Introduction to the Leading Practices for Cross Bore Risk Reduction

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The ***Leading Practices for Cross Bore Risk Reduction*** is available at www.crossboresafety.org.

1. ABSTRACT

The new *Leading Practices for Cross Bore Risk Reduction* was finalized in 2019 with recommendations from representatives of utility owners, pipeline installers, inspection service providers, regulators and manufacturers. The 90 page document's focus is of cross bores of gas distribution pipelines in sewers with recommendations transferable for all types of utilities with a desire to reduce damage from cross bores. The target stakeholder includes project managers for utilities, installers and inspection providers with added recommendations for improvement of regulatory rate support, revision of regulatory safety regulations and state Call Before You Dig legislation. The definition of a cross bore is defined as an intersection of an existing underground utility or underground structure by a second utility resulting in direct contact between the transactions of the utilities that compromises the integrity of either utility or underground structure

The document guides users on how to achieve high confidence verification results by integrating QAQC and identifying overall risk through modeling processes with geo-located data. Recommendations for new construction include inspections using cameras, daylighting and other verifiable methods, which allow separate quality control. Risk Prioritization models, often using AI, to bring focus on elimination of the highest risk first for more front-end risk elimination for legacy installation.

Figure 1: Graphic of sewer cleaning risk of a gas cross bore in sewer

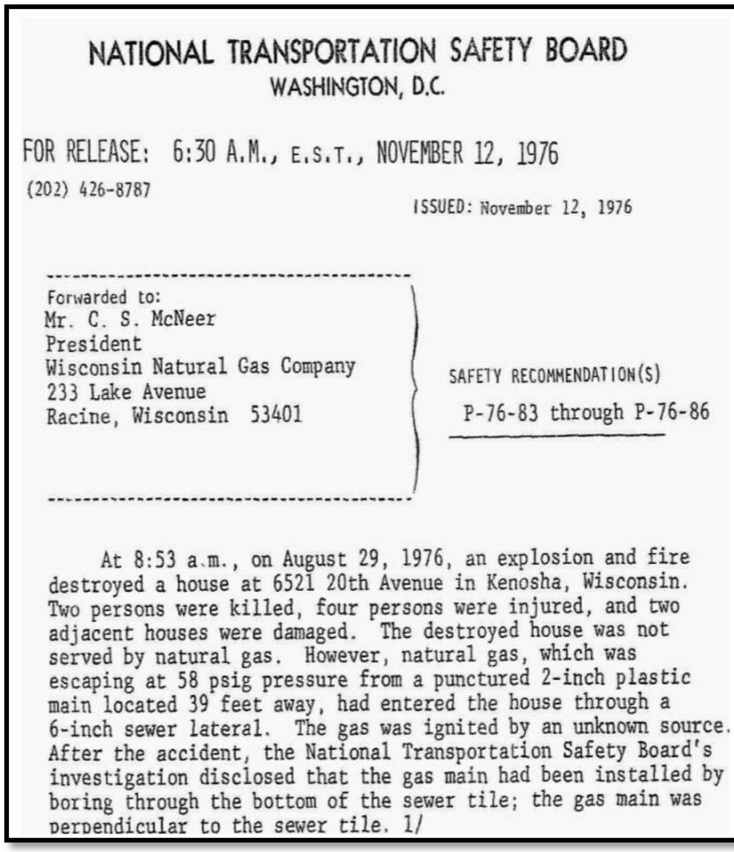
Risk modeling, risk prioritization, QAQC and the use of GIS data structures are included throughout the recommendations as the tools to achieve high confidence results. Recommendations for revised municipal ordinances, state regulators and sewer system operators combine with other efforts by all stakeholders. In short, the document includes details for operations as well as improvements for all stakeholders, flow charts, examples of project documentation and descriptive graphics. References included in the *Leading Practices for Cross Bore Risk*

Reduction are extensive and offer a path for further expanding the user’s knowledge base of cross bores risk reduction.

2. INTRODUCTION

Cross bores have been recognized as a high-level risk to utilities system integrity. This risk was recognized in 1976, when the U.S. Department of Transportation investigation[2] concluded that a death and four injuries were attributed to an intersection of gas distribution line and a sanitary sewer.

In a 1999 ruling the Kentucky Public Service Commission received a complaint that directional drilling used during gas line installations intersected three of the fifty-six potential sanitary sewer lateral intersections. The Commission ruled visual inspections were required of the gas utility “to determine if any damage to either facility has occurred”[5].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Mr. C. S. McNeer
President
Wisconsin Natural Gas Company
233 Lake Avenue
Racine, Wisconsin 53401

SAFETY RECOMMENDATION(S)
P-76-83 through P-76-86

At 8:53 a.m., on August 29, 1976, an explosion and fire destroyed a house at 6521 20th Avenue in Kenosha, Wisconsin. Two persons were killed, four persons were injured, and two adjacent houses were damaged. The destroyed house was not served by natural gas. However, natural gas, which was escaping at 58 psig pressure from a punctured 2-inch plastic main located 39 feet away, had entered the house through a 6-inch sewer lateral. The gas was ignited by an unknown source. After the accident, the National Transportation Safety Board's investigation disclosed that the gas main had been installed by boring through the bottom of the sewer tile; the gas main was perpendicular to the sewer tile. 1/

Figure 2: NTSB 1976 Report of injury and death resulting from cross bore

This ruling, as well as two explosions in the late 1990’s that were the result of cross bores, resulted in contractors and utilities starting to look for ways to minimize the risk of cross bores from past (legacy) and new installations.

Reported cross bore explosions, though infrequent, have been indicated (though formally constrained by non-disclosure settlements) to have costs of up to thirty million dollars per single incident. This document encourages the use of tools, processes and quality control methods to ensure high quality results. High confidence cross bore risk mitigation practices should be an expectation and can be achieved with thoughtful planning and verifiable leading practices.

3. DEFINING THE NEED, DEVELOPMENT AND REVIEW PROCESS FOR LEADING PRACTICES

The natural gas industry, led primarily by associations and regulatory individuals, have requested a guidance document to help minimize the creation of unplanned intersections of one utility with another, cross bore[1], and eliminate legacy cross bores that have been installed in past construction activities.

One of the most serious cross bore risks is the presence of natural gas distribution lines installed through sewer pipes. Several natural gas utilities system integrity evaluations have identified cross bores as the highest risk as determined by DIMP requirements from PHMSA regulations.

Figure 3a: Class 1 Cross bore of Gas in Sewer.

Awareness of the risk has gradually spread through most of the gas distribution industry, but effective ways to mitigate the risk are not standardized. New projects are being implemented without historical perspective and good sources of. This document is intended to share the leading practices for cross bore risk reduction practices.

Cross bore risk reduction began in the mid-late 1990's using improved process focus and then technologies based upon visual verification in the 2000's. Updated lateral launching and push camera systems are remain the primary tool of preference for most cross bore inspection projects. Thorough, deliberate construction practices also reduce the creation of new cross bores. As experience has been gained, better practices using more capable tools and processes have been developed. Many tools, techniques and processes are needed to successfully complete an effective risk mitigation program. More recently, sophisticated risk models coupled with prioritization modeling using artificial intelligence (AI) are proving effective for decreasing risk faster and with more efficiency.

Proven practices are providing utilities efficient high confidence results. Low confidence practices can leave a false sense of security and result in incorrect cross bore determinations. Industry leaders now recognized low confidence risk mitigation practices are no bargain, impede their reputation and allow risk to remain for the gas distribution industry. Inadequate confidence of the processes may require costly re-work.

Figure 4: Class 2 Cross Bore. New communications HDD intersects sewer lateral then gas distribution line

A well-founded cross bore risk mitigation effort benefits from using all the resources that are available to achieve the best results and highest confidence. To achieve high confidence, collection of data should be designed to allow robust quality control processes including GPS tracked locations of cameras traversing through sewers compared to the gas line locations, separate office review of inspection videos and office personnel determining the final status vs. relying on field determinations. Quality control elements should use appropriate statistical analysis to monitor processes to ensure high confidence metric results are achieved.

Figure 5: Results of Class 2 Cross Bore Explosion, Texas as shown in Fig. 4

A well planned program consists of many elements. Cost effective, strong public outreach efforts to inform and educate customers, utility workers and drain cleaners of cross bore risk should be included. Drain cleaner support and cross bore risk information to reduce impacts from drain cleaning cutting tool are important components of any cross bore mitigation program.

A risk reduction program should be used with local knowledge specific to the area to allow for variations of installation methods, geology and building practices. Stakeholders are cautioned to use existing information that can be fully trusted. Project plans and requirements should evolve as new data is gained and opportunities for improvement are identified.

A long-term implementation strategy for installation processes which eliminate new cross bore risk and for identifying and removing all legacy cross bores is appropriate. Cross bores have been created over a period of decades. Reasonable timelines focused on reducing the highest exposure should be allowed for planning, implementation and refinement to achieve a high confidence risk mitigation program result.

The participating individuals in the *Leading Practices for Cross Bore Risk Reduction* has been led by the Cross Bore Safety Association with primary development and review from contractors, manufacturers, regulators, pipeline inspection providers, utilities, consultants and industry associations.

Trenchless technology has resulted in the creation of essentially all cross bores. However, trenchless installation use has numerous social and economic advantages with benefits to the industry and, ultimately, the public. Some advantages follow:

- Less impact to sensitive surface areas such as wetlands and environmentally sensitive areas.
- Reduced social impact and other disruptions to the community
- Reduced road and landscape repairs and replacements
- Less disruption to traffic and potential replacement of pavement savings.

Trenchless installation practices also have the highest potential to create a cross bore. Trenchless installation methods used in either new construction or replacement projects include percussion pneumatic piercing tools (impact moles, missiles, gophers, hole hogs, bullets), boring, tunneling/microtunneling, pipe ramming, pipe jacking, pipe driving, horizontal directional drilling (HDD), boring/auger boring, plowing, and any other method for the installation of pipe with minimal disruption and minimal excavation of the ground surface. It is essentially everything other than open cut/open trench installation. These and similar tools and methods do not allow visual observation of the installation. It is of significant importance to protect the utilization of trenchless methods with corresponding verification and validation that cross bores do not remain behind after construction.

4. MAGNITUDE OF RISK

Gas distribution pipelines are generally more susceptible to catastrophic results from cross bores than other utilities. Smaller gas lines have relatively thin walls and are frequently made of plastic materials that are more easily damaged than larger pipelines that are thicker or made of steel.

Also, the smaller distribution gas lines are frequently located at structures where sewer laterals are prevalent and more likely to encounter drain cleaning activities.

Gas distribution pipelines are often identified as the highest utility risk category from cross bores. The ratio of gas lines intersecting lateral sewers as compared to intersecting mainline sewers is in the range of 4:1 in some systems and in others approach a 1:1 ratio (source CBSA). Intersections in mainline sanitary sewers are less frequent due to the depth of collection sewers and the frequent (but not always) relatively higher elevation of gas pipeline installation.

Storm drain sewers typically have catch basins at street level. Cross bores in storm sewers can be pierced with a drain cleaning tools, however, the gas can readily vent to the surface and is not as likely to reach an explosive concentration. Compared to sanitary sewer lateral cross bores, storm sewer lateral cross bores are generally lower risk. Storm and sanitary sewers which are combined should be assumed to be connected directly to the interior of structures, and have higher risk than storm only sewers.

Large transmission lines have greater wall thickness and are often made of steel or iron resulting in less likelihood of penetration from a drain cleaning tool. Transmission lines are not often identified as high risk for resulting catastrophic damage from cross bores and less likely to be associated with drain cleaner activity.

Common Ground Alliance's DIRT Report for 2016 identified natural gas as representing 46.2% of the total $1.5 billion excavation damage societal costs for all utilities (excludes injury, death and other non-direct costs). Total number of all types of excavation damages to all facilities in the CGA 2017 DIRT reporting is estimated at 439,000. The report includes Canada and the U.S. DIRT has come to recognize the importance of the potential problems associated with cross bores. Their newest reporting format now enables damage as a result of cross bores to be documented.

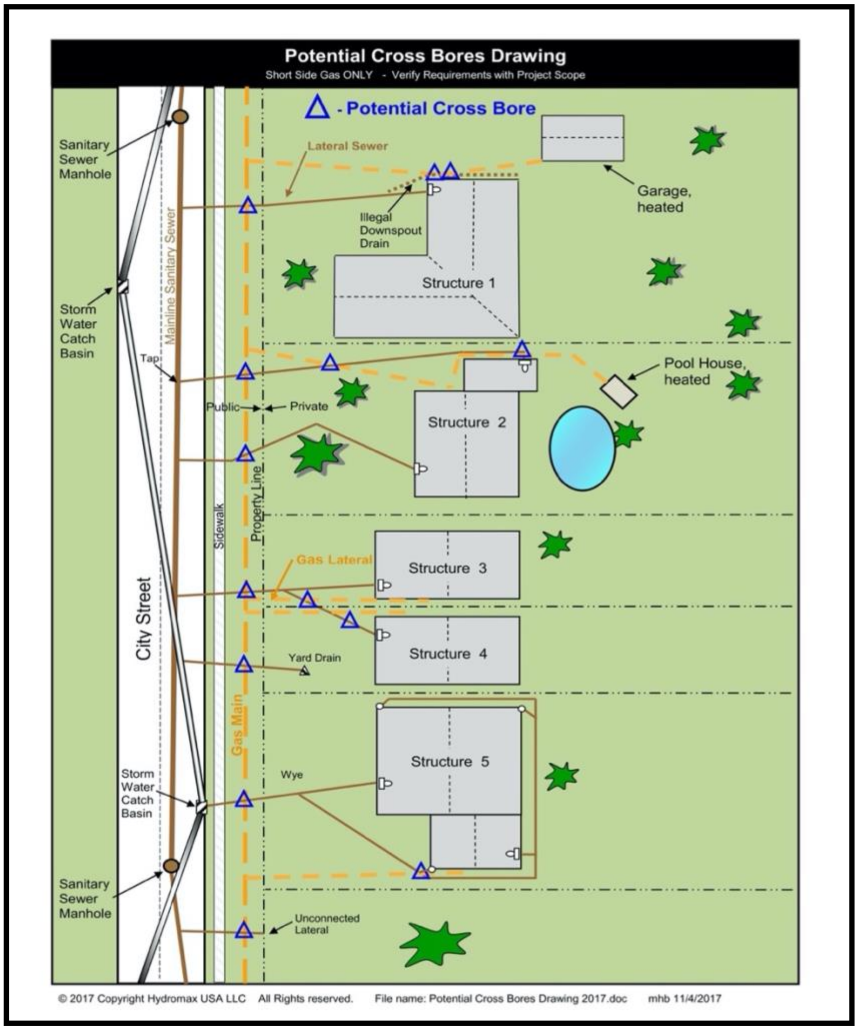

Figure 6: Potential cross bore intersections, shown as △, of gas and sanitary sewers. Storm sewer intersections NOT shown. Short side gas ONLY, laterals on same side of mainline.

Prior to specific records of past cross bore damage, information may be gleaned from damage repair records. Repair descriptions that included sewer components are useful in assessing if damage was from cross bores. This information can assist in determining the quantity of historical cross bores discovered, often by drain cleaners.

Nationally, existing and found cross bores of sewers by gas lines is estimated at approximately four tenths (0.4) per main mile. This estimate by CBSA is based upon numerous, but far from comprehensive, industry informal reports. There are approximately 1.3 million miles of natural gas mainlines. A large targeted large cross bore project had over 2.3 cross bores per mile, 430 per nearly 200 miles. The range of cross bores per mile is highly variable from system to system.

5. Current Practice Gaps

Opportunities for improvement are first generated by identifying the need. The following are some identified practice gaps that should be addressed.

- New and previously installed (legacy) gas lines, require validation to ensure trenchless installations are cross bore free. This is a central to reducing risk potentials from cross bores.
- Using vacuum excavation to daylight existing utilities is effective when the existing utility locations are known. However, when unknown, a vacuum excavate/daylight does not occur.
- The utility industry's current practices for minimizing the creation of new cross bores and eliminating impacts from existing cross bores lack standardization.
- Many of the processes that have been used lack effective quality control resulting in the inability to validate and verify. This results in the utility having a false sense of security.
- Plastic pipe installations may exceed the locatable life of the traceable conductors that are installed. This may lead to long term difficulty in locating utilities.
- New and replacement construction requires identification of all utilities in the installation zone following regulatory damage prevention procedures. However, storm and sanitary are typically not provided by the sewer operators nor sewer lateral owners. State regulators have typically not required the location of gravity mainline sewers nor sewer laterals, but should change regulations to require sewer location.
- Sewer drain cleaners are frequently unaware of cross bore risks. Additionally, they typically are not adequately trained and do not have written processes dealing with potential cross bores in sewers.
- Coordination of efforts with regulators, utility operators, contractors and the public needs to be maximized. Some examples include:
    - Local sewer regulations can require the inspection of sewers prior to final sale of a property;
    - Municipal sewer authorities can require the installation of exterior cleanouts next to the foundation of structures which will facilitate easy maintenance and inspection for cross bores.
    - To protect their facilities and provide support for safety to the public, sewer operators can elect to provide location of sewers or mapping even when regulations do not require locates.
    - Sewer operators may assist by locating private sewers or providing available lateral mapping when available.

Utility regulators are progressing to more fully support funding of legacy cross bore elimination programs. Inadequate recovery of costs or long delays can contribute to the slower elimination of cross bore risk.

6. Technical Recommendations to Meet Cross Bore Risk Reduction Goals

The technical recommendations provide a framework for high confidence cross bore risk reduction, verifiable processes, metrics for evaluation and opportunities to share information within organizations and throughout the industry. The expected results are increased safety, enhanced damage prevention, increased external and internal customer satisfaction and potentially better economic returns. Enterprise value of installers, inspection providers and utilities can be best protected.

The following list includes elements that should be considered for determining cross bore risk and development of a program to mitigate the risk.

Evaluate potential exposure, determine if systemic risk is evident. Include regulatory requirements for integrity and safety.

- Determine new and replacement construction risks

- Determine replacement construction risk
- Determine existing legacy risk from prior construction
- If risk is found, consider the elements recommended in the *Leading Practices*

Prioritization models are an extension of a risk model. Projects benefit from using the risk model together with custom prioritization factors. Prioritization factors include budget limitations and timing of the program budget.

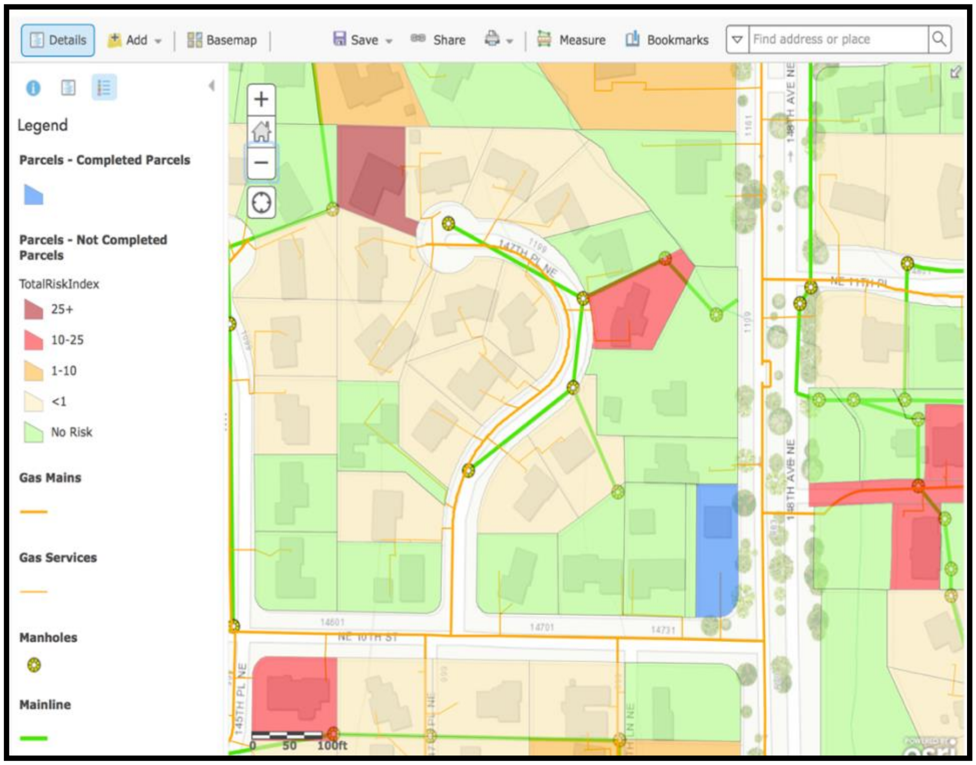

Figure 7: Risk modeling visualization based on parcel Boundaries and using color coding within GIS mapping

Adding factors for the material life of the existing utility, known obsolescence, for the planned capital improvement (replacement) budget or other types upgrades that affect the life of the existing utility will drive the prioritization results.

Shorter life would typically lower the risk.

Combining both legacy and new/replacement construction inspections is frequently more cost effective and results in greater risk reduction for a given amount of physical and financial resources. This is frequently found to be effective in sewer inspections for cross bores where a main sewer line is traversed for a single structure that has a new utility installed and the area has been modeled for legacy risk reductions.

Once the determination that legacy risk of cross bores needs to be addressed with an inspection program, cross bore programs typically will take several months to get organized. Initial steps may be to begin by inspecting highest risk structures such as schools, hospitals and nursing homes and adjacent parcels during the risk modeling and program startup phases. Radius of impact should be considered in risk evaluations with impact radius of two hundred feet (200 ft, 60 m).

Project startup, field work, quality control, re-work and billing are shown below in a simplified flow chart for legacy inspections in Figure 8.

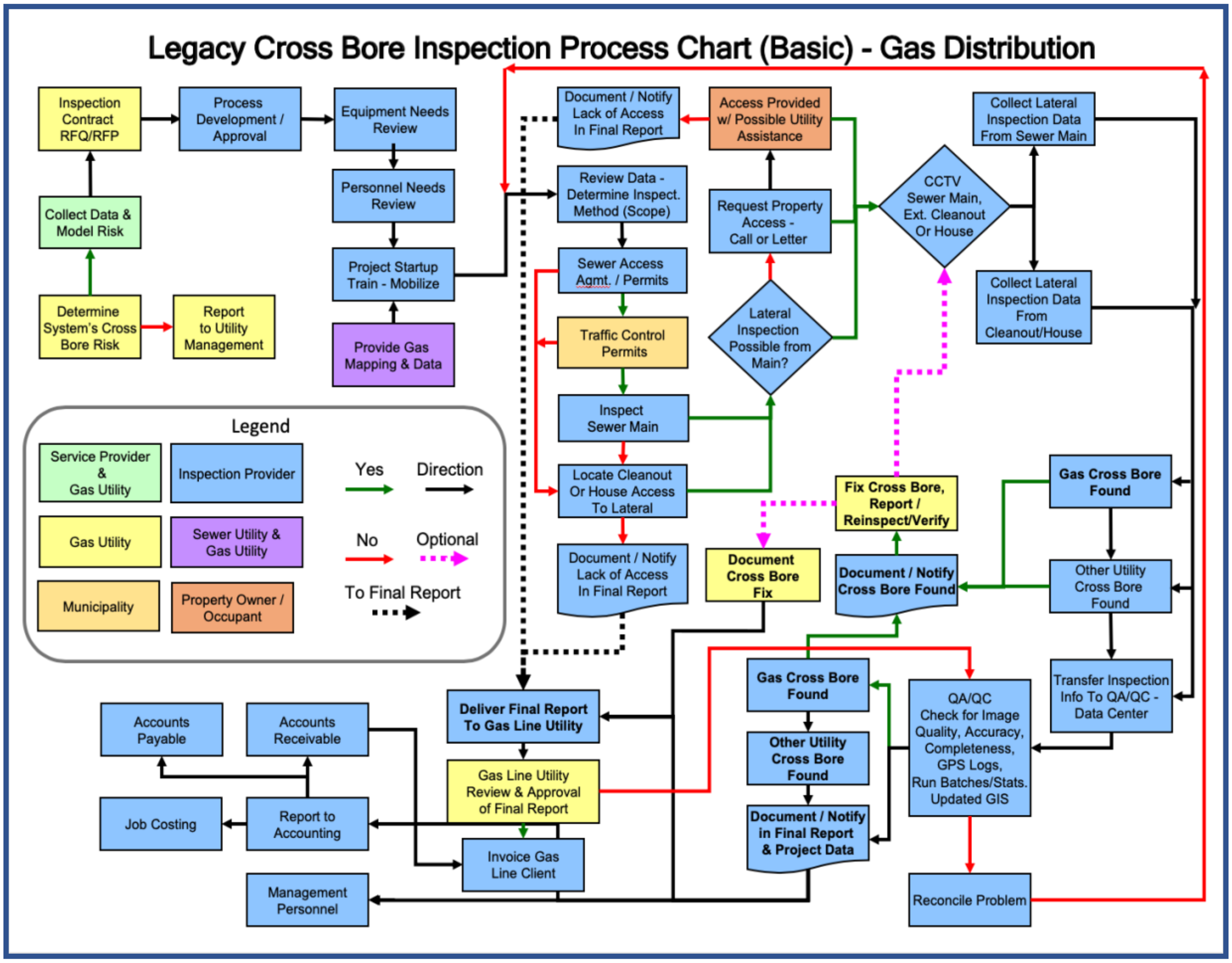

Figure 8: Basic Legacy Cross Bore Inspection Process Chart

7. NEW INSTALLATIONS AND REPLACEMENT CONSTRUCTION RISK REDUCTION

New construction and replacement projects should include verifiable, high confidence construction and inspection processes which eliminate the risk of creating new cross bores. Since replacement installations have a higher risk of creating a cross bore, this paper primarily addresses replacement installations. For new installations the same steps should be considered and then tailored to each specific new construction project since there are often situations when certain steps are applicable for replacement installations but not for new installations; for example, when it has been confirmed that there are no existing utilities in the area. Again, new construction and replacement installations are best addressed as two separate yet related processes in order to achieve maximum thoroughness and efficiency. Utility and installation contractors' liability will be reduced when the work includes high confidence inspection programs. Cross bore risk reduction methods should be integrated in the utility project requirements for construction.

Many regulations suggest exposing the existing known utility crossings during construction as a means of minimizing risk. Vacuum excavations are often used to expose crossings. However, since gravity sewers are not typically located per 811 requirements, pre-construction sewer locating and post-construction cross bore CCTV inspections have been used to mitigate cross bore risk to ensure they have not been created.

- The decision to televise sewers before or after construction or both should be made by the management team in coordination with the utility risk evaluation team.
- Pre-construction locates of gravity sewers can minimize risk since the contractor then knows where the existing sewer is, but this does not verify that the installer did not accidentally intersect the sewer. In some regards, if this is the only technique used, it can provide a false sense of success.
- Daylighting, with good verification processes, can confirm all crossing utilities do not intersect will eliminate risk if all utility locations are known in advance.
- Combining post construction inspections with a good notification system to inform occupants to call the utility until their property is cleared of risk has proven to be effective and efficient. Risk remains until the post construction inspection process using leading practices is complete.
- An advantage of post-construction inspections of sewer pipes is that inadvertently installed cross bores can be found. The results can be considered higher confidence, when good program processes are utilized.

The recommended leading practice is to include the use of both pre- and post-camera inspections. Post construction inspections definitively determine if cross bores have been created and subsequently removed, but lack the advantage of damage prevention. Costs and resource availability are appropriate to include in the decision on which methods to use. If only post construction is performed with the same amount of resource, it is possible to have greater risk reduction and at an earlier time.

Alternately, pre-construction CCTV inspections followed by vacuum excavation/daylighting, performed as recommended within *Leading Practices for Cross Bore Risk Reduction* with all processes to be verifiable and with 100% quality control, may be considered suitable to determine a cross bore has not been created. In such cases the following minimum requirements are recommended.

The vacuum excavation shall remain open until after the trenchless bore, reaming processes (if any) and the pull back of new utility at the crossing is installed. Photos or video shall be taken subsequently. The photo, video and location shall show separation of existing and the new utility meets installation requirements at the correct geo-referenced location and determine a cross bore nor damage has been created. The recommended accuracy of the GPS equipment is 12 inches (30 cm) or better, usually requiring a differentially corrected mobile or satellite signal.

If a property cannot be inspected from the mainline sewer, an attempt to push-camera the property should be made. If the owner is not present, a door hangar explaining the work and requesting a follow up call should be left in plain sight. Samples of these and other public outreach are available in the *Leading Practice for Cross Bore Risk Reduction*.

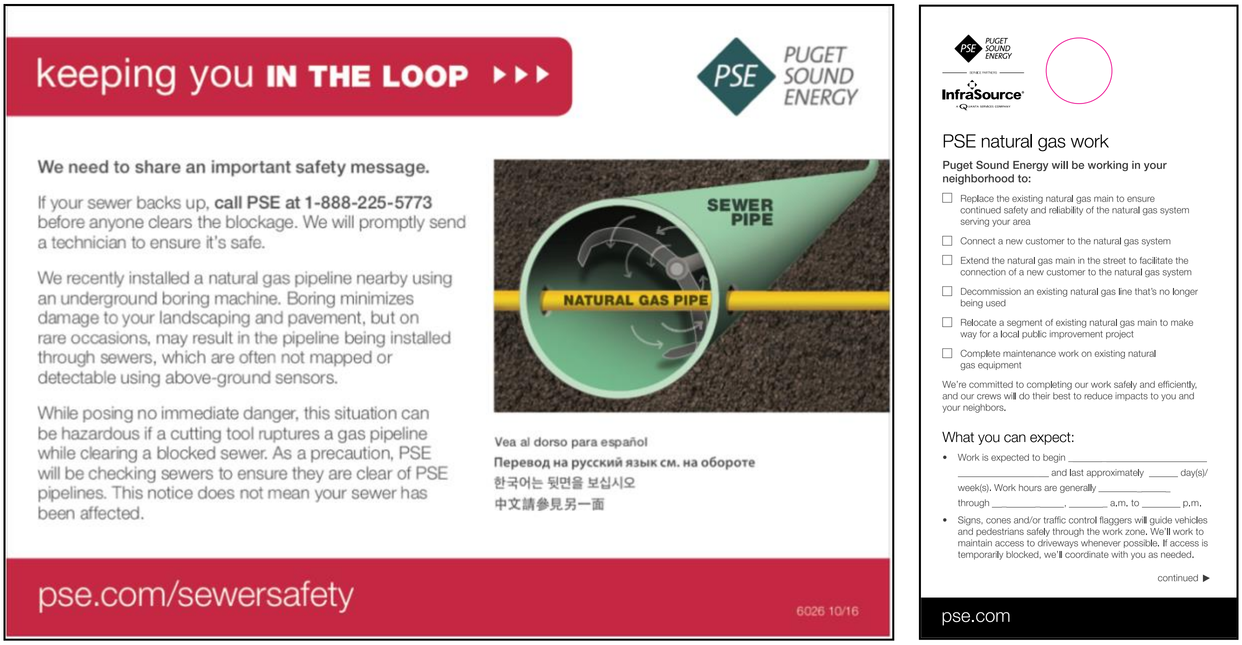

Figure 9: Notices (adhesive and door hanger type) for new construction and cross bore risk reduction

8. QUALITY CONTROL AND QUALITY ASSURANCE

The enterprise should be assured that the quality control processes increase system integrity and provide expected value. The project management team should specify work processes which can be validated and verified for quality assurance and quality control to provide high confidence determinations. Accurate work is required to determine the integrity of the system and provide assurance of risk mitigation. If the confidence is below an acceptable threshold, the value of the work may be of little value and require re-work.

The level of confidence should be appropriate for the expected, continually accelerating and higher future expectations from the public and regulators.

All technicians and data analysts should be made aware of the significance of inaccurate information to avoid catastrophic results which would discredit the value of performing cross bore mitigation.

Confidence levels are often described statistically. The confidence level goals should be designed to control work performed in less than ideal field conditions, widely dispersed work areas, with challenging access and in somewhat inhospitable conditions without sacrificing safety and quality.

For perspective, some process standards have goals between two sigma and six sigma levels. See Table 1.

Sigma Performance Levels – One to Six Sigma	
Sigma Level	**Defects Per Million Opportunities (DPMO)**
1	690,000
2	308,537
3	66,807
4	6,210
5	233
6	3.4

Table 1: Statistical Confidence, 1 Sigma to 6 Sigma

- It is recommended that project management include metrics for quality assurance to ensure high confidence results.
- A higher level approaching six-sigma may be considered more appropriate. For instance, 1,000,000 customers which may require 2,000,000 inspections at a five-sigma level would allow 466 defects/cross bores, which is clearly not acceptable.
- One project initially selected metrics for failure of one unreported cross bore, after risk mitigation actions were complete, per 10,000 inspections as appropriate. This was subsequently raised to a level where one unidentified cross bore would cause review of the program.
- Program management should define the performance level goals with approval from upper management.

Field data review is required for separate quality control processes. The elements to be considered for CCTV based inspections include the following:

- Compare the location of inspections to ensure that the work was performed at the correct locations, as directed.
    - Mainline CCTV robotic cameras, lateral launched cameras and manual push cameras have the ability to carry radio frequency transmitting sondes which can be located at the surface.
    - Sondes in inclined pipes (*see Figure 14*), distortion of electro-magnetic signals and other distortions may limit accuracy of locators to 5% of depth.
    - The most frequently used method to store data for visualizing mapping is with GIS based data systems.
- Review 100% of the sewer videos to ensure that the internal pipe circumference is fully visible to the extent required to determine if a cross bore exists and to identify for additional inspection of any branched connections at wyes or tees.
    - If the traverse of the sewer reaches the foundation and visual circumferential view is adequate (as described in the section above), that particular sewer segment can be determined risk-free with no cross bores observed.
    - If the inspection cannot be determined cross bore free without additional effort, a recommendation for the next process to be used should be made.
    - It is recommended that each parcel's gas line tracer wires be energized, located

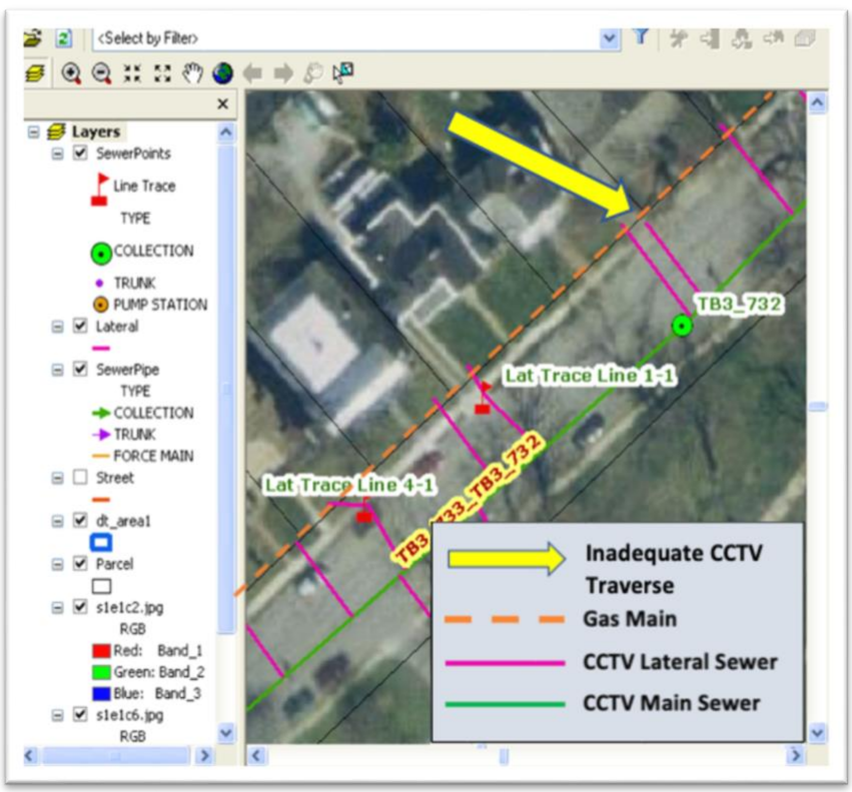

Figure 10: GIS mapping illustrates sewer inspection has not adequately traversed beyond the gas risk. Note the YELLOW arrow.

and mapped during the field inspection as required for mapping. This information is used in the field and in quality assurance.

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If the inspection is incomplete, the data analyst is assisted by knowing where the gas line is in comparison to the traverse of the sewer inspection, see Figure 10, which illustrates an inspection which was not beyond the gas line and the risk of a cross bore remains after an inspection. Re-work is required in such circumstances.

Confirm that the distance between gas lines to inspection limits of adequate visibility meets the defined requirement. A good starting limit of between 5 feet (1.5 m) and 10 ft (3 m) at the beginning of a project, subject to revision with verification of accuracy results.

Typically, the quality control data analyst will compare the traverse to risk of gas line proximity. If the portion of traverse had adequate visibility, but not to the foundation, and the traverse was a defined distance beyond the gas risk; the determination can be made as risk-free of that particular sewer segment. Branch sewer risk must also be considered as described later.

- Validate that sewer laterals and branched laterals are traversed beyond where there is a potential risk of crossing the gas line.
- Properties without gas may have risk of crossing the gas corridor when the sewer lateral crosses adjacent property. For an example, see *Figure 11*, Structure 3 and Structure 4.
- Branched sewer lateral risk is prevalent when the sewer drain is below the elevation of the mainline sewer directly in front of the structure and the gravity sewer access at a lower elevation is achieved by crossing the adjacent property or properties.
- This risk also occurs when sewers are first installed in an area where the home is already in existence.

Figure 11: Note structure 4 is connected to 2 mainlines and has 3 additional structures on one lateral. Additionally, the need for good goe-location accuracy of field locations is illustrated by the closeness of two laterals at the property line between 4 and 5.

- The sewer lateral may be added across undeveloped property for an extended distance. Subsequent development may then be developed on either side of the sewer lateral and the lateral sewer is not connected to the subsequently installed mainline sewer that is directly in front of the structure, see Figure 11 for an example. If the inspection is not performed from the mainline initially, all of the lateral connections my not remain at risk, because they may not have been discovered otherwise.

- Review, with extra focus, each horizontal crossing of sewers and gas lines using GIS mapping.
    - These recognized crossings identified in the field should have a GPS location taken at that point to help with determinations if cross bore risk remains.
    - Measured results, with comparison to metric goals, should be provided to the management team. Deviations from goals should be evaluated for corrective actions.

Quality control processes similar to the above are recommended to be required for vacuum excavation to provide high confidence the work was performed at the correct location and the correct observation was recorded.

- Horizontal GPS positions, depth, photos, videos and other data as appropriate to validate a location and depth.
- Information collected should be adequate to validate the location and depth (elevation).
- If a crossing is to be observed, a geo-referenced photo or video should also provide enough information to show that the new and existing utilities did not intersect.

Quality control should have processes which recognize and allow for the tolerances of the collection equipment.

- The signal of the sondes can be tracked from the surface with locators and recorded with GPS receivers. The rated accuracy of the device should be included in the sum of the tolerances.
- Sonde accuracy can be affected by the angle of the sonde and the receiver. Proper procedure in the field should minimize the effects of angles from horizontal. Field technicians should be trained for this possibility and steps taken to obtain accurate locations.

Summary:

These *Leading Practices for Cross Bore Risk Reduction* from Cross Bore Safety Association is a guide for cross bore investigations to reduce new cross bores and eliminate existing cross bores. The current focus has been on natural gas line cross bores due to the catastrophic and public potential for damage, injury and death. This document has maintained that focus. However, all utility operators can learn from the processes described herein to minimize cross bore risk.

Proven technology, equipment and processes are available to create high confidence results to ensure that cross bores are no longer installed nor remain installed. Risk determination, planning and operations recommendations have been included as guidance for the creation of specific programs which recognize the unique variations of gas distribution, sewer and all other utilities.

Regulatory improvements for adding sewer and any other not included underground locations to requirements for 811 Call Before You Dig tickets is logical. All states are encouraged to make these improvements. Rate approval regulators are encouraged to recognize that cross bore inspections for legacy installations are, in reality, simply, delayed construction costs which were not completed at the time of the initial installation. Providing mechanisms to allow rapid recovery of these cross bore risk reduction costs will accelerate safety risk reduction due to cross bores.

Definitions:

CBSA: Cross Bore Safety Association, www.crossboresafety

CCTV: Closed Circuit television

Cross bore: “An intersection of an existing underground utility or underground structure by a second utility resulting in direct contact between the transactions of the utilities that compromises the integrity of either utility or underground structure.” http://crossboresafety.org/#Definition_of_a_Utility_Cross__Bore

Class 1 cross bore: an intersection of an existing underground utility or underground structure by a second utility resulting in direct contact between the transactions of the utilities that compromises the integrity of either utility or underground structure.

Class 2 cross bore: an intersection of two existing underground utilities or underground structure by a third utility resulting in direct contact between the transactions of the utilities that compromises the integrity of either utility or underground structure, which may allow transmission of product between the utilities.

HDD: Horizontal Directional Drill

Highest confidence: means that there is little or no doubt at all.

Legacy cross bore risk: the exposure to a cross bore in post-construction, existing installations.

Low confidence: there is little faith at all

Mainline sewer: a collector sewer with multiple lateral service connections, often owned and maintained by a sewer utility.

Main/lateral: an underground carriage system specifically for transporting sewage from houses and commercial buildings through pipes to treatment facilities or disposal.

SLC: Sewer Locate Card, to be completed by the inspection crew(s).

TIC: Trenchless Installation Card, to be completed by the installation crew(s).

Trenchless technology: a type of subsurface construction work that requires few open excavation or no continuous trenches.

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