as shown on project plants)
- Maintaining drainage
- Maintaining driveways drive openings, sidewalks, bike paths, mail deliveries, and solid waste/recycle pick-ups. This includes the placement and maintenance of gravel in driveway openings as directed by the Engineer
- Storing all materials and equipment off lawn areas
- Temporary relocation and final replacement/re-setting of mailboxes
- Site clean-up
- Coordination efforts to furnish various HMA mixtures as directed by the Engineer
- Coordination efforts to furnish and operate various-size vehicles/equipment as directed by the Engineer
- Furnishing and operating vacuum-type street cleaning equipment a minimum of once per week or more frequently as directed by the Engineer
- Furnishing and operating vacuum-type utility structure cleaning equipment
- Furnishing and operating both vibratory plate and pneumatic-type (“pogo-stick”) compactors
- Furnishing and operating a backhoe during all work activities
- Furnishing and operating a jackhammer and air compressor during all work activities
- Noise and dust control
- Mobilization(s) and demobilization(s)
- Furnishing submittals and certifications for materials and supplies
- Disposing of excavated materials and debris - The Contractor shall dispose of, at the Contractor’s expense, all excavated material. Costs for this work will not be paid for separately.
- All miscellaneous and incidental items such as overhead, insurance, and permits.
- Meeting all requirements relating to Debarment Certification, Davis Bacon Act, and Disadvantaged Business Enterprise, and providing the necessary documentation.

Data pertaining to existing soil borings and pavement sections which are included in Appendix B, of these Contract Documents are provided to help the Engineer and Contractor determine the soil conditions existing within the construction area. The City in no way guarantees existing conditions to be the same as shown in the data. The Contractor is solely responsible for any and all conclusions he/she may draw from the data.

Quantities as given are approximate and are estimated for bidding purposes. Quantities are not guaranteed and may vary by any amount. While it is the City's intent to complete the project substantially as drawn and specified herein, quantities may be changed or reduced to zero for cost savings or other reasons. **The City reserves the right to change the quantities, and no adjustment in unit price will be made for any change in any quantity.**

MEASUREMENT AND PAYMENT

This item of work will be paid for on a pro rata basis at the time of each progress payment. Measurement will be based on the ratio between work completed during the payment period and the total contract amount. When all of the work of this Contract has been completed, the measurement of this item shall be 1.0 Lump Sum, minus any deductions incurred for inadequate performance as described herein. This amount will not be increased for any reason, including extensions of time, extras, and/or additional work.

The completed work as measured for this item of work will be paid for at the Contract Unit Price for the following Contract (Pay) Item:

PAY ITEM	PAY UNIT
General Conditions, Modified, Maximum $100,000	Lump Sum

The unit price for this item of work shall include all labor, material, and equipment costs to perform all the work specified in the Standard Specifications and as modified by this Detailed Specification.

DETAILED SPECIFICATION
FOR
ITEM #201 - PROJECT SUPERVISION, MODIFIED, MAXIMUM $35,000

1 of 3

DESCRIPTION

The Contractor shall designate a full-time Project Supervisor to act as the Contractor's agent/representative, and to be responsible for scheduling and coordination of all subcontractors, suppliers, other governmental agencies, and all public and private utility companies.

The Project Supervisor shall not be an active crew member of the Contractor, shall not be an active member or employee of any subcontractor's work force, and shall not perform general or specialized labor tasks.

The Project Supervisor shall work exclusively on this project, and shall put forth his/her full effort into the organization and coordination of the work of this project.

Prior to the pre-construction meeting, the Contractor shall designate a proposed Project Supervisor by name, and shall furnish the City with a current, thorough, detailed summary of the proposed Project Supervisor's work history, outlining all previous supervisory experience on projects of a similar size and nature. The detailed work history shall include personal and professional references (names and phone numbers) of persons (previous owners or agents) who can attest to the qualifications and work history of the proposed Project Supervisor. Proposed candidates for Project Supervisor shall have a demonstrated ability to work harmoniously with the City, the public, subcontractors, and all other parties typically involved with work of this nature. The Supervising Professional will have the authority to reject a proposed Project Supervisor whom he/she considers unqualified.

The Project Supervisor shall be available 24 hours-per-day to provide proper supervision, coordination and scheduling of the project for the duration of the Contract. The Contractor shall furnish the City with telephone numbers of the Project Supervisor in order to provide 24 hour-per-day access during business and non-business hours, including weekends and holidays.

The Project Supervisor shall be equipped by the Contractor with a mobile telephone to provide the City with 24 hour-per-day access to him/her during daily construction activities, during transit to and from the construction site, and during all non-business hours including weekends and holidays.

The Project Supervisor shall be equipped with assistants as necessary to provide project supervision as specified herein, and in accordance with the Contract.

DUTIES AND RESPONSIBILITIES

The Project Supervisor work harmoniously with the City, the public, subcontractors, and all other parties typically involved with work of this nature.

The Project Supervisor shall have a thorough, detailed understanding and working knowledge of all construction practices and methods specified elsewhere herein, as well as the handling, placement, testing and inspection of aggregates, aggregate products, HMA concrete, and Portland cement concrete materials.

The Project Supervisor shall be responsible for all of the work of all of the Contractor's, subcontractors' and suppliers' work forces.

The Project Supervisor shall be responsible for proper and adequate maintenance (emissions, safety, and general operation) of all of the Contractor's, subcontractors' and suppliers' equipment and vehicles.

The Project Supervisor shall be responsible for the legal, proper and safe parking/storage of all of the Contractor's, subcontractors' and suppliers' equipment, work vehicles, and employee's vehicles.

The Project Supervisor shall schedule and coordinate the work of all parties involved in the project, including utility companies, testing agencies, governmental agencies, all City departments (such as Utilities and Transportation), and City inspectors.

The Project Supervisor shall coordinate and schedule the work of any independent survey crews that may be retained by the City to witness and reset existing and new geographic/benchmark monuments. Failure to have existing monuments witnessed and reset may result in delays to the Contractor's work. Costs for such delays will be the Contractor's sole responsibility.

The Project Supervisor shall coordinate and schedule both testing inspectors and City inspectors in a timely manner, to assure proper and timely testing and inspection of the work.

The Project Supervisor shall review the Inspector's Daily Reports (IDRs) for accuracy, and shall sign all IDRs on a daily basis as the representative of the Contractor. Items to be reviewed include descriptions, locations and measurements of quantities of work performed, workforce, equipment, and weather. The Project Supervisor shall also be responsible for its subcontractors' review and initialing of IDRs containing work items performed by each respective subcontractors.

The Project Supervisor shall submit to the Engineer, an updated, detailed schedule of the proposed work on a weekly basis, and an update of all proposed changes on a daily basis, all in accordance with the Detailed Specification for Project Schedule contained elsewhere herein.

The Project Supervisor shall schedule and chair a weekly progress meeting with the Engineer and all subcontractors to discuss the work. Upon the completion of each meeting, the Project Supervisor shall prepare and distribute, to all present, a written summary of the meeting's minutes. Those in attendance shall review the minutes and, if necessary, comment on any deficiencies or errors prior to or at the next scheduled progress meeting.

ADDITIONAL PERFORMANCE REQUIREMENTS

If, in the sole opinion of the Supervising Professional, the Project Supervisor is not adequately performing the duties as outlined in this Detailed Specification, the following system of notices will be given to the contractor with the associated penalties:

First Notice – A warning will be issued in writing to the contractor detailing the deficiencies in the Project Supervision. The contractor must respond within 7 calendar days in writing with a plan to correct the stated deficiencies. Failure to respond within 7 calendar days will result in the issuing of a second notice.

Second Notice – A second warning will be issued in writing to the contractor further detailing the deficiencies in the Project Supervision. The contractor must respond within 7 calendar days in writing with a plan to correct the stated deficiencies. Failure to respond within 7 calendar days will result in the issuing of a third notice. A deduction of 10% will be made from the original Project Supervision contract amount. At this time, the City reserves the right to meet with personnel with the necessary authority within the Contractor's organization to discuss the deficiencies in the Project Supervision.

Third Notice – An additional deduction of 25% will be made from the original Project Supervision contract amount, and the Project Supervisor shall be removed from the project, and replaced immediately with another individual to be approved by the Supervising Professional.

Should, in the sole opinion of the Supervising Professional, the Project Supervisor fail to perform his/her duties and responsibilities as described herein to such a degree that the successful completion of the project is put in jeopardy, the above system of notices may be foregone, and the Contractor shall immediately replace the Project Supervisor upon receipt of written notice. Failure to provide adequate project supervision, as determined by the Engineer, shall be considered basis for the Supervising Professional to suspend work without extension of contract time or additional compensation.

MEASUREMENT AND PAYMENT

This item of work will be paid for on a pro rata basis at the time of each progress payment. Measurement will be based on the ratio between work completed during the payment period and the total contract amount. When all of the work of this Contract has been completed, the measurement of this item shall be 1. 0 Lump Sum, minus any deductions incurred for inadequate performance as described herein. This amount will not be increased for any reason, including extensions of time, extras, and/or additional work.

The completed work as measured for this item of work will be paid for at the Contract Unit Price for the following Contract (Pay) Item:

PAY ITEM	PAY UNIT
Project Supervision, Maximum $35,000	Lump Sum

The unit price for this item of work shall include all labor, material, and equipment costs to perform all the work specified in the City Standard Specifications and as modified by this Detailed Specification.

DETAILED SPECIFICATION
FOR
ITEM #202 – AUDIO VISUAL TAPE COVERAGE, MODIFIED

1 of 3

DESCRIPTION

This work shall include digital audiovisual record of the physical, structural, and aesthetic conditions of the construction site and adjacent areas as provided herein. This work will be performed for the entire project limits prior to the start of construction.

The audio-visual filming shall be:

1. Of professional quality, providing a clear and accurate audio and visual record of existing conditions.
2. Prepared within the four (4) week period immediately prior to the start of construction
3. Furnished to the Engineer a minimum of one (1) week prior to bringing any materials or equipment within the areas described in this Detailed Specification.
4. Carried-out under the supervision of the Engineer.

The Contractor shall furnish one (1) copy of the completed audiovisual record to the Engineer. An index of the footage shall be included, which will enable any particular area of the project to be easily found. **This includes indexing the files according to street and Station number as applicable.** The Contractor shall retain a second copy of the audiovisual record for his/her own use.

Any portion of the film determined by the Engineer to be unacceptable for the documentation of existing conditions shall be filmed again at the Contractor's sole expense prior to mobilizing onto the site.

PRODUCTION

The audio-visual filming shall be completed in accordance with the following minimum requirements:

1. DVD Format, No Editing - The filming shall be done in color using equipment that allows audio and visual information to be recorded. Splicing or editing of the tape shall not be allowed and the speed and electronics of the videotaping equipment and DVD shall be equal to that which is standard to the videotaping industry.

2. Perspective / Speed / Pan / Zoom - To ensure proper perspective, the distance from the ground to the camera lens shall not be less than 10 feet and the filming must proceed in the general direction of travel at a speed not to exceed 48 feet per minute. Pan and zoom rates shall be controlled sufficiently so that playback will ensure quality of the object viewed.

3. Display - The recording equipment shall have transparent time, date stamp and digital annotation capabilities. The final copies of the tape shall continuously and simultaneously display the time (hours:minutes:seconds) and the date (month/date/year) in the upper left-hand corner of the frame. Accurate project stationing, where applicable, shall be included in the lower half of the frame in standard format (i.e. 1+00). Below the stationing periodic information is to be shown, including project name, name of area shown, street address, direction of travel, viewing direction, etc. If in the event, the stationing has not been established on-site, refer to the plans and approximate the proposed stationing.

4. Audio Commentary / Visual Features. Locations relative to project limits and landmarks must be identified by both audio and video means at intervals no longer than 100 feet along the filming route. Additional audio commentary shall be provided as necessary during filming to describe streets, buildings, landmarks, and other details, which will enhance the record of existing conditions.

5. Visibility / Ground Cover - The filming shall be performed during a time of good visibility. Filming shall not be performed during periods of precipitation or when snow, leaves, or other natural debris obstruct the area being filmed. The Contractor shall notify the Engineer in writing in the event that the weather or snow cover is anticipated to cause a delay in filming.

COVERAGE

The audio-visual film coverage shall include the following:

1. General Criteria - This general criteria shall apply to all filming and shall include all areas where construction activities will take place or where construction vehicles or equipment will be operated or parked and or where materials will be stored. The filming shall extend an additional 50 feet outside of all areas. The filming shall include all significant, existing man-made and natural features such as driveways, sidewalks, utility covers, utility markers, utility poles, other utility features, traffic signal structures and features, pubic signs, private signs, fences, landscaping, trees, shrubs, other vegetation, and other similar or significant features.

2. Other Areas - The Contractor shall film at his sole expense other areas where, in his/her opinion, the establishment of a record of existing conditions is warranted. The Contractor shall notify the Engineer in writing of such areas.

The Engineer may direct the filming of other minor areas not specified herein at the Contractor's sole expense.

AUDIOVISUAL FILMING SERVICES

The following companies are known to be capable of providing the filming services required by this Detailed Specification and shall be utilized, unless the Contractor receives prior written approval from the Engineer to utilize another company of comparable or superior qualifications.

- Construction Video Media
- Midwest Company
- Topo Video, Inc.
- Video Media Corp.
- Paradigm 2000, Inc.
- Finishing Touch Photo and Video

MEASUREMENT AND PAYMENT

The completed work as measured for these items of work will be paid for at the Contract Unit Prices for the following Contract (Pay) Items:

PAY ITEM	PAY UNIT
Audiovisual Tape Coverage, Modified	Lump Sum

Audiovisual Tape Coverage shall include all labor, equipment, and materials required to perform the filming and to provide the finished videotape the Engineer. The unit price includes filming the entire project limits, for each and every street, as described above.

DETAILED SPECIFICATION
FOR
ITEM #203 – MINOR TRAFFIC CONTROL, MODIFIED, MAXIMUM $50,000

1 of 5

DESCRIPTION

The work shall include, but is not limited to the following:

- The furnishing and operating of miscellaneous signs, warning devices, traffic regulators, flags, paddles, and cones;
- The operation of additional signs furnished by the City;
- Furnishing and installing meter bags;
- Coordinating with the City to have meter heads removed and reinstalled;
- Maintaining pedestrian traffic;
- Temporarily covering traffic controls;
- Temporarily covering existing signs as directed;
- Any and all other miscellaneous and/or incidental items which are necessary to properly perform the work.

This work shall consist of protecting and maintaining vehicular and pedestrian traffic, in accordance with Sections 104.11and 812 of the of the Michigan Department of Transportation (MDOT) 2012 Standard Specifications for Construction; Part 6 of the 2011 Edition of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD); and the City of Ann Arbor Standard Specifications for Construction, except as modified herein.

MATERIALS, EQUIPMENT, AND CONSTRUCTION METHODS

Materials and equipment shall meet the requirements specified in the above designated sections of the MDOT 2012 Standard Specifications for Construction.

The Contractor shall maintain two-way traffic on major streets, access for local traffic on local streets, and keep all intersections open to traffic at all times, unless specifically authorized in writing by the Engineer.

The Contractor shall maintain traffic such that no vehicle shall be required to drive into active work areas. Patch areas which extend more than halfway across the roadway shall be removed and replaced so as to provide a minimum of half the pavement width at all times for maintaining traffic.

The Contractor shall keep all driveways open at all times, unless specifically authorized in writing by the Engineer.

The Contractor shall maintain pedestrian traffic at all times. For maintaining normal pedestrian traffic while performing sidewalk and driveway repair, Plastic Drum, High Intensity, Lighted shall be placed by the Contractor as directed by the Engineer. The Contractor, when directed by the Engineer, shall place "Sidewalk Closed" and/or "Cross Here" signs and the cost shall be included in this pay item and will not be paid for separately.

All temporary traffic/pedestrian control devices furnished by the Contractor shall remain the property of the Contractor. The City shall not be responsible for stolen or damaged signs, barricades, barricade lights or other traffic maintenance items. The Contractor shall replace missing traffic control devices immediately, at no additional cost to the Contract or City.

All existing signs, and signs erected by the City of Ann Arbor on this project shall be preserved, protected, and maintained by the Contractor. The City will repair any existing City owned signs, at the Contractor's expense, which are damaged by the Contractor during the work.

The Contractor shall obtain a Traffic Detour or Lane Closure Permit from the City's Project Management Services Unit, at least 48 hours in advance of any proposed lane or street closing.

Traffic on major streets should not be impacted between the hours of 7:00 a.m. to 9:00 a.m. and from 3:30 p.m. to 6:00 p.m. without written permission from the Engineer or as specified on the Lane Closure Permit. All major changes in traffic control shall be made either between 9:00 a.m. and 3:30 p.m. or between 7:00 p.m. and 6:30 a.m. in order to minimize interference with rush hour traffic. All traffic controls must be in place and ready for traffic each day by 6:30 a.m. and 3:30 p.m.

The hours of work on all local streets are 7:00 a.m. to 8:00 p.m., Monday through Saturday, or as specified on the Lane Closure Permit. No equipment will be allowed in the street before or after these hours. Local streets may only be closed to through traffic (local access only) with written authorization of the Engineer. Work must be completed each day such that all streets are re-opened to through traffic by 8:00 p.m. unless otherwise specified, directed, or authorized in writing by the Engineer.

The Contractor shall temporarily cover conflicting traffic and/or parking signs when directed by the Engineer.

Parking violation citations issued to the Contractor, subcontractor, and material suppliers including each of their respective employees shall be enforced under appropriate City Code.

The Contractor shall replace missing or damaged traffic control devices as directed by the Engineer. When traffic control devices have been damaged by, or due to, the negligence of the Contractor, its subcontractors or material suppliers, the traffic control devices shall be replaced at the Contractor's expense.

The work for Minor Traffic Control, Modified shall include: furnishing and operating of miscellaneous signs and warning devices; furnishing cones; operating additional signs furnished by the City throughout the life of the Contract; furnishing and operating pedestrian traffic control devices; maintaining a safe trench during all non-working hours; maintaining access to all drives; covering conflicting existing signs and removal of these covers; and any and all other miscellaneous and/or incidental items which are necessary to properly perform the work.

Where there is metered parking, the Contractor shall either rent and install meter bags, or, with the Engineer's authorization, coordinate with the City Field Services to have meter heads removed and reinstalled.

The Contractor shall maintain vehicular and pedestrian traffic during the work by the use of traffic regulators, channelizing devices and signs as necessary, as directed by the Engineer, and in accordance with 2011 Edition of the MMUTCD. Typical applications for maintaining pedestrian traffic in accordance with the 2011 Edition of the MMUTCD are included in this detailed specification.

In order to maintain areas of on-street parking available for residents, the Engineer may direct the contractor to cover and uncover temporary "No Parking" signs within the project limits multiple times throughout the course of the project. Such repeated covering and uncovering of signs shall be included in this item of work and shall not be paid for separately.

MEASUREMENT AND PAYMENT

All temporary traffic/pedestrian control devices furnished by the Contractor shall remain the property of the Contractor. The City shall not be responsible for stolen or damaged signs, barricades, barricade lights or other traffic maintenance items. The Contractor shall replace missing traffic control devices immediately, at no additional cost to the City.

Costs for transporting barricades and other temporary traffic control devices shall be included in the bid prices for the individual items of work.

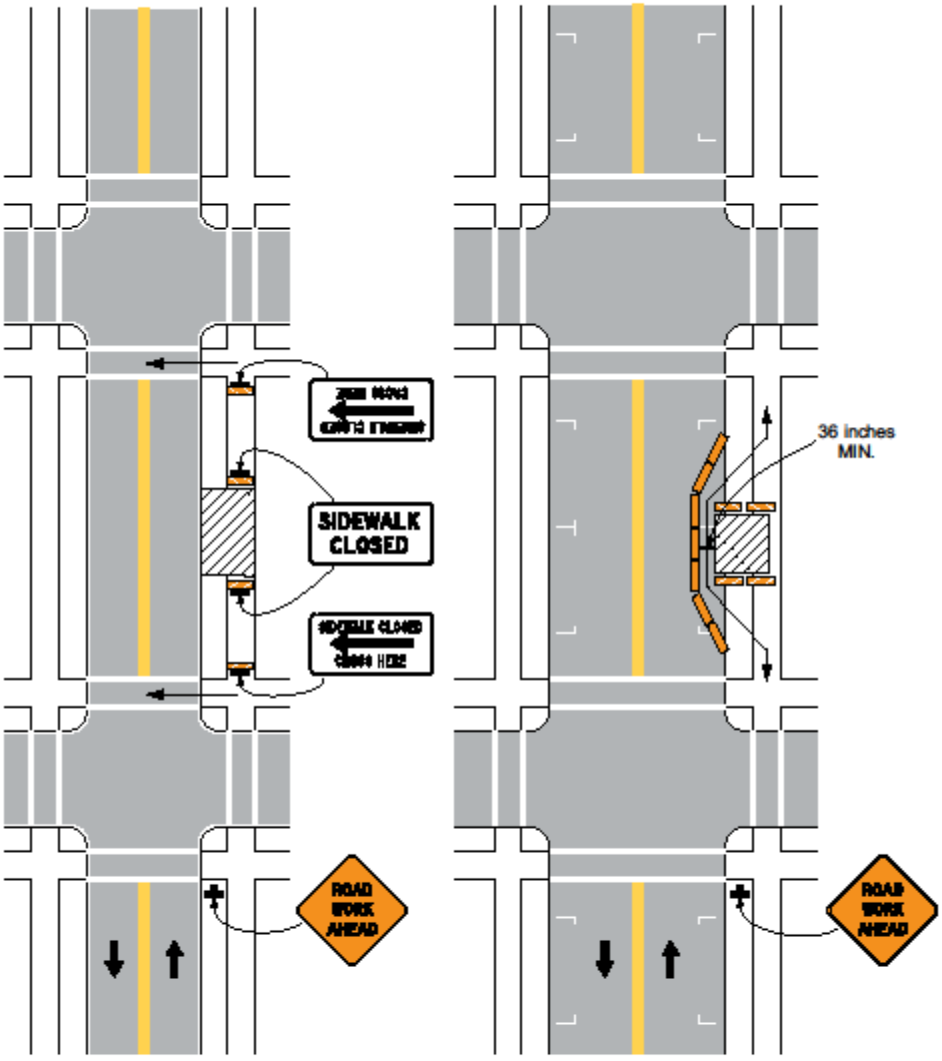
Minor Traffic Control, Modified, Maximum $25,000 will be paid for on a pro rata basis with each progress payment. Measurement will be based on the ratio between work completed during the payment period and the total contract amount. When all of the work of this Contract has been completed, the measurement of this item shall be 1.0 Lump Sum minus any deductions incurred for inadequate performance as described herein. This amount will not be increased for any reason, including extensions of time, extras, and/or additional work.

The completed work as measured for these items of work will be paid for at the Contract Unit Price for the following Contract (Pay) Items:

PAY ITEM	PAY UNIT
Minor Traffic Control, Modified, Maximum $50,000	Lump Sum

The unit price for this item of work shall include all labor, material, and equipment costs to perform all the work specified in the MDOT and City Standard Specifications for Construction, and as modified by this Detailed Specification.

Figure 6H-28. Sidewalk Detour or Diversion (TA-28)



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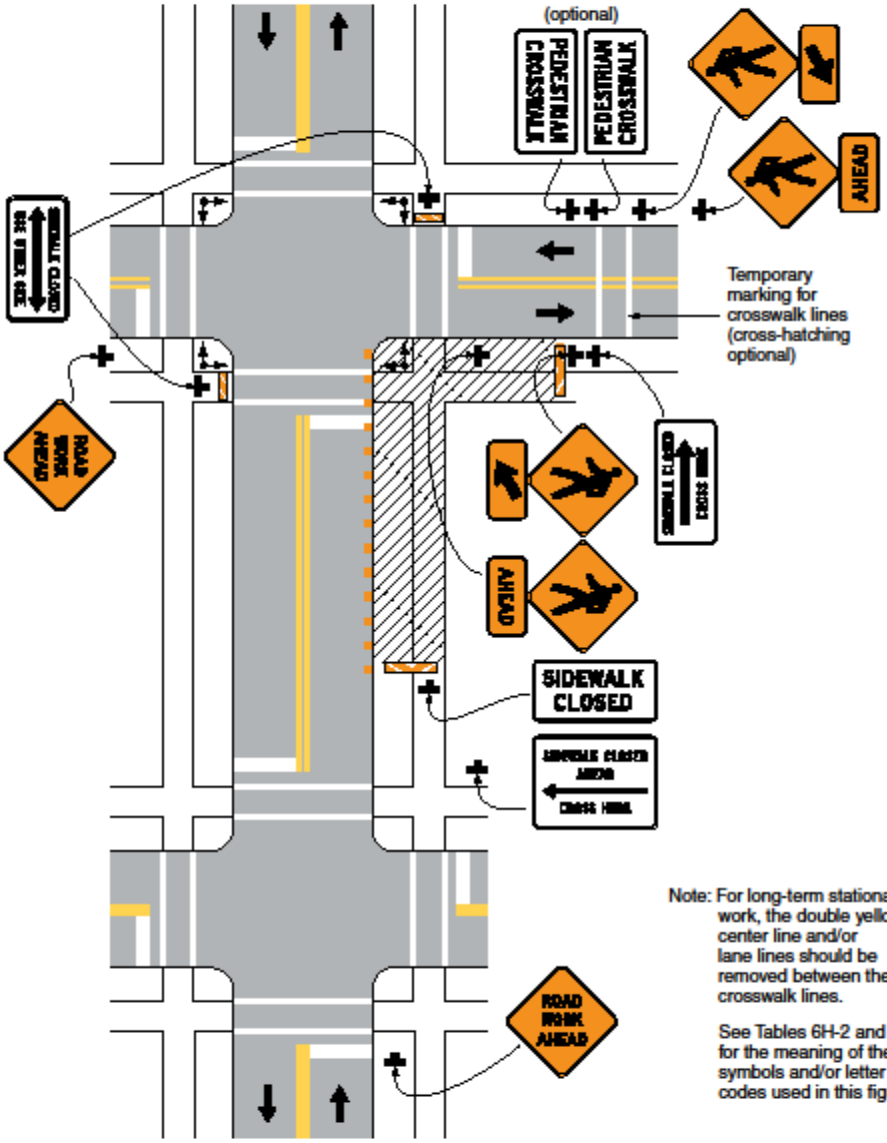
Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.

Figure 6H-29. Crosswalk Closures and Pedestrian Detours (TA-29)



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DETAILED SPECIFICATION
FOR
ITEMS #204/205 – BARRICADE, TYPE III, HIGH INTENSITY, DOUBLE SIDED, LIGHTED, FURN/OPER
ITEMS #206/207 – CHANNELIZING DEVICE, 42 INCH, FURN/OPER
ITEMS #208/209 – LIGHTED ARROW, TYPE C, FURN/OPER
ITEMS #210/211 – PLASTIC DRUM, HIGH INTENSITY, LIGHTED, FURN/OPER
ITEMS #212/213 – SIGN, TYPE B, TEMP, PRISMATIC, FURN/OPER

DESCRIPTION

This work shall consist of protecting and maintaining vehicular and pedestrian traffic in accordance with Sections 140.11, 812, and 922 of the Michigan Department of Transportation (MDOT) 2012 Standard Specifications for Construction; Part 6 of the 2011 Edition of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD); and the City of Ann Arbor Standard Specifications for Construction, except as modified herein.

MATERIALS, EQUIPMENT, AND CONSTRUCTION METHODS

Materials and equipment shall meet the requirements specified in the above designated sections of the MDOT 2012 Standard Specifications for Construction.

The Contractor shall maintain traffic such that no vehicle shall be required to drive into active work areas. Patch areas which extend more than halfway across the roadway shall be removed and replaced so as to provide a minimum of half the pavement width at all times for maintaining traffic.

The Contractor shall maintain pedestrian traffic at all times. For maintaining normal pedestrian traffic while performing sidewalk and driveway repair, Type III Barricades and/or Plastic Drums shall be placed by the Contractor, as directed by the Engineer. "Sidewalk Closed" and/or "Cross Here" signs shall be placed, by the Contractor, when directed by the Engineer.

All temporary traffic/pedestrian control devices furnished by the Contractor shall remain the property of the Contractor. The City shall not be responsible for stolen or damaged signs, barricades, barricade lights or other traffic maintenance items. The Contractor shall replace missing traffic control devices immediately, at no additional cost to the City.

All existing signs, and signs erected by the City of Ann Arbor on this project shall be preserved, protected, and maintained by the Contractor. Existing City owned signs which are damaged by the Contractor during the work will be repaired by the City at the Contractor's expense.

Parking violation citations issued to the Contractor, subcontractor, and material suppliers including each of their respective employees shall be enforced under appropriate City Code.

The Contractor shall replace missing or damaged traffic control devices, as directed by the Engineer. When traffic control devices have been damaged by, or due to, the negligence of the Contractor, his subcontractors or material suppliers, the traffic control devices shall be replaced at the Contractor's expense.

Lighted Plastic Drums, Type III Barricades, and Type B Temporary Signs

The Contractor shall furnish and operate these items as directed by the Engineer.

Type III Barricades shall have standard orange-and-white stripes on both sides of the barricade.

Sufficient signs shall be provided by the Contractor to insure the safety of the workers and the general public in accordance with the 2011 Edition of the MMUTCD.

"Construction Ahead" warning signs shall be placed, as indicated on the Plans, or as directed by the Engineer, prior to the start of work, regardless of the nature, magnitude or duration of the work.

MEASUREMENT AND PAYMENT

All temporary traffic control devices furnished by the Contractor shall remain the property of the Contractor. The City shall not be responsible for stolen or damaged signs, barricades, barricade lights or other traffic maintenance items. The Contractor shall replace missing traffic control devices immediately, at no additional cost to the City.

Costs for transporting barricades and other temporary traffic control devices shall be included in the bid prices for the individual items of work.

Barricade, Type III, High Intensity, Double Sided, Lighted, Furn/Oper

Payment for furnishing and operating lighted Type III barricades shall be for the maximum quantity in-place at any one time during the work of the entire project (all streets).

Channelizing Device, 42 inch, Furn/Oper

There will be a one-time payment for each street for the maximum number of channelizing devices in-place (operated) at any one time, as directed by the Engineer.

Lighted Arrow, Type C, Furn/Oper

Payment for lighted arrow shall be for the maximum quantity used on each street.

Plastic Drum, High Intensity, Lighted, Furn/Oper

There will be a one-time payment for each street for the maximum number of plastic drums in-place (operated) at any one time, as directed by the Engineer.

Sign, Type B, Temp, Prismatic, Furn/Oper

Payment for temporary signs shall be for the maximum quantity used on each street.

The completed work as measured for these items of work will be paid for at the Contract Unit Price for the following Contract (Pay) Items:

PAY ITEM	**PAY UNIT**
Barricade, Type III, High Intensity, Double Sided, Lighted, Furn	Each
Barricade, Type III, High Intensity, Double Sided, Lighted, Oper	Each
Channelizing Device, 42 inch, Furn	Each
Channelizing Device, 42 inch, Oper	Each
Lighted Arrow, Type C, Furn	Square Foot
Lighted Arrow, Type C, Oper	Square Foot
Plastic Drum, High Intensity, Lighted, Furn	Each
Plastic Drum, High Intensity, Lighted, Oper	Each
Sign, Type B, Temp, Prismatic, Furn	Each
Sign, Type B, Temp, Prismatic, Oper	Each

DETAILED SPECIFICATION
FOR
ITEM #206 – "NO PARKING" SIGN

1 of 1

DESCRIPTION

This work shall consist of installing, maintaining and removing of "No Parking" signs and posts as outlined herein and as referenced on the plans. "No Parking" signs shall be installed in accordance with the Public Services Department Standard Specifications and the 2011 Michigan Manual of Uniform Traffic Control Devices (MMUTCD).

MATERIAL

All materials for this work shall conform to the requirements of the Public Services Department Standard Specifications.

CONSTRUCTION METHODS

Prior to the commencement of any construction activity, the Contractor shall place "No Parking" signs as directed by the Engineer. The Contractor shall obtain a permit for "Temporary Permission of Reserve Parking Lane for Work Related Purposes" from the City's Project Management Services Unit. This permit shall be obtained a minimum of 5 business days prior to the posting of "No Parking" signs.

The City will furnish "No Parking" signs to the Contractor at no cost. The Contractor shall furnish the signposts and shall securely bolt the signs to the signposts as directed by the Engineer. The Contractor shall install the signposts at least two feet deep into the ground, and there shall be a minimum of six feet and maximum of seven feet of clearance maintained between the bottom of the sign and the ground. The signs are to be placed at intervals no more than 150 feet and as necessary to eliminate parking in the construction area.

The installation of "No Parking" signs shall be in accordance with the permit. "No Parking" signs shall be installed by the Contractor, as directed by the Engineer, at least 48 hours prior to the proposed start-of-work/enforcement date. "No Parking" signs shall be covered by the Contractor, thereby allowing on-street parking, until between 48 and 24 hours prior to the start of the work. "No Parking" signs shall be covered by the Contractor whenever there is no work being performed for a period of time longer than 72 hours. "No Parking" signs shall be returned to the City upon the completion of work. The cost of unreturned signs will be back charged to the Contractor.

MEASUREMENT AND PAYMENT

The unit price for this item of work shall include all labor, material, and equipment costs to perform all the work specified in the Standard Specifications and as modified by this Detailed Specification.

PAY ITEM	PAY UNIT
"No Parking" Sign	Each

"No Parking" signs will be measured as the maximum number installed on each street at any one time. The unit price includes the removal and return of "No Parking" signs to the City upon completion of the project. The Contractor shall be back charged for the replacement costs for damaged or unreturned signs.

DETAILED SPECIFICATION
FOR
ITEM #215 –SEWER FLOW CONRTOL

DESCRIPTION

The work covered by this Detailed Specification shall consist of furnishing all labor, supervision, tools, equipment, appliances, materials, incidental items, and the installation, operation, and maintenance needed to perform all operations in connection with the diversion of flow and bypass pumping of sanitary sewage for cleaning and inspecting of sewers and manholes, and sewer rehabilitation procedures. The purpose of which is to provide un-interrupted sewerage service at all times and to prevent sewage overflows.

It is the intent of this project to divert dry weather upstream sanitary sewer flow within the work zone to other City of Ann Arbor (City) sanitary sewers by installing plugs in the sewer system. The flows from the various laterals to the smaller diameter sewers connected to the sanitary sewer in the work zone shall be bypass pumped to a manhole either upstream of the plugs or downstream of the work zone. The design, installation, and operation of the temporary sewer flow control system shall be the Contractor's sole responsibility.

When working inside manholes or sewer, the Contractor shall exercise caution and comply with Occupational Safety and Health Administration (OSHA) and City requirements for working in confined spaces.

The Contractor shall manage, plan, and execute their operations such that there will be no backups, leaks, or unauthorized discharges of sewerage. The Contractor shall be completely responsible for the proper clean-up and any environmental remediation as may be required by the City and the Michigan Department of Environmental Quality (MDEQ) for any backup, leak, spill, or sanitary sewerage overflow.

SUBMITTALS

The Contractor shall provide a detailed Sewer Flow Control Plan to the Engineer for review and acceptance prior to the start of any flow control work. This plan must include descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing flow. The Sewer Flow Control Plan must be specific, including such items as schedules, locations, elevations, capacities of the equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of existing structures and pipes, and compliance with the requirements and conditions specified in these Contract Documents. The flow control plan shall be submitted to the Engineer for review and approval in accordance with Section 104.02 of the 2012 edition of the Michigan Department of Transportation Standard Specifications for Construction. No construction shall begin until all provisions and requirements have been reviewed and accepted by the Engineer.

For each submittal and re-submittal, the Contractor shall allow at least 14 calendar days from the date of the submittal to receive the Engineer's acceptance or request for revisions. The Engineer's comments shall be incorporated into the re-submitted plans, calculations, and descriptions. The Engineer's acceptance of the plan is required before beginning the work. Re-submittals shall be reviewed and returned to the Contractor within 14 calendar days. Required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their schedule.

Sewer Flow Control Plan submittal shall include at a minimum:

1. Overall flow control plan and sequence of construction;

2. Flow control schedule including times when the flow control system shall be temporarily shut down and flow allowed to return to normal operations;

3. Overall plan for removal of flow control system during wet weather events and/or emergency situations;

4. Plan for providing redundancy for all aspects of the system especially the plugs;

5. Safety Program for confined space entry and procedure for entering manholes and installing plugs under live flow conditions;

6. Emergency clean-up plan should a spill occur or backups in the system occur. The plan should include contact names and 24 hour phone numbers;

7. Procedure for continuous (24 hour) monitoring of system, including verifying that plugs are sealed and lateral bypass pumping system is operating. The plan is to include type and location of level sensors, method of installation, set elevations of sensors, and continuous monitoring system;

8. Maintenance of traffic plan for plug installation and removal in public roadways;

9. Sewer plug types, method of installation and removal, anchors and restraints, and hydraulic head limits;

10. Lateral bypass pump sizes, capacities, power requirements, and number of each size to be provided at each manhole including redundancy;

11. Calculations giving flow capacity provided by each pump given the system's Total Dynamic Head (TDH), including the calculations that are used to derive the system TDH. This data should also include the calculations determining what the Net Positive Suction Head available is in comparison to the Net Positive Suction Head required by each pump. Pump curves shall be submitted;

12. Number, size, material, and location of lateral bypass pumping suction and discharge piping, procedure for protecting lines, and location of bypass pumping discharge manhole;

13. Lateral bypass pumping system flushing and drainage plan;

14. Buried bypass pipe locations and details;

15. Environment protection including pump containment and leak detection;

16. Method of protecting discharge manholes or structures from erosion and damage;

17. Method of noise control for each pump; and,

18. Design plans for access to bypass pumping locations indicated on the Drawings.

FLOW DIVERSION EQUIPMENT

Provide materials and equipment suitable for, and known to be reliable to meet, the flow diversion requirements as shown on the Drawings and as needed for the Contractor's operations.

The plug shall be a temporary plug that allows for quick removal in case of emergency or wet weather situation and re-installation after wet weather event has passed. Plugs shall be capable of withstanding minimum static head pressure of 15 feet. Plugs shall include form or bracing, anchoring, or restraint to keep plugs properly installed. Plugs should be of the type capable of being installed under live flow conditions and in depths exceeding 35 feet as shown on the Drawings. Plugs should be able to be installed in either the incoming or outgoing pipe in a manhole and allow for quick removal under surcharged conditions.

Pressure gages shall be installed with the plugs to continuously monitor the plugs and adjust the air pressure as needed to maintain full blockage of flow.

Ultrasonic level sensors shall be installed, at a minimum, at the locations shown on the Drawings. The Contractor may elect to install sensors in other locations at their expense if they so choose. The Contractor shall be responsible for the installation and maintenance of the sensors. The level sensors shall provide continuous level readings that the Contractor shall be able to review remotely to monitor the level in the system during flow diversion. The level sensors shall provide notifications and alarms to allow the Contractor time to remove the plugs should an emergency or a wet weather event occur.

LATERAL BYPASS PUMPING EQUIPMENT

Provide materials and equipment suitable for, and known to be reliable to meet, the bypass pumping requirements.

The pumps must be capable of passing a minimum of a 3-inch solid. All pumps must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

Equipment used for bypass pumping shall be sufficient to handle anticipated average and peak flows from each sewer. The Contractor shall maintain sanitary sewer flows within their bypass pumping system, including all wet weather flows.

The Contractor shall take into account seasonal variations and include a safety factor above the indicated peak flow values in sizing pumping equipment.

For sanitary sewerage, bypass piping shall be PVC Schedule 80, or equivalent, with solvent welded joints; or HDPE with butt fused joints. The Contractor shall perform hydrostatic testing of bypass pump discharge pipes in accordance with ASTM F2164 for HDPE or ASTM F2261 for PVC pipe, prior to operating bypass pumping system to ensure structural integrity of pipeline. Any defects or leaks found during testing shall be repaired and the pipeline shall be re-tested until results are satisfactory in accordance with the ASTM standard, and as acceptable to the Engineer.

REDUNDANT EQUIPMENT

The Contractor shall have redundant flow diversion equipment including, but not limited to, plugs and level sensors, available for immediate use at the job site at all times in the event of a failure.

Any damage to the Contractor's equipment, sewer system, or delays to the Contractor's operations due to equipment or plug failure/leakage shall be the Contractor's sole responsibility and no additional payment shall be made for these occurrences. The Contractor shall take all necessary precautions to verify that the plugs and flow diversion plan is operational prior to performing the work.

The Contractor shall have redundant lateral bypass pumping equipment installed and ready for immediate operation and use in the event of an emergency or primary system breakdown or failure. The standby system shall be capable of pumping dry weather and peak flow. The standby pump(s) shall not be considered as any part of the primary system as designed for peak flow. The Contractor shall also furnish and have available onsite, and ready for operation, redundant pumping ancillary equipment in case of any failure of the pumping system including piping, electrical equipment, pipe appurtenances, etc. Redundant pumping facilities shall also include having a backup power generator in case the primary power source fails.

The Contractor shall not obstruct flows in the sewer unless the primary and redundant equipment is onsite and in operable condition and authorization has been granted by the Engineer.

FLOW DIVERSION

The Contractor shall install plugs and level sensors as shown on the Drawings and test the system for a minimum of 48 hours prior to the start of any other work onsite. The Contractor, City, and Engineer shall review the flow diversion during the testing period, including flow levels in the manholes. The Contractor shall not start any other work onsite until acceptance of the diversion test.

LATERAL BYPASS PUMPING

Service laterals that enter the mainline sewer shall be bypass pumped to the downstream bypass pumping manhole. At no time shall plugging and/or blocking of flow from lateral service connections be permitted.

The Contractor shall construct and maintain bypass pumping facilities as needed that will pump at the required flow rates. The Contractor shall provide the City with a minimum of 7 days advance notice prior to initiating the sanitary sewer bypass pumping system.

The Contractor is responsible for obtaining any approvals for placement of the temporary equipment and/or piping within public ways from the Agency having jurisdiction.

The Contractor shall provide an adequate labor force and have designated personnel onsite for maintenance and operation, and emergency back-up service, of the bypass pumping facility 24 hours per day 7 days per week during bypass operations.

Anytime bypass pumping operations cease as required due to weather conditions described in Detailed Specification "Extension of Time, Additional Compensation" or as required by the Engineer, the Contractor

shall drain the bypass pump discharge line back into the sanitary system as described in the Sewer Flow Control Plan and as directed by the Engineer to avoid freezing of the pipeline. Under no circumstances shall sanitary sewage within the bypass discharge line be drained to the Huron River.

The Contractor is to arrange for and provide all necessary temporary power, electrical service, board switches, etc. as required by DTE Energy and the National Electrical Code (NEC) current edition to provide temporary bypass pumping.

All bypass pumping discharge pipes shall be protected from the pipe header to the discharge structure. The Contractor shall provide necessary fittings or deflection in pipe to route pipe as necessary to minimize environmental impact and conflict with pedestrian, construction, and emergency vehicle traffic. When the bypass pipeline crosses drives or trails, or when pipeline is within any Contractor work zone/staging area, the Contractor shall place the bypass pipeline in a casing pipe and bury in temporary trenches with compacted backfill as indicated on the Drawings, as required for the Contractor's operations, and as approved by the Engineer. All work associated with temporary bypass discharge pipe trench, including piping, fittings, deflections, casing, spacers, trenching, and backfill shall be included in the contract pay item "Sewer Flow Control."

WET WEATHER EVENT

A wet weather event is defined as an event that causes the flow in the system to surcharge.

When a wet weather event occurs, the Contractor shall cease all operations in the sewer system and remove all plugs. The plugs shall be removed as not to cause a surge downstream.

It is the Contractor's responsibility to monitor the weather and verify weather conditions prior to the start of any work that could have an impact on the capacity of the affected sewers. Any damage to the Contractor's equipment, sewer system, or delays to Contractor's operations due to wet weather conditions shall be the Contractor's sole responsibility and no additional payment shall be provided.

The only exception to that is if the temporary removal of the flow diversion plugs and lateral bypass pumping system occurred after the sewers had been cleaned, televised, prepped for lining, and approved by the Engineer before the sewers were lined. In such an event, the Contractor may request compensation for the re-cleaning of the pipes only. The re-cleaning must first be approved by the Engineer prior to the work beginning.

No compensation shall be provided for the removal and re-installation of the plugs due to wet weather events as described in Detailed Specification "Working in the Rain."

NOISE CONTROL

All noise generated by the bypass pumping operation shall not exceed the sound limits, and shall follow necessary procedures as required for temporary exemptions, as defined in Detailed Specification "Hours of Work."

FLOW DIVERSION AND BYPASS PUMPING COMPLETION

At the end of the flow control operation, and after receipt of written permission from the Engineer, the Contractor shall remove all flow diversion and bypass pumping equipment, including level control system, temporary power equipment, and suction/discharge piping in a manner that permits the sewage flow to return to normal without overflowing to the environment, surcharging, or causing other major disturbances downstream. The Contractor shall restore all disturbed areas and structures, and restore all pavement in accordance with Detailed Specification, "Project Clean-Up and Restoration, Special" and as directed by the Engineer.

The duration of the bypass pumping shall be determined by the Contractor as needed to perform the work under this contract while maintaining un-interrupted sewage service.

FLOW CONTROL PRECAUTIONS

When flow in a sewer line is bypassed or plugged, sufficient precautions must be taken to protect the sewer liner and the Contractor's operations from damage that might result from sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved. At no time shall sewage be pumped in or allowed to flow into a catch basin, storm sewer, or open watercourse.

MEASUREMENT AND PAYMENT

The completed work shall be paid for at the contract unit price for the following contract pay item:

PAY ITEM	PAY UNIT
Sewer Flow Control	Lump Sum

The contract unit price for this item shall include all labor, supervision, tools, permits, shop drawing submittals, materials, equipment, operation, any incidental items, and all other work as noted on the Drawings and as specified herein to allow the Contractor to perform the work of diverting and bypass pumping flows as detailed herein.

The installation, maintenance, operation, monitoring, and removal of the level sensors shall not be paid for separately, but shall be included in the item of work "Sewer Flow Control."

The cost for the sewer flow control shall be paid for as a Lump Sum item regardless of the duration, number of, and/or duration of the wet weather events encountered, flow encountered, weather conditions, or number of times flow control system is temporarily removed and re-installed.

30% of the lump sum shall be paid for Sewer Flow Control following the initial installation, 48-hour test, and acceptance of the system by the Engineer. The remainder of the cost shall be paid for at the conclusion of all flow diversion activities and after the removal of all equipment from the site.

DETAILED SPECIFICATION
FOR
CLEANING AND TELEVISING SEWER AND MANHOLES

1 of 6

DESCRIPTION

This work shall consist of the cleaning and video inspection of sewer and siphon pipes, chambers, and manholes, and providing the required documentation as described herein. All work shall be performed in accordance with the City of Ann Arbor (City) Standard Specifications, except as modified herein, and as directed by the Engineer.

The Contractor is responsible for video recording and cleaning the pipe before lining, and video recording after lining. Pipeline inspection and videotaping shall be in accordance with National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) requirements.

The Contractor is responsible for inspecting all manholes and chambers as indicated on the Drawings in accordance with NASSCO Manhole Assessment and Certification Program (MACP) Level 2 requirements.

SUBMITTALS

The Contractor shall provide a detailed sewer cleaning and televising plan to the Engineer for review and acceptance prior to beginning the work. This plan must include descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing flow. The cleaning and televising plan must be specific, including such items as schedules, locations, type of equipment, details on water source, plans for disposal, and all other incidental items necessary and/or required to ensure proper protection of the facilities and surroundings, including protection of the access locations from damage, and compliance with the requirements and permit conditions specified in these Contract Documents.

The cleaning and televising plan shall be submitted to the Engineer for review and approval in accordance with Section 104.02 of the 2012 edition of the Michigan Department of Transportation Standard Specifications for Construction. No work shall begin until all provisions and requirements have been reviewed and accepted by the Engineer.

For each submittal and re-submittal, the Contractor shall allow at least 14 calendar days from the date of the submittal to receive the Engineer's acceptance or request for revisions. The Engineer's comments shall be incorporated into the re-submitted plans, calculations, and descriptions. The Engineer's acceptance of the plan is required before beginning the work. Re-submittals shall be reviewed and returned to the Contractor within 14 calendar days. Required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their schedule.

Sewer cleaning and televising plan and submittals shall include at a minimum:

1. Copy of PACP/MACP Certifications for sewer televising personnel and manhole inspection personnel;

2. Proof of PACP/MACP certified software;

3. Safety program for confined space entry;

4. Information on equipment, trucks, tanks, etc., including, but not limited to, dimensions, required turning radius, fuel type, any special requirements, etc.;

5. Staging areas for equipment, trucks, tankers, etc.;

6. Schedule for cleaning and televising of pipe lines, manholes, and chambers.;

7. Planned hours of operation, including equipment idling, etc.;

8. Number, size, material, and location of hose/piping;

9. Information on cleaning equipment;

10. Sludge and debris dewatering, transportation, and disposal procedure and location;

11. Environment protection including equipment and pipe containment, leak detection, and/or remediation plan; and,

12. Method of noise control for all equipment.

CONSTRUCTION

The Contractor shall carry out their operations in strict accordance with all Occupational Safety and Health Administration (OSHA), Michigan Occupational Safety and Health Administration (MIOSHA), and manufacturer's safety requirements.

Safety. – The Contractor shall be solely responsible for safety of all those involved with the work during the performance of all work. The Contractor shall not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by the Contractor. The Contractor shall perform all work in accordance with the latest OSHA confined space entry regulations. The Contractor shall coordinate their work with local fire, police, and emergency rescue unit.

The Contractor shall be responsible for any damage to public or private property resulting from their televising and cleaning activities and shall repair or otherwise make whole such damage at no cost to City and owner of the property.

Flow Diversion/Lateral Bypass Pumping.- The Contractor shall provide for the transfer of main line flow around the section or sections of pipe that are to be cleaned and televised, as required to complete cleaning, televising, and inspection work. The diverting and lateral bypass pumping work shall be performed in accordance with Detailed Specification “Sewer Flow Control” and as directed by the Engineer.

If the Contractor chooses to only divert part of the flow during their sewer cleaning operations, the Contractor must indicate that in their submittal, including which plugs would be installed. Contractor to note that all plugs, level sensors, and lateral bypass pumping system shall be in operation for the sewer televising, manhole inspections, and the chamber inspections.

Sewer Cleaning.- Each sewer section shall be cleaned to a degree sufficient to allow video inspection and cured-in-place pipe (CIPP) lining to be completed in accordance with this specification and Detailed

Specification "CIPP Sewer Lining." The Contractor shall take precautions to protect the sewer lines from damage. The existing sewer has not been cleaned or inspected in decades. The Contractor shall assume the sewer will require heavy cleaning with unlimited passes to achieve a clean sewer and that rodding and root cutting shall be required and are included in the contract pay item.

The Contractor must adhere to the requirements of ASTM F1216 or ASTM F1606 for the following types of cleaning: hydraulic cleaning, high velocity hydro-cleaning, and mechanical cleaning.

Remove dirt, grease, rocks, sand, roots, and other solid or semisolid materials and obstructions from the sewer line and manholes. Cleaning shall be of the entire reach between manholes and/or chambers.

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, debris from collapsed pipe, sediment deposits, mineral deposits, stalactites, and all major blockages that would prevent sewer rehabilitation work to be performed at no additional cost to the project.

The sewers shall be cleaned by using a high pressure water cleaning machine with minimum capability of 5,000 pounds per square inch (psi) at 80 gallons per minute (gpm). A high pressure hose with a jet nozzle shall be introduced into the sewer so that a spray shall scour and clean the sewer line without applying internal pressure and damaging the pipe. This will require an unlimited amount of passes of the jet nozzle, or other cleaning measures to remove all debris. The hose shall be self-propelled by a minimum water pressure of 1,000 psi. Cleaning pressures to 5,000 psi may be required to remove heavy tuberculation and adhered debris from the pipe interior. The jet nozzle hose, upon withdrawal, will scour the pipe (invert, walls, and crown), flushing all materials into the downstream manhole for removal.

Due to the sensitive nature of the project work site the Contractor shall notify the Engineer for review and approval before proceeding.

Material removal shall be performed at the identified-for-access manholes for the cleaning operation. At no time during cleaning shall material be allowed to enter or flow in the sewer past the downstream access manhole. Passing material from manhole section to manhole section shall not be permitted. All debris and waste material shall be completely removed from the sanitary sewer system and shall be disposed of by the Contractor in accordance with Detailed Specification “Removal and Disposal of Sludge and Debris Material.”

Mechanical root cutting shall be performed with powered equipment. The Contractor shall furnish suitable power machinery which shall be used to remove tree roots and deposits remaining after jet cleaning that prevent passage of television inspection equipment or prevent the lining of the sewer.

The Contractor shall provide digital video on DVD, flash drive, or hard drive that verify that the sewer is clean and free of sediment and debris to the satisfaction of the Engineer. If any sewer is not satisfactorily cleaned, it shall be promptly cleaned and re-inspected by closed-circuit television camera and video provided to the Engineer for review and approval.

If the sewer has material and debris that prevents the proper installation of the CIPP, prohibits video inspection, or is not cleaned to the satisfaction of the Engineer, the sewer shall be re-cleaned and re-televised at the Contractor's sole expense.

The sewer shall not be lined until such time as the cleaning operations have been approved in writing by the Engineer. Field Inspection personnel shall not be allowed to authorize the Contractor to begin installation of the CIPP sewer liner.

Extensions of contract time will not be granted for delays associated with re-cleaning and re-televising the sewer except as outlined under Detailed Specification "Extension of Time, Additional Compensation."

The cleaning and removal of the material out of the sewer system shall be paid for as part of the "Clean __-inch Dia. Sanitary Sewer" contract pay item. All other work necessary for the final disposal of the material shall be paid for as part of the "Removal and Disposal of Sludge and Debris Materials" contract pay item.

Manhole and Chamber Cleaning.- All sanitary manholes shall be cleaned to a degree sufficient to perform the Level 2 MACP manhole inspection and as acceptable to the Engineer. The manhole structures shall be cleaned below their invert elevations with a power vacuum, or other Engineer-approved method, to remove all sediment to allow for the inspection of the bottom of the structures.

The Contractor shall assume the manholes require heavy cleaning with multiple passes to achieve a clean manhole. Manhole cleaning shall be incidental to the sewer cleaning and no additional payment shall be provided.

Sewer Television Inspection.- The initial "pre-rehabilitation" television inspection of the sewers pipes shall be conducted within a week of the cleaning of each segment as long as the flow diversion and lateral bypass pumping system has remained in operation. Should the flow diversion have been temporarily suspended between the cleaning and the televising, or between the initial televising and the lining, then both the cleaning and televising shall be repeated at no additional cost to the project except as described in Detailed Specification "Extension of Time, Additional Compensation."

The camera must be operative in 100% relative humidity conditions. The live image obtained by the camera shall be transmitted to a color monitor of not less than 19 inches. The camera and monitor shall have a minimum 500 line resolution. The monitor shall be located inside the mobile recording studio.

Lighting for the camera shall be adequate to allow a clear picture of the entire periphery of the sewer and shall be varied as required to be effective for all pipe diameters inspected. Remote control of lighting brilliance, camera focus, and camera movement shall be from a control panel inside the mobile recording studio. Cables and equipment used to propel the camera shall not obstruct the camera view or interfere with the documentation of the sewer conditions.

The camera shall be moved through the sewer line at a uniform rate, maximum 30 feet per minute. Whenever possible, the camera shall move in an upstream direction. The camera shall be stopped for no less than 10 seconds at the manhole entrances, each service lateral, exit manholes, and at all points where the sewer is damaged or deficient. The camera shall pan and tilt to provide full view of each service lateral, and at all points where the sewer is damaged or deficient.

If the camera fails to pass through a pipe section, the Contractor shall re-set the equipment and attempt to perform the inspection coming back from the next upstream, identified-for-access, and manhole. If the

inspection cannot be completed from the next manhole, the inspection shall be considered complete and the Engineer will provide written instructions to the Contractor describing how to proceed with the work in that reach of sewer.

The cost of the initial television inspection shall be included in the Pay Item: "Clean __-inch Dia. Sanitary Sewer". The post rehabilitation television inspection shall be performed once the liner has been installed and cured. No payment shall be provided for post rehabilitation television inspection.

Manhole Inspection.- All sanitary manholes 2 shall be Level 2 MACP inspected. The Level 2 MACP inspections shall gather detailed information to fully document all defects, determine condition of the manhole, and provide specific information needed to recommend corrective action. Level 2 MACP inspection shall use the established defect coding system found in the PACP to the extent possible.

Line Obstructions/Repairs.- If the pre-rehabilitation video inspection reveals areas that require excavation and removal of a section of pipe, and/or spot repair, the Contractor shall submit in writing a request for authorization to perform the excavation, removal, and spot repairs, along with sufficient proof that these repairs are indeed necessary. Such requests shall include method of spot repair, type and manufacturer of repair pipe, method of connection, etc., and shall be submitted prior to commencement of the rehabilitation process. If removal and replacement of pipe, spot repairs, or other measures are required to allow the sewer pipe to be properly rehabilitated, this will be paid for as Extra Work at a price as agreed upon between the Contractor and the Engineer.

Documentation.- The Contractor shall use the City's manhole numbering system on all project documentation. The City will provide the Contractor with utility maps or Drawings showing the manhole numbers.

The Contractor shall provide to the City inspection logs listing the location in relation to adjacent manholes of each infiltration point, service leads, unusual conditions, roots, sewer connections, collapsed sections, presence of scale and corrosion, cracked pipe, wide joints, and other discernible features. The logs shall indicate size and type of pipe material, length of line from manhole, and direction of sewage flow, if present. The logs shall also indicate the time and date of recording. Each log shall be named with the pipe inspections from starting manhole to terminus manhole for each stretch of sewer. All logs shall be in accordance with NASSCO PACP and MACP standards, Version 7.0.

The Contractor shall provide color photographs of sewer laterals and all problem areas.

A color DVD and suitable log with voice and/or computer generated description for both pre- and post-rehabilitation inspection shall be made by the Contractor and kept for later reference by the Engineer.

The Contractor shall supply the Engineer with two electronic copies of the entire and final televised program, including PACP database, MACP database, video pipe recordings, reports on two separate flash drives or portable hard drives. Each drive shall contain the entire package of information. The data shall be provided within 15 working days of completion of field work. The information for individual databases,

sewer segments, and recordings shall not be split into several drives. The flash drives or portable hard drives and information within it shall become the property of the City.

MEASUREMENT AND PAYMENT

The completed work shall be paid for at the contract unit price for the following contract pay item:

PAY ITEM	PAY UNIT
Clean __-inch Dia. Sanitary Sewer	Lineal Foot
Level 2 MACP Inspect Manhole	Each

Payment shall be made on a lineal foot basis for the cleaning and televising of sanitary sewer. Measurements shall be from manhole to manhole, and shall take place with both the Engineer and the Contractor (or their agents) present. Measurements shall be recorded and logged on a daily basis.

The unit prices for these items of work shall include all labor, material, and equipment costs to perform all the work specified herein.

DETAILED SPECIFICATION
FOR
ITEM #219 - REMOVAL AND DISPOSAL OF SLUDGE AND DEBRIES MATERIAL

1 OF 2

DESCRIPTION

This work shall consist of removal and disposal of sludge and debris material as a result of the sanitary sewer, manhole, and chamber cleaning operations.

Sanitary Sewer Material.- The material removed from cleaning the 36-inch sanitary sewer pipes and manholes shall be removed from the system as described in Detailed Specification, "Cleaning and Televising Sewer and Manholes" and hauled offsite for legal disposal.

The removal of the material out of the sewer system shall be paid for as part of the sewer or chamber cleaning contract pay item. All other work necessary for the final disposal of the material shall be paid for as part of the "Removal and Disposal of Sludge and Debris Material" contract pay item.

Disposal.- The Contractor shall remove the wet sludge, sediment, debris, and other material from the sewer system and dewater the material at an offsite location, in vactor trucks onsite, or by other means as required for legal disposal and as approved by the Engineer. No material shall be accumulated onsite unless approved by the Engineer. When removing waste, the material shall be decanted to remove as much of the free liquid as possible. If dewatering onsite, the Contractor may discharge the free liquid (supernatant) back into the sanitary sewer at a downstream manhole. The hauled off solids/sludge/material shall be transported in sealed transport trucks. Supernatant shall not be allowed to leak out of the transport trucks onto the roads.

The Contractor shall be responsible for all fees, including all testing fees, material transport, dewatering, drying, and disposal at an approved landfill facility. The Contractor shall provide certified manifests from the landfill, indicating in and out weights of all transport vehicles containing wastes absent of free liquids, to the Engineer.

Solids Material Testing.- Solid waste material holding free liquids are prohibited from disposal at municipal solid waste landfills. The Contractor shall demonstrate the absence or presence of free liquids in accordance with Method 9095B (Paint Filter Liquids Test) as described in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846. Material passing the Paint Filter Liquids Test shall be considered "dry."

The City of Ann Arbor (City) believes the sludge is not hazardous and can be disposed of in a Type II landfill. The landfill may require the Contractor to provide proof that the materials are non-hazardous prior to disposal. The Contractor shall be responsible for collecting a sample of the sludge and testing it prior to the start of the sewer/siphon/chamber cleaning.

The Contractor shall provide copies of the sampling results to the Engineer. If required by the landfill, the Contractor is responsible to re-test the material and verify there are no hazardous materials in the sludge and/or debris prior to shipping it to the landfill. No additional payment shall be made for testing or re-testing and verifying the material content.

DETAILED SPECIFICATION
FOR
ITEM #218 - REMOVAL AND DISPOSAL OF SLUDGE AND DEBRIES MATERIAL

1 OF 2

MEASUREMENT AND PAYMENT

The completed work shall include all labor, material, fees, tests, and equipment costs to perform all the work specified in the Detailed Specifications and as modified herein to properly dispose of the sediment, debris, sludge, and all other inert material removed from the sewer system.

The complete work as measured for these items of work will be paid for at the contract unit prices for the following contract pay items:

PAY ITEM	PAY UNIT
Removal and Disposal of Sludge and Debris Material	Tons

The item "Removal and Disposal of Sludge and Debris Material" shall be a paid for in tonnage of "dry" material absent of free liquids based on the landfill manifests and shall be payment in full for all materials, equipment, and labor necessary to complete this item, including drying the material to the point where it will pass the paint filter test as required by the disposal facility and transporting it to the landfill for disposal.

DETAILED SPECIFICATION
FOR
CIPP SEWER LINING

1 of 9

DESCRIPTION

This work shall consist of rehabilitating pipelines by the insertion of a resin impregnated flexible lining and cured-in-place to form a pipe. The cured-in-place pipe (CIPP) shall be saturated with a thermosetting resin and inserted into the existing pipeline. Curing shall be accomplished by circulating hot water only to harden the resin into a hard impermeable pipe. When cured, the hardened CIPP shall be a tight fitting watertight pipe within a pipe. The CIPP shall be continuous from manhole to manhole with no circumferential joints or seams. Except as otherwise specified herein, all work shall be performed in accordance with the City of Ann Arbor (City) Public Services Area Standard Specifications, and as directed by the Engineer.

For a CIPP system to be considered acceptable, the CIPP system must have at least two million lineal feet of successful, documented installations, a minimum of 250,000 lineal feet of which shall have been in Midwestern United States or Canada.

When requested by the Engineer, the Contractor shall submit test results from previous field installations of the same resin system and tube materials as proposed for this installation. The test results must verify that the CIPP physical properties specified in this Detailed Specification have been achieved in the field.

The lining operation shall not begin until the sewer has been cleaned and video inspected in accordance with the Detailed Specification "Cleaning and Televising Sewer and Manholes" and authorization to begin by the Engineer has been granted.

DESIGN CONSIDERATIONS

The required structural CIPP wall thickness shall be based, at a minimum, on the physical properties of the cured composite and per the design of the Professional Engineer. The finished liner shall be designed per ASTM F1216 Appendix X1 for the following condition:

Condition	Fully deteriorated gravity pipe
Safety Factor	2
Ovality	As measured by Contractor during sewer inspection, assume 2% for bidding purposes
Soil Density	130 pounds per cubic foot (lbs/cft)
Soil Modulus	700 pounds per square inch (psi) for pipe inverts up to and including 15 feet deep, 1,000 psi for pipe inverts greater than 15 feet deep
Groundwater Depth:	As field verified
Surcharge Loading	HS-20 (Highway) when any part of the sewer is under any major street, county road, or state highway; E-80 (Railroad) when under any railroad.

The acceptable resin system values to be incorporated into the formula for liner thickness shall not be greater than the following:

Table 1

	Polyester	Enhanced Polyester	Vinyl Ester	Epoxy
Short Term Flexural Modulus (psi)	300,000	400,000	250,000	300,000
Long Term Flexural Modulus (psi)	150,000	200,000	125,000	150,000
Creep Retention Factor	50%	50%	50%	50%
Flexural Strength (psi)	4,500	4,500	4,500	5,000

Where the requirements of this specification conflict with ASTMF 1216 or ASTM D5813 this Detailed Specification shall govern.

The Contractor shall determine the liner thickness and resin quantity for this project per ASTM F1216, Appendix X1. Liner thickness, resin, and resin quantity shall be furnished to the Engineer for review and approval prior to beginning work. The design calculations for wall thickness shall be completed by a Professional Engineer proficient in the design of pipeline systems, licensed in the State of Michigan, with design calculations signed and sealed. The CIPP design shall assume no bonding to the original pipe wall.

The Contractor shall submit, prior to installation of the lining materials, certification of compliance with these specifications. Certified material test results shall be included that confirm that all materials conform to these specifications. Materials not complying with these requirements will be rejected.

For each submittal and re-submittal, the Contractor shall allow at least 14 calendar days from the date of the submittal to receive the Engineer's acceptance or request for revisions. The Engineer's comments shall be incorporated into the re-submitted plans, calculations, and descriptions. The Engineer's acceptance of the submittal is required before beginning the work. Re-submittals shall be reviewed and returned to the General Contractor within 14 calendar days. Required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their schedule.

MATERIAL

All materials shipped to the project site shall be accompanied by test reports certifying that the material conforms to the ASTM standards listed herein. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the CIPP system manufacturer to avoid damage. Onsite storage locations shall be as indicated on the Drawings and approved by the Engineer.

Preliner Tube.- The preliner shall be a polyethylene material compatible with the lining system, and shall be utilized where necessary to accommodate infiltration, damaged, or missing pipe.

Felt Liner Tube.- The tube shall consist of one or more layers of absorbent, flexible, non-woven felt material. The tube shall be capable of carrying the specified resin, constructed to be able to withstand installation pressures and curing temperatures, have sufficient strength to bridge missing pipe and stretch to fit irregular pipe sections at all pipe locations, and be compatible with the resin used.

The outer tube coating shall consist of an impermeable, flexible membrane that contains the resin and allows for visual inspection and verification of proper resin impregnation ("wet-out") procedure. The coating shall hold the resin inside the tube without leakage, accommodate installation, and stretch to the size and shape of the existing sewer, and shall not delaminate before, during, or after curing.

The tube shall have a uniform thickness that when compressed at installation pressures will meet, or exceed, the design thickness. The thickness of the tube shall be calculated based upon the resin system values given in this Detailed Specification.

The CIPP wall thickness shall be calculated from the equation in ASTM F1216, Appendix X1, based upon the parameters given in this Detailed Specification. The minimum CIPP wall thickness shall be not less than the value calculated by that equation. Any layers of tube that are not saturated with resin and capable of being cured shall not be deemed to have been included in the calculated CIPP wall thickness.

The tube shall be fabricated to a size and length that when installed will fit sufficiently tight within the existing pipe so as to not leak at manholes, at service connections, or through the wall of the installed pipe. The tube shall be properly sized to the diameter of the existing pipe and the length to be rehabilitated and be able to stretch to fit irregular pipe sections and negotiate bends. The Contractor shall determine the minimum tube length necessary to effectively span the designated run between manholes. The Contractor shall verify the lengths in the field prior to impregnation of the tube with resin, to ensure that the tube will have sufficient length to extend the entire length of the run. The Contractor shall also measure the inside diameter of the existing pipelines in the field prior to ordering liner so the liner can be installed in a tight-fitted condition. Allowance for circumferential stretching of the tube during insertion shall be made as per manufacturer's recommendations. Overlapped layers of felt in the longitudinal seam that cause lumps in the final product shall not be utilized

The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

The wall color of the interior pipe surface of the CIPP after installation shall be a light reflective color so that a clear detail examination with closed circuit television inspection equipment may be made. The hue shall be dark enough to distinguish a contrast between the fully resin saturated felt fabric and dry or resin lean areas.

Seams in the tube shall be stronger than the unseamed felt and shall meet the requirements of ASTM D5813. Where the length of the tube to be installed requires joining along the circumference of the tube, the sewn joint shall not be perpendicular to the long axis but spirally formed and sewn.

The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 feet. Such markings shall include the manufacturers name or identifying symbol. The tubes must be manufactured in the USA.

The length of the tube shall be that deemed necessary by the Contractor to effectively carry out the insertion and seal the pipe at the inlet and outlet points, plus that amount required to run-in and run-out for the

installation process. The Contractor shall verify the lengths in the field before cutting the tube to length. Lengths of sewer shall be lined over one or more access points as shown on the Drawings.

Resin.- Resin shall be a polyester, enhanced polyester, vinyl ester, or epoxy system including all required catalysts, initiators, or hardeners that when cured within the tube creates a composite that satisfies the requirements of ASTM F1216 and ASTM F1743, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project. Resin selected shall be resistant to the chemical composition of the sewage and comply with the structural requirements of this specification. **Resin selected shall be Styrene-Free.**

The resin shall be thermosetting resin that is compatible with the lining process and shall meet the requirements of ASTM F1216 except as otherwise specified in this Detailed Specification. The resin shall be able to cure in water with an initiation temperature for cure as required by the liner manufacturer, but not greater than maximum temperatures required under ASTM F1216. The cured resin/felt system shall be suitable for the expected conditions within the existing sanitary sewer.

The Contractor is responsible for choosing a resin system that is capable of meeting the physical and cured-in-place properties and performance requirements as detailed in this specification.

Field Cured Line.- The completed liner as installed and fully cured-in-place shall meet the minimum physical properties for short term flexural modulus and flexural strength as shown in Table 1.

Remote Temperature Sensing Devices-. Fiber optic probes shall be installed to monitor the average temperature along the entire length of the tube as it cures. Devices shall be provided by VeriCure or an Engineer-approved equal.

CONSTRUCTION METHODS

The Contractor shall carry out their operations in strict accordance with all Occupational Safety and Health Administration (OSHA), Michigan Occupational Safety and Health Administration (MIOSHA), and manufacturer's safety requirements. The Contractor shall be solely responsible for safety during the performance of all work. The Contractor shall not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by the Contractor and/or the City. The Contractor shall coordinate their work with local fire, police, and emergency rescue unit.

The Contractor shall be responsible for any damage to public or private property resulting from their sewer lining or televising activities and shall repair or otherwise make whole such damage at no cost to the City.

Cleaning of Pipelines.- Prior to rehabilitation of any sewer, it shall be the responsibility of the Contractor to remove all internal deposits from the pipeline. This shall include dirt, debris, mud, bricks, grease or oils, mineral deposits, root masses, pieces of broken pipe, etc. Cleaning of sewer shall be in accordance with the City of Ann Arbor Public Services Area Standard Specifications, Detailed Specification “Cleaning and Televising Sewer, Manholes, and Chambers,” and as directed by the Engineer.

Pre-Rehabilitation Inspection of Pipelines.- Inspection of pipelines shall be performed after the pipe has been cleaned, by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television.

The interior of the pipeline shall be carefully inspected to determine the location and extent of any structural failures. The location of any conditions which may prevent proper installation of lining materials into the pipelines shall be noted so these conditions can be corrected as specified in this Detailed Specification and Detailed Specification "Cleaning and Televising Sewer, Manholes, and Chambers".

Diverting/Bypassing Flow.- The Contractor shall provide for the transfer of main line and/or lateral flow around the section or sections of pipe that are to be cleaned, televised, and rehabilitated. The work shall consist of diverting, pumping, and bypassing flow in the existing sewers in accordance with Detailed Specification "Sewer Flow Control" and as directed by the Engineer.

Line Obstructions.- It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, root masses, protruding branch connections, or broken pipe that will prevent proper insertion of the liner in accordance with Detailed Specification "Cleaning and Televising Sewer, Manholes, and Chambers" and as directed by the Engineer.

Installation of Resin Impregnated Tube.- The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated liner will be resin impregnated prior to installation. The Contractor shall allow the Engineer to inspect the materials and procedure. A resin and catalyst system compatible with the requirements of this Detailed Specification shall be used. The quantities of the liquid thermosetting materials shall be provided in accordance with manufacturer's standards to provide the cured liner properties specified. Sufficient resin shall be used to fill the volume of air voids in the liner with additional allowance for polymerization, shrinkage, and loss of resin through cracks and irregularities in host pipe wall. The Contractor shall ensure the proper amount of resin is uniformly distributed throughout the entire length of the tube.

The wetting out, installation, and curing of the resin impregnated tube shall be in accordance with ASTM F1216 and per manufacturer's specifications. The tube shall be inserted through existing opening by means of an inversion process, the application of a hydrostatic head sufficient to fully extend the liner to the next designated access point, or other means as approved by the Engineer.

The process will be adjusted as necessary to ensure a complete lining without over-stressing or tearing the lining, with sufficient pressure to hold the liner snug to the pipe wall, and to produce dimples at side connections and flared ends at the entrance and exit access points. The use of a lubricant is recommended and if used, such lubricant shall be compatible with the rehabilitation process.

The manufacturer's standards shall be closely followed during the elevated curing temperature so as not to over-stress the felt fiber and cause damage or failure of the liner prior to cure.

Curing.- Hot water is required for full length liners. After installation of the resin impregnated liner is completed, the Contractor shall supply a suitable heat source and water recirculation equipment as necessary to cure the liner. The equipment shall be capable of delivering hot water to the far end of the liner through a hose, which has been perforated per manufacturer's recommendations, to uniformly raise
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the water temperature in the entire pipe above the temperature required to affect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.

For quality control during the CIPP lining operation, the Contractor shall utilize remote temperature sensing devices placed between the host pipe and the liner to continuously monitor the liner cure incrementally

every 18 inches or less to verify that an exothermic reaction has occurred and that a full cure has taken place along the full length of the CIPP liner. Measuring temperatures at the liner endpoints only will not be permitted. The cure information must be taken from the bottom third of the pipe liner. Cure parameter information shall be provided by the resin manufacturer.

Liner and/or host pipe interface temperature shall be monitored and logged during curing of the liner. The monitoring system must have the ability to be remotely viewed live by the Engineer. Data collected shall be provided to the Engineer in Excel spreadsheet and graphical viewer formats at the same time as the post-lining inspection videos are provided.

Initial cure shall be deemed to be completed when the remote sensing devices reflect that the cure temperature, as recommended by the resin/catalyst system manufacturer, have been achieved. The cure period shall be of a duration recommended by the resin manufacturer, as modified for site-specific conditions, during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature in the liner continues.

Cool-Down.-The Contractor shall cool the CIPP in accordance with the CIPP manufacturer's recommendations, to a temperature below 100°F before relieving the static head in the liner. Temperatures and curing data shall be monitored and recorded by the Contractor throughout the installation process to ensure that each phase of the process is achieved in accordance with the CIPP manufacturer's recommendations. Cool-down may be accomplished by the introduction of cool water into the liner to replace water being drained from the downstream end. Care shall be taken in the release of the static head such that a vacuum will not be developed that could damage the newly installed liner. The cooled water shall be released to the existing sanitary sewer at a rate that is approved by the Engineer and the City of Ann Arbor's Waste Water Treatment Plant (WWTP) superintendent.

Finish.- The cured liner shall be continuous over the entire length of an insertion run and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall be impervious and free of any leakage.

Any defects which will affect the integrity of the liner, or any deficiencies in required strengths or thicknesses, shall be repaired or removed and replaced at the Contractor's expense, in a manner acceptable to the Engineer.

Sealing Liner at the Ends.- A seal, consisting of a hydrophilic sealing gasket compatible with the installed CIPP, shall be installed at each manhole/pipe wall interface. The seal shall be a seamless molded tubular design that swells in the presence of water. The seal shall be secured in place by a retaining ring.

Post-Rehabilitation Television Inspection.- The completed sewer shall be television inspected and color videotaped, by the Contractor, in accordance with Detailed Specification "Cleaning and Televising Sewer and Manholes" No payment shall be provided for post rehabilitation television inspection.

Acceptance Tests.- The Engineer shall perform Acceptance Testing in accordance with ASTM F1216 (including appendices) and ASTM D5813.

The Contractor shall prepare plate test samples to be cured with the CIPP operation. The Contractor shall capture and prepare 10 sample specimens of the liner for the Acceptance Testing to be performed by the Engineer for each section of sewer lined in accordance with Section 8 of ASTM F1216 for testing flexural strength and delamination. The Contractor shall prepare the samples for shipment to the laboratory, including cutting samples to proper length and width as described in the applicable ASTM test procedures. Samples shall be labeled for date, diameter, section of sewer, and delivered to the Engineer for testing. The cost of the sample postage, shipping, and testing will be paid for by the City. When tested, each sample shall meet the physical properties for flexural modulus and flexural strength used in the design calculations.

Air testing on isolated sections of sewer (minimum of 2 to 3 feet in length) shall be required if post-rehabilitation inspection indicates leaks in the liner. Air testing shall be performed on longer sections or multiple sections of sewer as required to identify the location(s) and full extent of defects. Such testing shall be performed by the Contractor at no additional expense to the project.

CIPP wall thickness shall be verified in accordance with Section 8.6 of ASTM F1216 and using test methods consistent with Section 8.1.2 of ASTM D5813.

The Engineer will have all flexural and delamination testing performed by an independent, ASTM-certified testing laboratory. The testing laboratory shall submit all test results directly back to the Engineer within 14 calendar days. The Engineer will provide a written copy of the test results to the Contractor within 3 business days of receiving them from the laboratory. The Contractor may elect to restore flow in the mainline sanitary sewer during this period of time. However, if the test results indicate that the liner fails to meet the project requirements and that remedial work is required to be performed, the Contractor shall perform any required cleaning in order to allow the remedial work to be performed at no additional cost to the project.

Should the test results indicate that the liner fails to meet the required physical properties as specified herein, the work shall be rejected. The Contractor shall have up to 10 calendar days to propose a repair/replacement plan consistent with the requirements of Section d.15 of this Detailed Specification for the Engineer's review and acceptance.

While repair/replacement work is performed, the Contractor shall continue to be responsible for maintaining flows in the mainline and lateral sanitary sewers in accordance with the requirements of the Detailed Specification "Sewer Flow Control." The unit price for the item of work "Sewer Flow Control" shall not be adjusted for any increase in contract time or required work due to the repair or replacement of defective materials or faulty workmanship.

The Contractor shall remove and replace or repair any defects in the installed liner to the satisfaction of the Engineer at no additional cost to the project. Contract time will continue during the period of time from the receipt of failing test results to the completion of the repairs.

Clean-Up.- Upon completion of the installation work and after required testing indicates the linings are acceptable, the Contractor shall restore the project area affected by their operation in accordance with Detailed Specification "Project Clean-Up and Restoration, Special."

Traffic Control.- During the entire rehabilitation process, the Contractor shall provide all necessary barricades, signs, traffic regulators (flaggers), minor traffic devices, etc., to maintain both vehicular and pedestrian traffic in accordance with the Michigan Manual of Uniform Traffic Control Devices, as shown on the Drawings, and in accordance with Detailed Specification "Maintenance of Traffic."

Warranty.- The materials used for the project shall be certified by the manufacturer for the specified purpose. The Contractor shall warrant the liner material and installation for a period of 2 years. During the Contractor warranty period, any defect which may materially affect the integrity, strength, function, and/or operation of the pipe, shall be repaired at the Contractor's expense in accordance with procedures described in this Detailed Specification, Section d.15, "Liner Repair/Replacement," and as recommended by the manufacturer.

The Contractor shall conduct warranty CCTV inspection of sewers which were lined. This work shall be completed at the Contractor's expense, no sooner than 2 months prior to the expiration of the original warranty period. The televising shall be performed in the presence of the Engineer. Television inspection that is not performed within the presence of the Engineer will not be accepted and shall be performed again at the Contractor's sole expense. Any areas that do not meet the requirements of this Detailed Specification will be repaired or re-lined at no additional cost to the City.

Liner Repair/Replacement.- The Contractor shall submit their Liner Repair/Replacement Plan and all design calculations to the Engineer for review and acceptance. The plan shall include:

A. The Contractor shall outline specific repair or replacement procedures for potential defects that may occur in the installed liner, in accordance with recommendations by the liner system manufacturer.

B. The manufacturer shall provide a detailed step by step repair procedure, resulting in a finished product meeting the estimated life cycle of the component and requirements of these Detailed Specifications. For the purposes of this project, the life-cycle of this rehabilitation shall be considered to be 50 years.

C. Should a potential issue be un-repairable, in the opinion of the Engineer, the Contractor, together with the manufacturer, shall define the best recommended procedure for the total removal and replacement of the system.

D. The Contractor shall receive no additional compensation for the repair or replacement of systems deemed non-conforming to the requirements of these Contract Documents and unacceptable by the City.

MEASUREMENT AND PAYMENT

The completed work as measured for this item of work will be paid for at the contract unit price for the following contract item:

Pay Item	Pay Unit
CIPP Line 36-inch Dia. Sanitary Sewer	Lineal Foot
Preline 36-inch Dia. Sanitary Sewer	Lineal Foot
CIPP Line 42-inch Dia. Sanitary Sewer	Lineal Foot
Preline 42-inch Dia. Sanitary Sewer	Lineal Foot

Rehabilitation of sanitary sewer will be paid for at the contract unit price per lineal foot. The contract unit price paid shall be payment in full for all labor, material, and equipment required for rehabilitation of existing sanitary sewers by insertion of a CIPP liner and shall include, but is not limited to; furnishing, transporting, preparing, and installing the structural pipe liner and CIPP end seals; furnishing and installing remote temperature sensing devices used during the liner curing process; reconnecting existing sewers or leads; performing any needed liner repairs; gaining access to work site; removal and replacement of site improvements; post-lining sewer televising; all required warranty work; and all other work and items necessary to complete the work as detailed within this Detailed Specification.

DETAILED SPECIFICATION
FOR
ITEM #234 – INLET FILTER, SPECIAL

1 of 1

DESCRIPTION

This work shall consist of properly installing curb and gutter inlet filters, at locations indicated on the plans, and as directed by the Engineer, maintaining during the entire construction period, and removing at the end of construction. The curb and gutter inlet filters shall be constructed in accordance with the detailed plans.

MEASUREMENT AND PAYMENT

The unit price for this item of work shall include all labor, material, and equipment costs to perform all the work specified in the Standard Specifications, the project plans and as modified by this Detailed Specification.

Curb and gutter inlet filters will be paid for by the unit "Each". A filter will be paid for when initially installed at a particular structure. Payment will be for installing, maintaining, reinstalling, and, removing the filter at the end of construction and as directed by the Engineer.

PAY ITEM	PAY UNIT
Inlet Filter, Special	Each

DETAILED SPECIFICATION
FOR
ITEM # 235 – INTERNAL CHIMNEY SEAL

1 of 2

DESCRIPTION

This specification includes the materials and procedures required for the internal sealing of the frame-chimney joint area of brick, block and precast manholes, as required in the contract documents.

A plural component, urethane internal manhole frame-chimney sealant, as specified herein shall be applied in all assigned manholes within the areas included in this project. If excavation is required to repair, rebuild, or replace a manhole; or if manhole linings or coatings are required, the sealant shall be applied after that work has been completed.

Design Requirements – The manhole frame-chimney sealant shall be designed to prevent leakage of water through the above-described portions of the manhole throughout its design life.
The manhole frame-chimney sealant shall remain flexible and bonded to the inside surfaces of the manhole frame and masonry throughout its design life.

MATERIALS

Manhole frame-chimney sealant consisting Cretex Easy Seal SG or engineer approved equal of a plural component, spray applied, quick setting urethane material conforming to the following requirements:

Viscosity

a. Part A, 12,000-17,000 cps @ 25C, 20 RPM per ASTM D2393
b. Part B, 300-510 cps @ 25C, 300 RPM per ASTM D4287

Weight

a. Weight/Gallon Part A, 8.90-9.20 lb/gal per ASTM D1875
b. Weight/Gallon Part B, 9.60-9.75 lb/gal per ASTM D1875
c. Weight/Gallon Mixed, 9.25-9.48 lb/gal per ASTM D1875

Processing

a. Mix Ratio By Weight, 100:107
b. Mix Ratio by Volume, 100:100
c. Cure Schedule, Hours, 4-5 hours @ 25C

Gel Time

Gel Time, Seconds, 0-15 seconds @ 25C, 100 grams per ASTM D3056

Cured Properties

a. Hardness, Shore A, 95-100 per ASTM D2240
b. Elongation, 379-473% per ASTM D638 or ASTM D412
c. Tensile Strength, 2616-3216 psi per ASTM D638 or ASTM D412
d. Peel Strength, 30.8-46.8 PLI (AL to AL) PER ASTM D1876

CONSTRUCTION METHOD

All concrete and masonry surfaces must be clean. Grease, organic matter, roots must be completely removed.

DETAILED SPECIFICATION
FOR
ITEM # 235 – INTERNAL CHIMNEY SEAL

2 of 2

The CONTRACTOR shall have the manufacturer's recommended plural cartridge dispensing tool and all other equipment/tools necessary to prepare the surfaces of the manhole and apply the manhole frame-chimney sealant.

All loose and protruding mortar and brick that would prevent proper application of the Seal, shall be removed and the appropriate areas of the manhole frame, chimney and or cone/corbel cleaned and prepared. All areas to be sealed shall be free of surface contaminates, be dry and free of any excessive voids or defects. If an adequate sealing surface does not exist on the masonry, repair materials such as Cementitious grout shall be used to fill voids and profile the chimney area of the manhole.

"CEMENTITIOUS GROUT Cementitious grout shall be a premixed, non metallic, high strength, non-shrink grout which meets the requirements of ASTM C-191 and C-827 as well as CRD-C-588 and C-621. When mixed to a mortar or "plastic" consistency, it shall have minimum one day and 28 day compressive strength of 6,000 and 9,000 psi, respectively."

All surface preparation shall be completed in strict accordance with the frame-chimney sealant manufacturer's published instructions.

The internal frame-chimney sealant shall be applied to cover 24 vertical inches inside of the entire circumference of the chimney at a minimum thickness of one hundred (100) mils.

MEASUREMENT AND PAYMENT

This item shall be paid at the unit price bid per manhole and shall include the cost of furnishing and applying the frame-chimney sealant material along with the surface preparation work needed to facilitate proper application.

The completed work as measured for these items of work will be paid for at the Contract Unit Prices for the following Contract (Pay) Items:

PAY ITEM	PAY UNIT
Internal Chimney Seal	Ea.

The unit prices for these items of work shall include all labor, material, and equipment costs to perform all the work specified in the Standard Specifications and as modified by this Detailed Specificatio

DETAILED SPECIFICATION
FOR
ITEM # 236 – RECONSTRUCT FLOW CHANNEL

1 of 2

DESCRIPTION

This work shall consist of reconstructing flow channel in accordance to what was described in Section 403 of the Michigan Department of Transportation 2012 Standard Specifications for Construction, and as specified herein.

MATERIALS

Manhole bases and flow channel shall be formed of QUIKRETE Fast Setting

Concrete Mix PRODUCT NO.1004-50 or Engineer approved equal. The use of PVC SDR-26 to establish and form the flow channel if and when applicable upon Engineer approval.

METHODS OF CONSTRUCTION

All concrete and masonry surfaces must be clean. Grease, organic matter, loose bricks, mortar, unsound concrete, roots and other materials must be completely removed.

Thoroughly clean existing flow channel and remove any accumulated sediment, debris, and broken or loose concrete. Properly dispose of all materials removed from the flow channel.

Where the process requires interruption of flow, the Contractor shall provide all necessary diversion or bypass pumping equipment to handle the flow for the duration of the flow channel rehabilitation, including curing times where applicable.

Form and place the concrete mix, meeting City of Ann Arbor Materials Standards, to create new flow channel up to the springline of the flow channel.
Install concrete flow channel up to springline of pipe with ¾" to 1" gap at pipe ends provided to maintain joint flexibility.

Changes in direction of the sewer and entering branch or branches shall be laid out in smooth curves of the longest possible radius which is targeted to the centerlines of adjoining pipelines. Regardless of differences in entrance and exit elevations, flow channels for all pipes are to be formed to present a smooth transition of flow and shall be subject to the approval of the ENGINEER.

Flow channels for sewer structures shall be finished in accordance with the city details. All flow channels shall be screeded and floated to a smooth, uniform surface and troweled to a hard surface finish. The flow channel and surface surrounding it, shall be reformed and finished to provide flow channels. All such work shall be done with the proper tools and by careful workmen competent to do such work.

All necessary adjustments required to accommodate encountered field conditions for reconstructed

flow channel including all necessary dewatering shall be included in the cost of the flow channel reconstruction and will not be paid for separately.

MEASUREMENT AND PAYMENT

The completed work as measured shall be paid at the contract unit price for the following contract items (pay items):

PAY ITEM	PAY UNIT
Reconstruct flow channel	Ea

Payment for this item of work shall include all labor, materials and equipment needed to accomplish the work, regardless of depth or type of structure.

DETAILED SPECIFICATION
FOR
ITEM #237 - MANHOLE CEMENTITIOUS LINER

1 of 3

DESCRIPTION

Sanitary sewer manhole cementitious liner with spray applied or centrifugally cast light-weight structural reinforced concrete.
The Cementitious Liner shall be applied on the manhole base, bench, walls, corbel/cone, and chimney of brick, block, or precast manholes.

INSTALLER EXPERIENCE AND QUALIFICATIONS

Contractor must demonstrate a minimum of 3-years of recent experience.

SUBMITTALS

Submit to the Owner for review and acceptance at least 14-days prior to starting manhole cementation for the following:

- Manufacturers' Certificate of Compliance certifying compliance with the applicable Specifications and Standards. The certifications shall list all materials furnished under this Section.
- Certified copies of factory tests required by the applicable Standards, the Manufacturer, and this Section.
- Manufacturer's handling, storage, and installation instructions and procedures.

MATERIALS

- The materials used shall be designed, manufactured, and intended for sewer manhole rehabilitation and the specific application in which they are used.
- The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages clearly labeled with the manufacturer's identification and printed instructions.
- All materials shall be stored and handled in accordance with recommendations of the manufacturer.
- All materials shall be mixed and applied in accordance with the manufacturer's written instructions.
- The material applied to the surface of the manhole shall be a cementitious blend
- of calcium aluminate cement and manufactured calcium aluminate aggregates
- for constructing a liner that is impervious to the flow of water, is resistant to
- sulfide attack, and restores structural integrity to existing manhole walls.
- A monolithic liner shall be formed which covers all interior manhole surfaces and
- shall have the following minimum requirements at 28-days:

- Compressive Strength (ASTM C-579B) 3,000-psi
- Tensile Strength (ASTM C-496) 300-psi
- Flexural Strength (ASTM C-293) (Modified) 600-psi
- Shrinkage (ASTM C-596) 0% at 90% R.H.
- Bond (ASTM C-321) 130-psi
-

PREPARATORY PROCEDURES

Contractor will perform preliminary cleaning of the structure with high-pressure water-blasting at a minimum of 4000psi and 4gpm to obtain the desired concrete surface profile (CSP) of 3 or greater. If the desired CSP is not achieved by high-pressure water-blasting other methods of obtaining the surface profile such as abrasive blasting and acid etching shall be used.

The Contractor shall remove all the existing manhole steps. The metal portion of all steps will be removed to within ½" of the manhole interior wall surface. The remaining protruding metal portion of the step shall be covered with a cementitious material to provide a smooth surface on and around the protrusion for the liner to bond.

All open joints, voids, holes, cracks, and missing bricks larger than 3 inches in diameter or equivalent shall be patched with a cementitious material to provide a smooth surface for the cementitious liner to bond.

All roots, loose, cracked or disintegrated material shall be removed from the area to be patched exposing a sound substrate. The cementitious patch material shall be allowed to cure according to the manufacturer's specifications before continuing with the cementitious Liner installation process.

Bench shall be sloped so that water will flow back into channel.

When the channel is required to be lined the Contractor shall plug the inlet pipe, inspect for infiltration leaks around the inlet and outlet pipes and in the channel. All leaks present shall be stopped by the use of chemical grout injection and/or by the use of fast-setting cement.

The final prepared surface shall have a concrete surface profile of 3 or greater and have a smooth uniform appearance.

FINISHED LINER

The finished Cementitious Liner shall be continuous over the entire length of the structure from the cover seat to the invert, including the channel. Liner shall be bonded to the structure, as required by design, and in such a way as to not allow any water to flow behind the liner and enter back into the waste stream.

The liner shall be visually inspect from inside the structure for any defects that may affect performance of the liner. All defects shall be fixed to conform with these specifications.

DETAILED SPECIFICATION
FOR
ITEM #237 - MANHOLE CEMENTITIOUS LINER

3 of 3

CLEANUP

Clean up the entire project area after the work is completed and all testing accepted. Remove and dispose of all excess material and debris not incorporated into the permanent installation.

MAINTENANCE

Any defects shall be repaired in accordance with the manufacturers' recommendations on an as needed basis.

WARRANTY

Manufacturer and Installer of the Liner system shall provide a 10 year warranty on materials and labor.

MEASUREMENT AND PAYMENT

Cementitious Liner shall be measured as units, complete in place. The completed work as measured shall be paid at the contract unit price for the following contract items (pay items):

PAY ITEM	PAY UNIT
Cementitious Liner	Vf

Payment for this item of work shall include all labor, materials and equipment needed to accomplish the work, regardless of depth or type of structure.

DETAILED SPECIFICATION
FOR
ITEM #238 – CLEAN-UP & RESTORATION, SPECIAL

1 of 2

DESCRIPTION

This item of work shall conform to Division IX, Section II, Item No. 891, Clean-Up & Restoration of the Public Services Area Standard Specifications, except as specified herein.

This work shall include the removal of all surplus materials from the site including; but not limited to; tools, dirt, rubbish, construction debris, and excess excavated material. This work shall also include the restoration of all existing lawn areas, road surfaces, culverts, drives, and sidewalks disturbed by the work. This work includes placing topsoil, fertilizer, seeding, and furnishing and installing mulch blankets on all disturbed areas as approved by the Engineer. Mulch blankets are required on all seeded areas.

MATERIALS

The materials shall meet the requirements specified in the MDOT 2012 Standard Specifications as designated, as specified herein, and as approved by the Engineer:

- Seed shall be THM seed mixture as described in Table 8 16-1.
- Fertilizers shall be a Class A. The percentages by weight shall be 12- 12- 12, or as approved by the Engineer.
- Water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances.
- Mulch blankets shall be High Velocity Straw Mulch Blankets as specified in MDOT section 917.

MAINTENANCE AND ACCEPTANCE

It is the responsibility of the Contractor to establish a dense lawn of permanent grasses, free from mounds and depressions prior to final acceptance and payment of this project. Any portion of a seeded area that fails to show a uniform germination shall be reseeded. Such reseeding shall be at the Contractor's expense and shall continue until a dense lawn is established. The Contractor is responsible for restoring all areas disturbed by his construction.

The Contractor shall maintain all lawn areas until they have been accepted by the Engineer. Lawn maintenance shall begin immediately after the grass seed is in place and continue until final acceptance with the following requirements:

Lawns shall be protected and maintained by watering, mowing, and reseeding as necessary, until the period of time when the final acceptance and payment is made by the Engineer for the project, to establish a uniform, weed-free, stand of the specified grasses. Maintenance includes furnishing and installing additional topsoil, and reseeding all as may be required to correct all settlement and erosion until the date of final acceptance.

DETAILED SPECIFICATION
FOR
ITEM #238 – CLEAN-UP & RESTORATION, SPECIAL

2 of 2

Damage to seeded areas resulting from erosion shall be repaired by the Contractor at the Contractor's expense. Scattered bare spots in seeded areas will not be allowed over three (3) percent of the area nor greater than 6"x 6" in size.

When the above requirements have been fulfilled, the Engineer will accept the lawn.

Cleanup and Restoration must be performed upon the completion of each sub-phase of work (as described in the Detailed Specification for Project Schedule), and not as one single operation at the completion of the entire project.

MEASUREMENT AND PAYMENT

Measurement and payment for this item of work shall conform to Division IX, Section 2, Item No. 891, Clean-Up & Restoration of the Public Services Area Standard Specifications except as modified herein.

The completed work for "Clean-Up & Restoration, Special" will be paid for on a lump sum (LS) basis. 80% of said lump sum shall be paid upon completion and approval of the site by the Engineer. By May 31st of the year following the completion of the project, the Engineer will inspect the seeded turf to ensure that the end product is well established; weed free, and in a growing and vibrant condition. If the Engineer determines that the restored areas meet the project requirements, the remaining 20% of the lump sum will be paid. If the Engineer determines that the restored areas do not meet the project requirements, the Contractor will continue with any and all measures necessary to meet the project requirements. All costs associated with the remedial measures shall be borne entirely by the Contractor.

Pay Item	Pay Unit
Clean-Up & Restoration, Special	Lump Sum

DETAILED SPECIFICATION
FOR
FINAL ACCEPTANCE

1 of 3

DESCRIPTION

The Contractor shall conform to the requirements of Sections 104.07 and 109.07 of the 2012 edition of the Michigan Department of Transportation (MDOT) Standard Specifications for Construction, "Contractor Obligations" and "Final Inspection, Acceptance, and Final Payment," respectively.

Partial Acceptance.- Upon completion of a portion of the work, the Contractor may request, in writing, partial acceptance of that portion of the work. Within 7 days of the Contractor's written request, the Engineer will conduct an inspection to determine if the Contractor has satisfactorily completed that portion of the work in accordance with the contract.

Within 7 days of the inspection, the Engineer will provide written notice of either partial acceptance for that portion of the work, or an explanation for rejecting the Contractor's request for partial acceptance. If the Engineer grants the partial acceptance, the Engineer will designate in writing what portion of the work is partially accepted and the effective date of the partial acceptance.

Should the Engineer consider that the portion of the work is not complete, the Engineer shall notify the Contractor in writing stating the reasons. The Contractor shall complete the work and send a second written notice to Engineer certifying the project, or designated portion of the project, is partially complete. The Engineer and City of Ann Arbor (City) will re-inspect the work.

Partial acceptance will relieve the Contractor of maintenance responsibility and third-party damage liability for the designated portion of the work. By relieving the Contractor of maintenance and third-party damage claims, the City does not relieve the Contractor of responsibility for defective work or damages caused by the Contractor's operations. The Contractor shall not construe partial acceptance to be final inspection, final acceptance of any part of the work, or waiver of any legal rights specified under Section 107 of the 2012 edition of the MDOT Standard Specifications for Construction.

Delayed Acceptance.- Upon completion of contract work items designated for delayed acceptance, the Contractor must notify the Engineer, in writing, of the completion of the designated work. Within 7 days of the Contractor's written request, the Engineer will conduct an inspection to determine if the Contractor has satisfactorily completed the designated portion of the work in accordance with the contract. Within 7 days of the inspection, the Engineer will notify the Contractor, in writing, of the date the delayed acceptance period begins.

Delayed acceptance will relieve the Contractor of maintenance responsibility and third-party damage liability for the designated portion of the work. By relieving the Contractor of maintenance and third-party damage claims, the City does not relieve the Contractor of responsibility for defective work or damages caused by the Contractor's operations. The Contractor shall not construe delayed acceptance to be final inspection, final acceptance of any part of the work, or waiver of any legal rights specified under Section 107 of the 2012 edition of the MDOT Standard Specifications for Construction.

Final Clean-Up.- Unless otherwise required in the Contract Documents, the cost of final clean-up is included in the contact unit price for the related items of work (contract pay items).

Before final acceptance, the Contractor must complete all of the following:

DETAILED SPECIFICATION
FOR
FINAL ACCEPTANCE

2 of 3

1. Remove the following from the project limits, unless otherwise required in the Contract Documents or directed by the Engineer:

   A. Unused and/or unneeded materials;

   B. Temporary aggregates;

   C. Temporary soil erosion and sedimentation control devices;

   D. Rubbish;

   E. Protective fencing;

   F. Temporary pipe and supports;

   G. Equipment;

   H. Temporary traffic control devices; and

   I. All other temporary construction items, equipment, and debris not specifically listed above.

2. Restore areas occupied during the project in accordance with Detailed Specification "Project Clean-Up and Restoration, Special," and as determined by the Engineer.

3. Replace or repair damaged features.

4. Provide the Engineer with written certification that all property that was used or damaged during performance of the work, including property outside of the project limits, has been restored in accordance with the Contract Documents, and applicable local, state, and federal requirements.

5. Provide written certification that the project has been inspected in compliance with the Contract Documents, the work has been completed in accordance with the Contract Documents, including applicable testing in the presence of the Engineer.

6. Clean paved areas, including public sidewalks directly adjacent to the site within 5 working days before opening the pavement surface to traffic taking precautions so as not to produce airborne dust when cleaning pavement.

7. Rake clean other surfaces of the grounds.

Final Inspection.- The Engineer will conduct the final inspection within 7 days of receiving the Contractor's written notification that the work has been completed. The Contractor must attend the final inspection.

DETAILED SPECIFICATION
FOR
FINAL ACCEPTANCE

3 of 3

Within 7 days of the final inspection, the Engineer will provide written notice to the Contractor of a satisfactory final inspection or will provide a list of specific defects to be remedied in order to achieve a satisfactory final inspection.

Should the Engineer consider the work not complete and ready for final payment, the Engineer shall notify the Contractor in writing, stating the reasons. The Contractor shall take immediate steps to remedy the stated deficiencies and send a second written notice to the Engineer certifying that the work is complete. The Engineer will re-inspect the work.

Should the Engineer be required to perform additional re-inspections because of failure of the work to comply with the original certifications of the Contractor, the Engineer will deduct the cost of the re-inspections from the final amount to be paid to the Contractor.

After achieving satisfactory final inspection, the Contractor is relieved of the duty of maintaining and protecting the project. In addition, the Contractor is relieved of their responsibility for third-party damage claims, and for damage to the work that may occur after satisfactory final inspection.

Final Acceptance.- Within 7 days of satisfactory final inspection and submission of all required project and materials testing documentation by the Contractor, the Engineer will give the Contractor written notification of final acceptance.

The Contractor, without prejudice to the terms of the contract, is liable to the City at any time, both before and after final acceptance, for latent defects, fraud, such gross mistakes as may amount to fraud, or actions affecting the City's rights under any warranty or guarantee.

Final Payment.- The Contractor shall submit a final Application for Payment in accordance with the requirements of the Contract Documents.

Within 30 calendar days after final acceptance, the Engineer will prepare a final estimate of work performed. The Contractor will have 30 calendar days from the issuance of the final estimate to file a claim or objections to the quantities within the final estimate. If no claim or objections are filed within 30 calendar days, the City will process the final estimate for approval and final payment. At that time, the Contractor will be furnished a copy of the approved final estimate.

The final payment will be made when the Contractor has provided the following:

A. All reports or documents required by the Engineer.

B. The Consent of Surety for payment of the final estimate.

C. Signed Contractor's Declaration (see Section 43 of the "General Conditions").

D. Satisfactory evidence by signed Contractor's Affidavit (see Section 44 of the "General Conditions") that all the indebtedness due to the contract has been fully paid or satisfactorily secured.

The City can recover all overpayments from the Contractor in the final estimate.

DETAILED SPECIFICATIONS
FOR
GENERAL CONSTRUCTION NOTES

The following notes pertain to all Plan sheets issued as part of this Contract, and these notes shall be considered part of each Plan sheet or Detailed Information Sheet.

1. All work shall conform to latest revision of the City Standard Specifications.

2. The Contractor shall maintain access to all drives throughout the course of construction. Drives shall never be closed during non-working hours, unless otherwise authorized in writing by the Engineer.

3. The Contractor shall completely restore all existing site features to better than, or equal to, their existing condition.

4. The Contractor shall be aware that there are above-ground and below-ground utilities existing in and on these streets which include, but are not limited to: gas mains and service leads; water mains and service leads; storm sewer mains and service leads; sanitary sewer mains and service leads; telephone poles, wires, cables and conduits; electrical poles, wires, cables and conduits; cable television wires, cables and conduits, and other various utilities. The Contractor shall conduct all of its work so as not to damage or alter in any way, any existing utility, except where specified on the Plans or where directed by the Engineer. The City has videotaped and cleaned all sanitary and storm sewers, including storm sewer inlet leads, and has found all of these facilities to be in good condition, with the exception of those shown on the Plans for repairs or replacement.

5. The Contractor is solely responsible for any delays, damages, costs and/or charges incurred due to and/or by reason of any utility, structure, feature and/or site condition, whether shown on the Plans or not, and the Contractor shall repair and/or replace, at its sole expense, to as good or better condition, any and all utilities, structures, features and/or site conditions which are impacted by reason of the work, or injured by its operations, or injured during the operations of its subcontractors or suppliers.

6. No extra payments or adjustments to unit prices will be made for damages, delays, costs and/or charges due to existing utilities, structures, features and/or site conditions not shown or being incorrectly shown or represented on the Plans.

DETAILED SPECIFICATION
FOR
DISPOSING OF EXCAVATED MATERIAL

The Contractor shall dispose of, at the Contractor's expense, all excavated material. Costs for this work will not be paid for separately, but shall be included in the bid price of the Contract Item "General Conditions."

DETAILED SPECIFICATION
FOR
PROTECTION OF UTILITIES

Damages to utilities by the Contractor's operations shall be repaired by the utility owner at the Contractor's expense.
Delays to the work due to utility repairs are the sole responsibility of the Contractor.

The Contractor shall keep construction debris out of utilities at all times. The Contractor shall be back charged an amount of $50.00 per day for each manhole/inlet/utility pipe that contains construction debris caused as a result of the Contractor's (including subcontractors and suppliers) work.

The Contractor is solely responsible for any damages to the utilities or abutting properties due to construction debris.

Certain sanitary and storm sewers within the influence of construction may have been cleaned and videotaped prior to construction. The City may also choose to videotape utility line(s) during or after the work of this Contract to inspect them for damages and/or construction debris. If such inspection shows damage and/or debris, then all costs of such inspection, cleaning, repairs, etc, shall be the Contractor's sole responsibility. If such inspection is negative, the City will be responsible for the costs of such inspection.

Costs for this work will not be paid for separately, but shall be included in the bid price of the Contract Item "General Conditions."

DETAILED SPECIFICATION
FOR
SOIL EROSION AND SEDIMENTATION CONTROL MEASURES

The Contractor shall furnish, place, maintain and remove soil erosion and sedimentation control measures, including but not limited to, fabric filters at all drainage structures, all in accordance with all applicable City (and other governmental agencies) codes and standards, as directed by the Engineer, as detailed in the Standard Specifications, and as shown on the Plans.

Costs for this work will not be paid for separately, but shall be included in the bid price of the Contract Item "General Conditions."

DETAILED SPECIFICATION
FOR
VACUUM TYPE STREET AND UTILITY STRUCTURE CLEANING EQUIPMENT

The Contractor shall furnish and operate throughout the construction period, vacuum type street cleaning and utility structure cleaning equipment (Vac-All, Vactor, etc.) approved by the Engineer, as and when directed by the Engineer for dust control, for dirt/debris control, and for street cleaning immediately prior to, and for street and utility structure cleaning after any and all paving. The cleaning equipment shall be of sufficient power to remove dust, dirt, and debris from the pavement and from utility structures in and adjacent to the construction area.

Costs for this work will not be paid for separately, but shall be included in the bid price of the Contract Item "General Conditions."

DETAILED SPECIFICATION
FOR
MATERIALS AND SUPPLIES CERTIFICATIONS

The following materials and supplies shall be certified by the manufacturer or supplier as having been tested for compliance with the Specifications:

HMA materials
Hot-poured Joint Sealants
Cements, coatings, admixtures and curing materials
Sands and Aggregates
Steel and Fabricated metal
Portland Cement Concrete Mixtures
Reinforcing Steel for Concrete
Reinforcing Fibers for Concrete
Pre-cast Concrete products
Sanitary Sewer Pipe
Storm Sewer Pipe
Water Main Pipe
Corrugated Metal Pipe
High Density Polyethylene Pipe
Timber for retaining walls
Modular Concrete Block for retaining walls
Edge Drain and Underdrain Pipe
Geotextile Filter Fabric and Stabilization Fabric/Grids

The Contractor shall submit all certifications to the Engineer for review and approval a minimum of three business days prior to any scheduled delivery, installation, and/or construction of same.

Costs for this work will not be paid for separately, but shall be included in the bid price of the Contract Item "General Conditions."

ATTACHMENTS

CITY OF ANN ARBOR
PREVAILING WAGE DECLARATION OF COMPLIANCE

The "wage and employment requirements" of Section 1:320 of Chapter 14 of Title I of the Ann Arbor City Code mandates that the city not enter any contract, understanding or other arrangement for a public improvement for or on behalf of the city unless the contract provides that all craftsmen, mechanics and laborers employed directly on the site in connection with said improvements, including said employees of subcontractors, shall receive the prevailing wage for the corresponding classes of craftsmen, mechanics and laborers, as determined by statistics for the Ann Arbor area compiled by the United States Department of Labor. Where the contract and the Ann Arbor City Code are silent as to definitions of terms required in determining contract compliance with regard to prevailing wages, the definitions provided in the Davis-Bacon Act as amended (40 U.S.C. 278-a to 276-a-7) for the terms shall be used. Further, to the extent that any employees of the contractor providing services under this contract are not part of the class of craftsmen, mechanics and laborers who receive a prevailing wage in conformance with section 1:320 of Chapter 14 of Title I of the Code of the City of Ann Arbor, employees shall be paid a prescribed minimum level of compensation (i.e. Living Wage) for the time those employees perform work on the contract in conformance with section 1:815 of Chapter 23 of Title I of the Code of the City of Ann Arbor.

At the request of the city, any contractor or subcontractor shall provide satisfactory proof of compliance with this provision.

The Contractor agrees:

(a) To pay each of its employees whose wage level is required to comply with federal, state or local prevailing wage law, for work covered or funded by this contract with the City,

(b) To require each subcontractor performing work covered or funded by this contract with the City to pay each of its employees the applicable prescribed wage level under the conditions stated in subsection (a) or (b) above.

(c) To provide to the City payroll records or other documentation within ten (10) business days from the receipt of a request by the City.

(d) To permit access to work sites to City representatives for the purposes of monitoring compliance, and investigating complaints or non-compliance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services in accordance with the terms of the wage and employment provisions of the Chapter 14 of the Ann Arbor City Code. The undersigned certifies that he/she has read and is familiar with the terms of Section 1:320 of Chapter 14 of the Ann Arbor City Code and by executing this Declaration of Compliance obligates his/her employer and any subcontractor employed by it to perform work on the contract to the wage and employment requirements stated herein. The undersigned further acknowledges and agrees that if it is found to be in violation of the wage and employment requirements of Section 1:320 of the Chapter 14 of the Ann Arbor City Code it shall has be deemed a material breach of the terms of the contract and grounds for termination of same by the City.

LANZO COMPANIES, INC.
Company Name

10/08/2020
Signature of Authorized Representative — Date

ROBERT BEATY III, ASSISTANT SECRETARY
Print Name and Title

28135 GROESBECK HIGHWAY, ROSEVILLE, MI 48066
Address, City, State, Zip

(586) 775-5819
Phone/Email address

Questions about this form? Contact Procurement Office City of Ann Arbor Phone: 734/794-6500

CITY OF ANN ARBOR
LIVING WAGE ORDINANCE DECLARATION OF COMPLIANCE

The Ann Arbor Living Wage Ordinance (Section 1:811-1:821 of Chapter 23 of Title I of the Code) requires that an employer who is (a) a contractor providing services to or for the City for a value greater than $10,000 for any twelve-month contract term, or (b) a recipient of federal, state, or local grant funding administered by the City for a value greater than $10,000, or (c) a recipient of financial assistance awarded by the City for a value greater than $10,000, shall pay its employees a prescribed minimum level of compensation (i.e., Living Wage) for the time those employees perform work on the contract or in connection with the grant or financial assistance. The Living Wage must be paid to these employees for the length of the contract/program.

Companies employing fewer than 5 persons and non-profits employing fewer than 10 persons are exempt from compliance with the Living Wage Ordinance. If this exemption applies to your company/non-profit agency please check here [___] *No. of employees*__

The Contractor or Grantee agrees:

(a) To pay each of its employees whose wage level is not required to comply with federal, state or local prevailing wage law, for work covered or funded by a contract with or grant from the City, no less than the Living Wage. The current Living Wage is defined as $13.91/hour for those employers that provide employee health care (as defined in the Ordinance at Section 1:815 Sec. 1 (a)), or no less than $15.51/hour for those employers that do not provide health care. The Contractor or Grantor understands that the Living Wage is adjusted and established annually on April 30 in accordance with the Ordinance and covered employers shall be required to pay the adjusted amount thereafter to be in compliance with Section 1:815(3).

Check the applicable box below which applies to your workforce

[___] Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage without health benefits

[X] Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage with health benefits

(b) To post a notice approved by the City regarding the applicability of the Living Wage Ordinance in every work place or other location in which employees or other persons contracting for employment are working.

(c) To provide to the City payroll records or other documentation within ten (10) business days from the receipt of a request by the City.

(d) To permit access to work sites to City representatives for the purposes of monitoring compliance, and investigating complaints or non-compliance.

(e) To take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee covered by the Living Wage Ordinance or any person contracted for employment and covered by the Living Wage Ordinance in order to pay the living wage required by the Living Wage Ordinance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services or agrees to accept financial assistance in accordance with the terms of the Living Wage Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Living Wage Ordinance, obligates the Employer/Grantee to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract or grant of financial assistance.

LANZO COMPANIES, INC.	28135 GROESBECK HIGHWAY,
Company Name	Street Address
10/08/2020	ROSEVILLE, MI 48066
Signature of Authorized Representative — Date	City, State, Zip
ROBERT BEATY III, ASSISTANT SECRETARY	(586) 775-5819 ; ESTIMATING@LANZO.ORG
Print Name and Title	Phone/Email address

CITY OF ANN ARBOR
LIVING WAGE ORDINANCE

RATE EFFECTIVE APRIL 30, 2020 - ENDING APRIL 29, 2021

$13.91 per hour
If the employer provides health care benefits*

$15.51 per hour
If the employer does **NOT** provide health care benefits*

Employers providing services to or for the City of Ann Arbor or recipients of grants or financial assistance from the City of Ann Arbor for a value of more than $10,000 in a twelve-month period of time must pay those employees performing work on a City of Ann Arbor contract or grant, the above living wage.

ENFORCEMENT

The City of Ann Arbor may recover back wages either administratively or through court action for the employees that have been underpaid in violation of the law. Persons denied payment of the living wage have the right to bring a civil action for damages in addition to any action taken by the City.

Violation of this Ordinance is punishable by fines of not more than $500/violation plus costs, with each day being considered a separate violation. Additionally, the City of Ann Arbor has the right to modify, terminate, cancel or suspend a contract in the event of a violation of the Ordinance.

* Health Care benefits include those paid for by the employer or making an employer contribution toward the purchase of health care. The employee contribution must not exceed $.50 an hour for an average work week; and the employer cost or contribution must equal no less than $1/hr for the average work week.

The Law Requires Employers to Display This Poster Where Employees Can Readily See It.

For Additional Information or to File a Complaint contact
Colin Spencer at 734/794-6500 or cspencer@a2gov.org

Revised 2/10/2020

Vendor Conflict of Interest Disclosure Form

All vendors interested in conducting business with the City of Ann Arbor must complete and return the Vendor Conflict of Interest Disclosure Form in order to be eligible to be awarded a contract. Please note that all vendors are subject to comply with the City of Ann Arbor's conflict of interest policies as stated within the certification section below.

If a vendor has a relationship with a City of Ann Arbor official or employee, an immediate family member of a City of Ann Arbor official or employee, the vendor shall disclose the information required below.

1. No City official or employee or City employee's immediate family member has an ownership interest in vendor's company or is deriving personal financial gain from this contract.
2. No retired or separated City official or employee who has been retired or separated from the City for less than one (1) year has an ownership interest in vendor's Company.
3. No City employee is contemporaneously employed or prospectively to be employed with the vendor.
4. Vendor hereby declares it has not and will not provide gifts or hospitality of any dollar value or any other gratuities to any City employee or elected official to obtain or maintain a contract.
5. Please note any exceptions below:

Conflict of Interest Disclosure*	
Name of City of Ann Arbor employees, elected officials or immediate family members with whom there may be a potential conflict of interest.	( ) Relationship to employee ( ) Interest in vendor's company ( ) Other (please describe in box below)

*Disclosing a potential conflict of interest does not disqualify vendors. In the event vendors do not disclose potential conflicts of interest and they are detected by the City, vendor will be exempt from doing business with the City.

I certify that this Conflict of Interest Disclosure has been examined by me and that its contents are true and correct to my knowledge and belief and I have the authority to so certify on behalf of the Vendor by my signature below:

LANZO COMPANIES, INC.		(586) 775-5819
Vendor Name		**Vendor Phone Number**
	10/08/2020	ROBERT BEATY III, ASST. SECRETARY
Signature of Vendor Authorized Representative	**Date**	**Printed Name of Vendor Authorized Representative**

Questions about this form? Contact Procurement Office City of Ann Arbor Phone: 734/794-6500, procurement@a2gov.org

CITY OF ANN ARBOR
DECLARATION OF COMPLIANCE

Non-Discrimination Ordinance

The "non discrimination by city contractors" provision of the City of Ann Arbor Non-Discrimination Ordinance (Ann Arbor City Code Chapter 112, Section 9:158) requires all contractors proposing to do business with the City to treat employees in a manner which provides equal employment opportunity and does not discriminate against any of their employees, any City employee working with them, or any applicant for employment on the basis of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight. It also requires that the contractors include a similar provision in all subcontracts that they execute for City work or programs.

In addition the City Non-Discrimination Ordinance requires that all contractors proposing to do business with the City of Ann Arbor must satisfy the contract compliance administrative policy adopted by the City Administrator. A copy of that policy may be obtained from the Purchasing Manager

The Contractor agrees:

(a) To comply with the terms of the City of Ann Arbor's Non-Discrimination Ordinance and contract compliance administrative policy, including but not limited to an acceptable affirmative action program if applicable.

(b) To post the City of Ann Arbor's Non-Discrimination Ordinance Notice in every work place or other location in which employees or other persons are contracted to provide services under a contract with the City.

(c) To provide documentation within the specified time frame in connection with any workforce verification, compliance review or complaint investigation.

(d) To permit access to employees and work sites to City representatives for the purposes of monitoring compliance, or investigating complaints of non-compliance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services in accordance with the terms of the Ann Arbor Non-Discrimination Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Non-Discrimination Ordinance, obligates the Contractor to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract.

LANZO COMPANIES, INC.
Company Name

10/08/2020
Signature of Authorized Representative — Date

ROBERT BEATY III, ASSISTANT SECRETARY
Print Name and Title

28135 GROESBECK HIGHWAY, ROSEVILLE, MI 48066
Address, City, State, Zip

(586) 775-5819; ESTIMATING@LANZO.ORG
Phone/Email Address

Questions about the Notice or the City Administrative Policy, Please contact:
Procurement Office of the City of Ann Arbor
(734) 794-6500

CITY OF ANN ARBOR NON-DISCRIMINATION ORDINANCE

Relevant provisions of Chapter 112, Nondiscrimination, of the Ann Arbor City Code are included below. You can review the entire ordinance at www.a2gov.org/humanrights.

Intent: It is the intent of the city that no individual be denied equal protection of the laws; nor shall any individual be denied the enjoyment of his or her civil or political rights or be discriminated against because of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight.

Discriminatory Employment Practices: No person shall discriminate in the hire, employment, compensation, work classifications, conditions or terms, promotion or demotion, or termination of employment of any individual. No person shall discriminate in limiting membership, conditions of membership or termination of membership in any labor union or apprenticeship program.

Discriminatory Effects: No person shall adopt, enforce or employ any policy or requirement which has the effect of creating unequal opportunities according to actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight for an individual to obtain housing, employment or public accommodation, except for a bona fide business necessity. Such a necessity does not arise due to a mere inconvenience or because of suspected objection to such a person by neighbors, customers or other persons.

Nondiscrimination by City Contractors: All contractors proposing to do business with the City of Ann Arbor shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the guidelines of this section. All city contractors shall ensure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity and tends to eliminate inequality based upon any classification protected by this chapter. All contractors shall agree not to discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of any applicable protected classification. All contractors shall be required to post a copy of Ann Arbor's Non-Discrimination Ordinance at all work locations where its employees provide services under a contract with the city.

Complaint Procedure: If any individual believes there has been a violation of this chapter, he/she may file a complaint with the City's Human Rights Commission. The complaint must be filed within 180 calendar days from the date of the individual's knowledge of the allegedly discriminatory action or 180 calendar days from the date when the individual should have known of the allegedly discriminatory action. A complaint that is not filed within this timeframe cannot be considered by the Human Rights Commission. To file a complaint, first complete the complaint form, which is available at www.a2gov.org/humanrights. Then submit it to the Human Rights Commission by e-mail (hrc@a2gov.org), by mail (Ann Arbor Human Rights Commission, PO Box 8647, Ann Arbor, MI 48107), or in person (City Clerk's Office). For further information, please call the commission at 734-794-6141 or e-mail the commission at hrc@a2gov.org.

Private Actions For Damages or Injunctive Relief: To the extent allowed by law, an individual who is the victim of discriminatory action in violation of this chapter may bring a civil action for appropriate injunctive relief or damages or both against the person(s) who acted in violation of this chapter.

THIS IS AN OFFICIAL GOVERNMENT NOTICE AND
MUST BE DISPLAYED WHERE EMPLOYEES CAN READILY SEE IT.

Michigan Department
Of Transportation
CP-347 (04/10)

MICHIGAN DEPARTMENT OF TRANSPORTATION

CERTIFIED PAYROLL

COMPLETION OF CERTIFIED PAYROLL FORM FULFILLS THE MINIMUM MDOT PREVAILING WAGE REQUIREMENTS

(1) NAME OF CONTRACTOR / SUBCONTRACTOR (CIRCLE ONE) (2) ADDRESS

(3) PAYROLL NO. (4) FOR WEEK ENDING (5) PROJECT AND LOCATION (6) CONTRACT ID

(a) EMPLOYEE INFORMATION	(b) WORK CLASSIFICATION	(c) Hour Type	(d) DAY AND DATE — HOURS WORKED ON PROJECT	(e) TOTAL HOURS ON PROJECT	(f) PROJECT RATE OF PAY	(g) PROJECT RATE OF FRINGE PAY	(h) GROSS PROJECT EARNED / GROSS WEEKLY EARNED	(i) TOTAL WEEKLY HOURS WORKED ALL JOBS	(j) DEDUCTIONS: FICA	FEDERAL	STATE		OTHER	TOTAL DEDUCT	(k) TOTAL WEEKLY WAGES PAID FOR ALL JOBS
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											
NAME:				0			$0.00							$0.00	$0.00
ETH/GEN: ID #:	GROUP/CLASS #:	S		0											

Date _____

I, _____ _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
(Contractor or Subcontractor)

_____; that during the payroll period commencing on the
(Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,

all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Start. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

_____

_____

_____

_____

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

☐ – in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

☐ – Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.