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Cross Bore Best Practices Quick Reference Guide

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Foreward

This quick reference provides the companion to the Cross Bore Best Practices Guide (Guide) which was the result of the identification of a need for a single source of information that could be used by natural gas distribution system operators to investigate and remediate existing cross bores as well as prevent future cross bores. The need for a quick reference was identified as one of several techniques to ensure that the best practices to investigate and remediate existing cross bores and to avoid future cross bores could be made available to the widest audience possible. The information presented in the Guide was obtained from the 23 Local Distribution Companies (LDCs) representing 80% of the 75 million natural gas customers in the United States and Canada, installation contractors, remediation contractors, equipment providers, industry associations and industry literature.

The complete Guide can be obtained by following this link - http://www.otd-co.org/Documents/OTD_1_11_d_FinalReport_Nov2012_PublicVersion.pdf

Executive Summary

A cross bore could be any one of several types of utilities intersecting another utility, this set of best practices is focused on natural gas lines intersecting with a sewer or septic system as a result of the use of trenchless technology.

For simplicity, the terms sewer or sewer system are used to represent both the sanitary and storm sewer systems, as well as private septic systems. The Guide provides best practices, methodologies, technology recommendations, and procedures for identifying and detecting existing cross bores, clearing potential cross bores and preventing new cross bores.

The intersection of a sewer with a natural gas line has the potential to create a safety concern if the intersection results in a blockage of flow through the sewer system. Typical cleaning operations to clear a sewer blockage use a device that can pierce the natural gas line resulting in the rapid release of natural gas. This rapid release may result in the natural gas traveling back through the sewer system into the premise with the potential to create an unsafe situation.

The first recorded incident involving a cross bore occurred in Kenosha, Wisconsin on August 29, 1976 at a home that was not served by natural gas. The National Transportation Safety Board (NTSB) investigated the incident and issued the following set of recommendations in November of that year.

NTSB Recommendations

- Complete inspection of those locations along the construction route where gas mains and sewer laterals may be in proximity to one another and correct any deficiencies.
- Examine records to determine other locations where gas lines were installed near existing sewer facilities (including a review of sewer blockage complaints), then inspect these locations and take corrective action where necessary.
- Revise construction standards to require the underground facilities be located accurately before construction and to provide protection for these facilities near boring operations.
- Inform inspectors and supervisory personnel of the circumstances of this accident, train them to be alert for similar conditions, and advise them of preventive actions.

The NTSB's recommendations from 1976 capture the core of the best practices.

During the development of this Guide it was noted that the status of cross bore program development ranged from thorough and active with a full dedicated staff to those just getting underway to none at all. Consequently, the benefits will range from an opportunity to fine tune a program and improve the accuracy and efficiency of procedures to providing a foundation for the development of a new program. Out of the 23 companies interviewed, 83% had included or were planning to include cross bores in their Distribution Integrity Management Programs. In all cases, it is recommended that the inclusion of cross bores be included in the Distribution Integrity Management Program of every company that used or uses trenchless technology as an installation method.

To determine if regional issues played a role in the approach to cross bores, the 23 local distribution companies (LDCs) interviewed were divided into five regions – Mid-South (6), Mid-West (6), Northwest (3), Northeast (5) and Southwest (3). The majority of the differences in the approach used to assess the potential for a cross bore were obvious such as the likelihood of a full basement or the need to construct the sewer at a depth to be below the level of frost penetration in the north. Soil conditions, the influence of existing or proposed legislation, the use of the One-Call System or the Call Before You Clear programs, the use of bi-lingual outreach materials and other factors varied between companies sometimes within the same region. As regional differences were noted they are identified in the Guide.

The first section of the Guide provides best practices and general guidelines for LDCs on the cross bore topic.

The second section of the Guide provides best practices for addressing cross bore events that currently exist due to previous installations, referred to in the Guide as *legacy installations* or *legacy cross bores*. The approach used to conduct the investigations varied and in most instances was evolving. Of the companies interviewed, 39% have a legacy program in place, 17% are developing a legacy program, 13% do not have a legacy program but are exploring the option, and 30% do not have a legacy program. Several companies indicated that a "found" cross bore was the best indicator that there may be others in the immediate area.

To-date, only 17% of the companies indicated that they have made a process change that facilitates inspection or discovery of legacy cross bores. Among the process changes made, the best practices noted were the initiation of a collaborative effort with the sewer operators. If worked properly, advantages can accrue to the utility as well as the sewer operator. Other process changes included the creation of a separate department to maintain focus and awareness or an integrated team with staff from various departments all with a common goal, focus, and awareness.

The most cost effective approach to the investigative efforts for legacy cross bores uses a risk-based approach that progresses from an office review of records to a focused field investigation and remediation. The following table provides an overview of the approaches discussed during the interviews regarding legacy investigations.

Practice	Investigative Approach
Customer Type	Similar to public building inspections in a typical leak survey program. The type of customer can impact the magnitude of the potential outcome if an issue occurs.
Previous Claim Experience and/or Incident Reports	When a cross bore is reported it is probable that others may have occurred in the same area due to similar utility installation practices or field conditions.
Data Range	A determination of the date when trenchless technology was first used and/or the period when changes or improvements were made in the technique influenced the time period when a change in risk occurred.
Survey Completed Projects	Surveying completed trenchless technology projects on a random basis to identify patterns.
Service Path	Establishing the horizontal location of the sewer line and the crossing gas line through mapping and/or field locates to exclude the potential for the two facilities to intersect.
Risk-based with Attributes	Develop a list of attributes, which may be weighted, where each attribute would increase the probability of a cross bore occurrence. Risk attributes can be used in a matrix or added to prioritize investigations. The attributes would relate to the installation “environment” and would include but not be limited to: • Natural gas service depth • Sewer system depth • Service material type • Service installation type • Basement floor depth below surrounding grade • Building on slabs or with crawl spaces • Trailer parks • Sloped building lot • Water table elevation • Previous claims and/or incident reports in a specific locale

The development and deployment of a communications and educational outreach program was among the first steps taken by those companies interviewed that were addressing legacy installation with 70% having an outreach program and another 13% in the process of developing a program. Sewer tags were commonly used to alert plumbers or do-it-yourselfers of the potential issue along with websites, bill inserts, advertising, etc. to raise awareness within the general public. Of the 70% with an outreach program 56% have active training programs with plumbers and sewer cleanout companies.

Companies or their contractors commonly use a job site briefing at the beginning of each work day to ensure the crew is focused on safety and everyone is aligned on the tasks of investigating potential cross bores. A job site briefing for field investigations of existing installations is provided in Appendix C of the Guide.

The third section of the Guide is focused on preventing cross bores during new installations. Over 87% of the companies noted that they have taken actions to improve the trenchless technology approach being used, with over 50% indicating that those actions were taken since 2008. The most common method used to reduce risk of a cross bore during new installations was to expose the sewer at the potential point of intersection and observe the bore as it passes each intersection as well as when the reamer is pulled back. The next most common approach was the use of a camera inspection prior to and following the installation which may be done in combination with exposing the sewer at the potential point of intersection.

New technologies have the potential to assist in the prevention or discovery of a cross bore during new installation. Of those interviewed 70% of the companies indicated that they were not exploring new technologies with 17% indicating they were involved with technology development efforts at GTI.

As with the summary of methods to focus the field investigation of existing installations, a job site briefing is also provided in appendix C of the guide to ensure that the installation crew is focused on safety and the tasks required for new installations.

The Guide also provides contact information for organizations with additional information and a series of appendices that provide the full text of the NTSB summary of the first incident investigation in 1976, examples of a wide variety of communications and education materials, a summary of cross bore related legislation and regulations and a summary of technologies under evaluation for further development to detect if a transaction of a sewer line has taken place as part of a new installation.

Summary of Best Practices

The use of trenchless technology to install natural gas mains and services has been an industry practice since the 1970s. Any natural gas LDC using trenchless technology has the potential to have a cross bore event within their delivery system. Each LDC should:

- Comply with all regulatory guidelines within the state/provincial or local jurisdictions served.
- Evaluate whether the potential for a cross bore event exists within the natural gas delivery system and dedicate resources to complete the investigation of legacy installations and establish procedures, training, education and communications to prevent future events.
- Be able to answer – "Was any form of trenchless technology used to install mains or services?"
  - By the company?
  - By a contractor?
  - By a company acquired or part of a merger?
  - As a result of a propane system converted to natural gas?
- Do not assume that the lack of a natural gas service installation excludes the location from having a cross bore.
- Provide support from the highest level of the organization and dedicate the necessary resources to develop a program to evaluate the potential for cross bores throughout the delivery system and remediate what is found.
- Create a separate department to maintain focus and awareness or an integrated team with staff from various departments all with a common goal, focus and awareness.
- Use a coordinated and consistent methodology across the company to investigate and remediate existing cross bores and to prevent future cross bore events.
- Use a record keeping system to ensure all procedures, records, and techniques are fully auditable or third-party verifiable and is in compliance with federal and state/provincial requirements. The review of every potential cross bore should be documented with date/time stamps and signed by a representative of the company.
- Use a Geographic Information System (GIS) to collect and organize data, systematically manage the evaluation process, assess the risks and prioritize the approach for remediation.
- Use a risk based approach such as leak classification, high consequence area (HCA) criteria or one that recognizes physical attributes that increase the potential for a cross bore (ex. shallow sewer system, shallow basement, sloped lots, trailer park installations etc.) to prioritize the investigative efforts.
- Develop operating procedures and training programs specifically to investigate legacy cross bores and processes to prevent future cross bores.
- Coordinate information exchanges with One-Call Systems.
- Advocate for the inclusion of sewer location information in the One-Call System databases
- Develop processes and facility installation techniques to prevent future cross bore events.
- Include cross bores as a potential risk factor within the company DIMP.

Quick Guide

- Comply with all regulations
- Dedicate resources
- Do not assume a lack of a natural gas service precludes a location from having a cross bore
- Use a record keeping system that is fully auditable
- Use a GIS
- Use a risk based approach
- Include cross bores within the DIMP Plan
- Develop operating procedures and training programs specific to cross bores
- Coordinate information exchange with One-Call Systems

Legacy Cross Bore Guidelines

Investigative Techniques – Office

Starting the investigation of legacy cross bores in the office using a risk-based approach provides a cost effective means to focus subsequent field inspections. There are a number of techniques, described below, that can be used to gather the data required to perform a risk-based assessment of the probability of a cross bore.

- Determine the date when trenchless technology was first used for the installation of either mains or services, consider excluding installations prior to that date
- Review natural gas system installation records and as-built drawings to establish the time and date of the installation, installation method, names of the installers, depth of the installation, horizontal location relative to the structure and/or road center line as well as any notations or observations
- Do not assume the lack of a natural gas service installation excludes the location from having a cross bore. A cross bore could have occurred as a result of the natural gas main having pierced the sewer lateral, even though no natural gas service was installed
- Determine the date when the sewer system was installed compared to when the natural gas system was installed. In some locales the natural gas system pre-dates the installation of the sewer system. In these instances, the premise was being served by a septic system rather than a sewer system. Field verification would be required to determine if the previously used septic system was in the front of the premise and, if so, was it completely abandoned eliminating it as a pathway into the premise
- Interview the installers of both the natural gas and sewer systems, where available, for information to assist in focusing the investigation and corroborating the finding with other sources
  - Attempt to determine if there are any known areas where the sewer installation may have resulted in burial depths that would be shallow and in the range of typical natural gas lines
  - Conversely, attempt to determine if there are locations where the natural gas lines may have been installed in conditions where the burial depth would be deeper than normal
  - Determine if there were instances when a cross bore event was noted and repaired that may not have been recorded, as it was considered to be part of normal procedures at the time
- Review property taxation records and databases to determine the depth of the exit point of a sewer from a premise. In some locales, the government agency responsible for taxation maintains records to indicate whether the structure has a basement, a crawl space, or is on a slab. This information can be used to establish a relative depth of the exit point for the sewer from the structure. The depth of the exit point coupled with records indicating the depth of the junction point of the sewer lateral with the main could be used to assess the potential for a cross point with the natural gas system, assuming the sewer system is gravity based.
- In addition to the relative depth information that may be established by knowing the exit point of the sewer from the structure, a topographic review of the land surface between the structure and the sewer main might provide valuable information. Again, assuming a gravity based system, the relative depth of the service lateral can be estimated and compared to the installation depth of the natural gas system
  - Also consider the relative depth of the sewer lateral could be a regional issue of frost penetration. Sewer and water installation may be at a depth of 40+ inches/100+ centimeters or more to protect against freezing. Knowing the installation depth of the sewer system compared to the known depth of the natural gas system may allow the assessment of the potential for a conflict
- Review damage claim records for terms related to this topic – sewer, septic, sewer main, sewer lateral, sewage, blocked sewer, etc. Note any trends such as claims being more prevalent during a certain time period or in a particular geographic area or when using a specific contractor or installation technique

- Review county health department records as a potential source for sewer/septic system records
- Review road construction records, some locales record the location of facilities, including sewer systems, during a road project
- Review construction records to determine if the current structure, with the accompanying sewer system, is the original structure or if a previous structure had been occupied. It is possible to have more than one lateral on a parcel, with one being from a previous structure and it is no longer used. It is also possible the branched system may exist due to more than one structure being connected to the sewer system, prior to being connected to the main
- Use a GIS to collect the data needed for the investigation resulting in the creation of a relational database available throughout the company. The GIS can be used to assign locations for field investigations, track results, report progress, and trend the findings allowing future work to be directed at higher probability locations
- Ensure available procedures, record keeping, and techniques are fully auditable or third-party verifiable and in compliance with federal and state/provincial requirements

Investigative Techniques – Field

Following the completion of the office investigation of the legacy installations further investigations are required by field personnel to complete the process of clearing the system of potential cross bores. Technologies and techniques that provide useful information during a field investigation include:

- A visual inspection of the area coupled with a working knowledge of typical construction techniques. Items that may assist in locating the sewer lateral as well as determining the relative depth and location include:
  - Sewer manholes
  - Exterior cleanouts
  - In those locales where the natural gas system pre-dates the installation of the sewer system, field verification is required to determine if a septic system is in the front of the premise and in the path of the natural gas installation or if a previously used septic system was completely abandoned eliminating it as a pathway into the premise. The first requirement is to determine if the septic system is still in use or if the premise has transitioned to the use of the sewer system. If the septic system is still in use, locate the septic system and the relative position of the septic lateral to the natural gas service. If the septic system is no longer in use, determine if the transition to the sewer system included a full abandonment of the septic system eliminating the septic system as a pathway for natural gas into the premise
  - Sewer construction materials – cast iron, plastic or non-metallic. If the sewer system was constructed using metal, it may be locatable with standard pipe locating equipment
  - Typical sewer installations may vary based on local geography or past usage. In most instances, unless the premise is constructed on a level lot with a full basement and the sewer exits through the floor, the sewer could be constructed at an elevation that could have been intersected by a natural gas installation and would need to be investigated
  - The proximity of the sewer line and blockage to the natural gas line can also be used for those instances where a field investigation is required due to a blocked sewer that may be the result of a cross bore
- One-Call System ticket mark-outs can be effective for locating potential cross point between the natural gas and sewer systems depending on the availability of records for the sewer system. The effectiveness of using the One-Call system varies by region. For those locales where the sewer

operator participates in the One-Call system, the mains are typically mapped. In others, the location of the junction of the lateral on the main may also be available. The mapping of the lateral from the main to the structure is typically not known; however, this is changing on a state-by-state basis with states such as Minnesota requiring that all new sewer installations be locatable.

- In addition to the techniques outlined above, a wide variety of tools and technologies are used for field investigations. Details on each of the tools listed below can be found in the Guide:
  - Ground Penetrating Radar (GPR)
  - Truck mounted camera systems (Figure 2) or cameras on a cart with a reel and viewing monitor, or hand-held cameras
  - A probe, either tethered or un-tethered
  - A sonde
  - Potholing (also referred to as hand exposed or day-lighting)

The preferred method for conducting field investigations involves the use of a truck mounted camera system when the effort is to clear the sewer main as well as multiple service laterals at the same time. When a single service location is to be investigated, potholing which may also include the use of a metal fish tape and locator is the preferred approach providing a lower cost approach with less scheduling required for crews and equipment, with positive visual evidence at the cross points. All data collected during field investigations shall be maintained for future reference and entered into a GIS system or a permanent storage system that provides tracking and trend analysis as required by DIMP.

Interviews with LDCs and service providers confirm that the majority of the legacy field investigations are being conducted by contractors. Reasons for using contractors are detailed in the Guide.

In some locales such as Maryland, the entire sewer system is owned by one company. However, in most locations, the mains are owned by the municipality and the laterals are owned by the individual property owner. All field investigations should be coordinated with the sewer owner. Among the best practices noted was the initiation of a collaborative effort with the sewer operators. If worked properly, advantages can accrue to the utility as well as the sewer operator.

New Installations Guidelines

There are many parallels between the guidelines for legacy and new trenchless gas installations. The technologies described in the section "Investigative Techniques – Field" found in the legacy portion of the guide are also valuable tools that can be used to locate underground facilities prior to performing new installations. If due diligence performed in locating the sewer facility is inconclusive and investigative techniques are not able to provide a sufficient level of confidence, or if regulatory requirements are prohibitive for the use of trenchless technology, then utilities may have to use conventional direct burial techniques such as open cutting or trenching.

A variety of trenchless construction methods can be used for gas piping installation depending on local soil conditions. This manual assumes the user is familiar with and has procedures for trenchless construction techniques. The procedures identified below are further detailed in the Guide under the new installations guidelines and in Appendix C of the Guide along with construction steps that should be taken related to the prevention of cross bores.

- Prior to any trenchless construction the local One-Call system should be contacted to have the area where the new installation is to occur marked for all existing utilities including all sewer facilities. In those locales where the One-Call system does not include sewer information the sewer operator should be contacted to provide or assist in providing the mark-out. In no case should an installation be conducted via a "blind bore".

- A trenchless construction tolerance/safety zone should be established.
- The location, depth, and clearance of facilities to be crossed should be determined at the point where the proposed installation path crosses the existing facility.
- Where the depth of a sewer lateral is measured or calculated a pre-installation camera inspection is recommended for all sewer laterals crossed. Any existing damage or irregular finding identified during the inspection documented and reported to the property owner. A post-installation camera inspection of the sewer is also recommended with focus on new or additional damage to the sewer facility. Any new or additional damage should be addressed immediately.
- One or more of the following methods are recommended for verifying and documenting the location of facilities, prior to drilling operations:
  - Measured – determining the depth or location of a facility using a nearby reliable source such as a valve box, vent, clean-out, manhole, etc.
  - Calculated – determining the depth or location of a facility using two or more references located on either side of the trenchless installation path
  - Verified Burial Depth – exposing (pot holing, day-lighting) the shallower of an existing facility or the proposed path of the drilling equipment 2 feet/0.5 meters beyond its depth
  - Camera
  - Horizontal Separation
  - Overhead – identifies overhead facilities not involved in trenchless construction
  - Does Not Exist – identifies the type of facility has been confirmed to not exist in the area of trenchless construction
- Audio listening equipment placed in the sewer main closest to the boring head or in a lateral's clean out has been used as a supplemental technique during all phases of trenchless technology installation as a technique to detect a potential cross bore. Listening devices are not considered acceptable by most utilities for use alone.
- When using trenchless technology parallel to existing underground facilities, potholes should be excavated along the bore path to ensure the bore is on track as planned, depending on clearance distance from the existing facility.

After the natural gas facilities have been installed using trenchless technologies, one or more of the following methods are recommended to be used for verifying and documenting potential cross bores:

- Exposing the sewer at each potential intersection and observing the bore as it passes each point as well as the reamer as it is pulled back through the bore. This technique can be used alone or in combination with a camera inspection
- Pre and Post Camera Inspection/Comparison – utilizing a camera to identify the condition of the sewer prior to trenchless construction (pre inspection) and to confirm the sewer has not been damaged during trenchless construction (post inspection)
- Cameras equipped with sondes can also be used to determine the location of a sewer for visual verification (potholing) during trenchless construction.
- In some soil conditions the use of a camera drawn back through the bore prior to the installation of the natural gas line provides verification that no damage occurred during trenchless construction

Communications and Education

A wide variety of audiences will be part of a cross bore program and may vary depending on whether the activity is focused on the investigation and remediation of legacy cross bores or the installation of new infrastructure. These audiences will be comprised of personnel within the company, external contractors, government employees, and the public. Company personnel will range from those having regular contact with customers to field personnel to engineering. The external contacts will include, but may not be limited to, the customer or premise owner, plumbers, rental equipment business owners, the media, governmental agencies, and may include incident first responders. Examples of training material graphics and public relations items such as a set of responses to frequently asked questions, brochures, and press releases are included in Appendix C of the Guide which is made up of 8 sub-sections for each of the various items used for communications and education. The Guide includes communications and educational techniques for each potential audience listed below.

Internal	External

• Customer Service/Call Center Representative
• Dispatch Operator
• Engineering
  – Construction Specifications/Guidelines
  – Construction Personnel
• Gas First Responders and Field Operations
• General Utility Personnel
	• Customers and Premise Owners
	  – Bill Inserts
	  – Direct Mailings
	  – Door Hangers
	• Outgoing Calls and Other Forms of Customer Communication
	• Equipment Rental Business Owners
	• First Responders (external)
	• Media
	• Municipal Government and Sewer/Septic System Owners/Operators
	• One Call System
	• Other Utilities
	• Plumbers
	  – Sewer Tags
	• Regulatory Agencies

Organizations

The following provides contact information for organizations that have information related to cross bores. This listing is not meant to be comprehensive but rather complimentary to this Guide and to serve as a starting point to obtain additional information:

American Gas Association (AGA)
400 North Capital Street, NW
Washington, DC 20001
Website: www.aga.org
Phone: 202.824.7000

Call Before You Clear
Sponsored by Several Utilities
Website: www.callbeforeyouclear.com

Common Ground Alliance (CGA)
1421 Prince Street
Suite 410
Alexandria, VA 22314
Website: www.commongroundalliance.com
Phone: 703.836.1709

Cross Bore Safety Association (CBSA)
7424 Creekton Drive
Louisville, KY 40241
Email: info@crossboresafety.org
Website: www.crossboresafety.org
Phone: 812.719.4800

Distribution Contractors Association (DCA)
101 W. Renner Rd., Suite 460
Richardson, TX 75082-2024
Email: dca@dca-online.org
Website: www.dca-online.org
Phone: 972.680.0261

Gas Technology Institute (GTI)
1700 South Mount Prospect Road
Des Plaines, IL 60018
Website: www.gastechnology.org/
Phone: 847.768.0500

Midwest ENERGY Association (MEA)
2119 Cliff Drive
Eagan, MN 55122
651-289-9600
Website: www.midwestenergy.org

National Underground Contractors Association (NUCA)
3925 Chain Bridge Road
Suite 300
Fairfax, VA 22030
Website: www.nuca.com
Phone: 703.358.9300

North American Society for Trenchless Technology (NASTT)
7445 Morgan Road
Liverpool, NY 13090
Website: www.nastt.org
Phone: 703.351.5252

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1700 S Mount Prospect Rd
Des Plaines, IL 60018
Website – OTD: info@OTD-co.org
Website – Cross Bore: http://www.otd-co.org/Pages/Cross-Bores---Best-Practice-and-Outreach-Program.aspx
Phone: 847-544-3400