National Transportation Safety Board
Washington, D.C. 20594

Office of Railroad, Pipeline and Hazardous Materials Investigations

Date: November 2, 2020

To: Robert Hall, Director

Through: Sean Lynum, Chief, Pipeline and Hazardous Materials Division

From: Sara Lyons, Pipeline Accident Investigator
Pipeline and Hazardous Materials Division

Subject: Atmos Energy's Party Submission Containing Pre-Decisional Information
Investigation of Natural Gas-Fueled Explosion of Residence, February 23, 2018
Dallas, Texas (PLD18FR002)

Atmos Energy's Party Submission for the subject investigation referenced and provided full copies of pre-decisional documents (draft factual reports) that they were granted access to as a party to this investigation. Draft factual reports are not released by the NTSB. Instead, the NTSB's final factual, technically reviewed, reports are released to the public in accordance with 49 CFR 801.30, *Records from accident investigations*.

Parties to an investigation are encouraged to submit to the NTSB proposed findings of fact and conclusions that the party believes should be drawn from the technically reviewed evidence obtained during the investigation. The Technical Review for this investigation was held on July 14, 2020.

Atmos Energy exercised their privilege to provide a Party Submission which contained pre-decisional information. When asked to provide a Party Submission that did not contain pre-decisional information, Atmos Energy provided a redacted version of the same document. The NTSB is redacting any excerpts that include pre-decisional information. Consequently, about 134 pages of pre-decisional information have been redacted from Atmos Energy's Party Submission, dated September 4, 2020.

Supplement
to
Atmos Energy Corporation's
Proposed Findings, Probable Cause, and
Recommendations to
the National Transportation Safety Board

September 4, 2020

Docket No. PLD18FR002
Relating to Natural Gas-Fueled Explosion
3534 Espanola Drive in Dallas Texas
February 23, 2018

SUPPLEMENT TO PARTY SUBMISSION

Atmos Energy Corporation (Atmos) supplements its previously submitted its "Proposed Findings, Probable Cause, and Recommendations" to the National Transportation Safety Board (NTSB) relating to the accident that occurred in Dallas, Texas on February 23, 2018 (the Party Submission). The Party Submission was prepared at the direction of the then Investigator-in-Charge (IIC) and delivered on February 28, 2020, consistent with the IIC's instructions. The Party Submission and this Supplement comment only on the NTSB investigation; this narrow focus in no way diminishes the gravity of the tragic accident and its impact on the Rogers family to whom we send our deepest condolences.

Following the delivery of Atmos' Party Submission, the NTSB [redacted] the Party Submission continues to reflect Atmos' determination that:

1. **The probable cause of the explosion on February 23, 2018 was the unreported damage to a 2" steel main located in the alley behind 3534 Espanola Drive by third-party excavation during the installation of a sewer lateral in 1995/1996.**

    a. Post-accident excavation confirmed the 2" main was cracked in the area it had been gouged, bent, and dented by mechanized equipment, and was otherwise in good condition.

    b. The crack on the 2" main was located directly underneath a sewer lateral which was just 1 ½ inches above the top of the of the damaged main.

    c. The 2" main would not have failed but for this third-party damage.

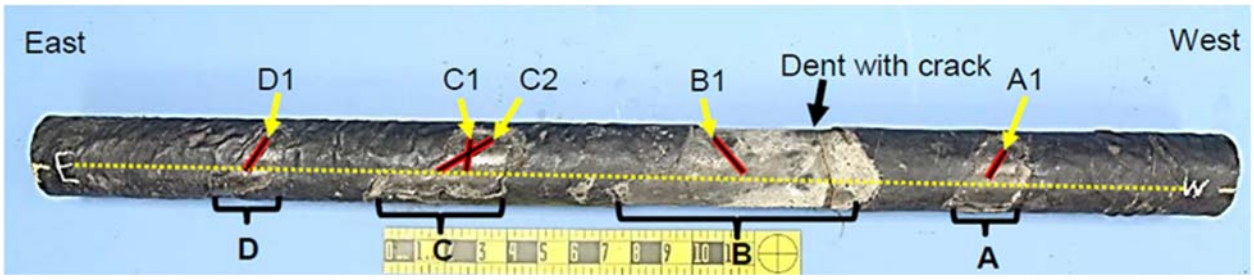
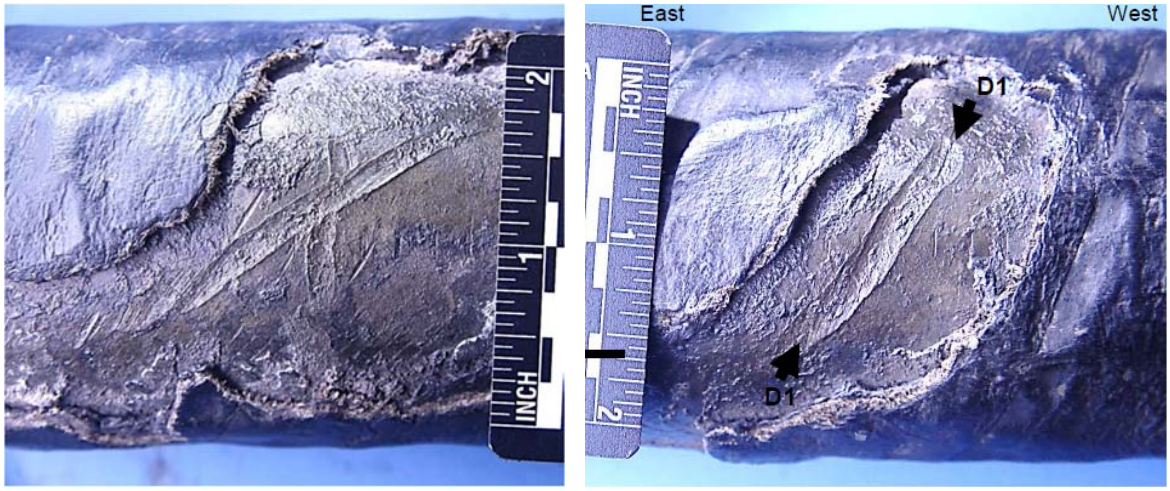


Figure 1 —Damaged main from the NTSB Materials Laboratory Factual Report 18-067 showing gouges (A1, B1, C1, C2, and D1) and location of dent and circumferential crack



Figures 2 and 3 - Showing gouges in the main caused by third-party damage

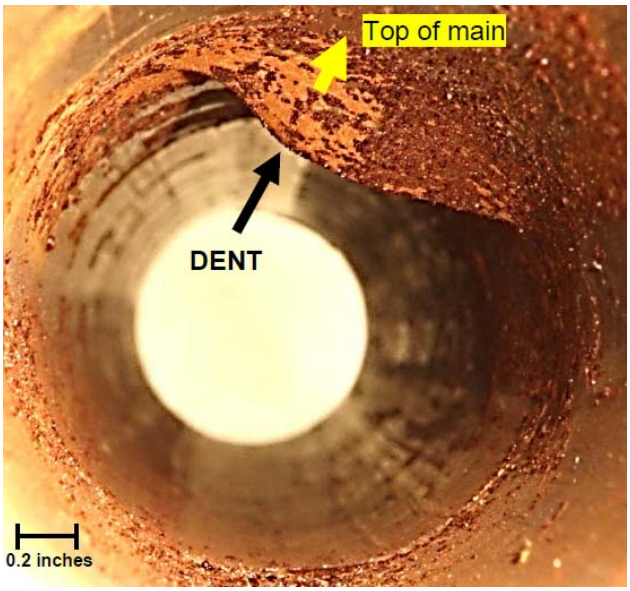


Figure 4 - Inside view of the damaged main and the location of the dent. The superficial oxidation occurred after it was removed from the alley and exposed to the air.

Figure 5 — Separation of 1.5" between the damaged top of the gas main and the bottom of the sewer lateral.

2. The house fires at 3515 Durango Drive and 3527 Durango Drive in the two days preceding the accident were not caused by gas leaking from the 2" steel main.

a. [redacted]

Operations Factual Report identified no facts that established a physical connection between two house fires on February 21 and 22 and the February 23 accident at 3534 Espanola. [redacted] NTSB never took custody of the two house fire sites to bring them officially into the investigation, and subsequently identified no facts to connect the fires to the incident, [redacted]

[redacted] more than two years after the incident, the NTSB prepared a new Materials Laboratory Fire Factual Report which was sent to the parties to the investigation. The Fire Factual Report did not identify facts establishing a connection between the two house fires or among the house fires and the incident on February 23.

b. Consistent with this conclusion, Atmos' leak investigations following each of these fires confirmed that gas was not migrating from the 2" main in the alley to either of the residences. Bar hole tests were conducted around each of these structures and did not detect the presence of natural gas (see Figure 19 of the final Operations Factual Report). Neither the newly-developed Fire Factual Report, nor [redacted] the Operations Factual Report or Emergency Response Factual Report, contain any factual evidence establishing a connection between the two house fires and Atmos' system. The house fires therefore fall outside the NTSB's investigation [redacted]. Any finding of a connection is speculation.

3. Atmos's response to the first two house fires, and the decision not to shut off the main prior to the incident on February 23, were appropriate based on what was known at the time.

a. Atmos' system was not involved in the first house fire. The investigation of the first house fire at 3527 Durango Drive on Wednesday, February 21 by Atmos Energy's Senior Service Technician was consistent with Atmos' procedures and did not reveal anything to suggest Atmos' system was involved in the fire. One of the DFR investigators on scene told the Senior Service Technician that the fire "probably came from inside the house,"[2] further indicating that this event was typical of other fire calls which Atmos responds to on a nearly daily basis that are unrelated to Atmos' system.[3] Dallas-Fire Rescue's own Fire Investigation Report states that this fire "most probably originated in, on or around the gas heater when it exploded causing major damage to the back of the house." Atmos' procedures are and were followed independent of initial on-scene reports regarding any possible source of ignition.

b. Atmos' system was not involved in the second house fire. The investigation of the second house fire at 3515 Durango Drive on Thursday, February 22, involved over a dozen Atmos personnel working from noon until the following morning in

[1] [redacted]
[2] Operational Factual Report (Final) dated July 22, 2020, pg. 31
[3] Interview of Director of Operations, 3/7/18, pg 25.

difficult conditions. This response began with technicians performing an extensive bar-hole test along the Durango/Espanola alley and checking the sewer clean-outs along the alley. No leaks were identified behind 3534 Espanola and no evidence of gas migration was detected from the damaged main prior to the accident.

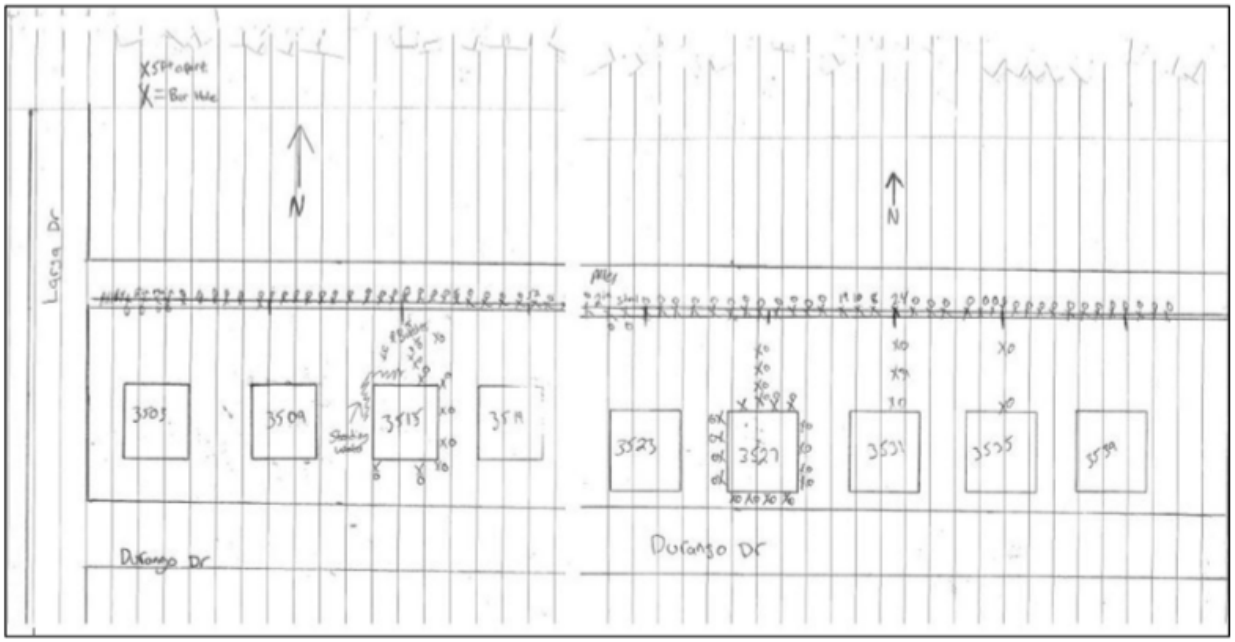


Figure 6 - Bar hole testing results at 3515 and 3527 Durango and in the alley between the 3500 Block of Durango Drive and Espanola Drive on Thursday, February 22, 2018. As noted in the upper left corner, "X" indicates the location of the bar hole test; "0" indicates that no gas was detected.

During the investigation of the second house fire, although there was no evidence of system involvement in the fire, technicians found two unrelated leaks on service lines of two different addresses. After one additional leak was found on a nearby street (Larga), the Director of Operations ordered a special leak survey out of an abundance of caution. Atmos' subsequent investigation of the neighborhood was comprehensive, complete, and exceeded procedural requirements. The leak survey specialists, accompanied by technicians, identified numerous leaks over an 8-block area and took immediate actions when a hazardous condition was found, including evacuating one resident. Only two, non-hazardous leaks were identified in the alley of the 3500 block of Durango/Espanola – one of which was repaired the evening of February 22 and the other of which was in the process of being repaired at the time of the accident on February 23. The operations supervisor on scene throughout the night stated that as the two non-hazardous leaks in the alley were being repaired, Atmos personnel were continuously monitoring the situation, responding immediately to identified hazards, conducting bar hole testing as needed, and checking sewers to keep the area safe. Importantly, although the bar-hole testing and the special leak survey identified leaks on *service lines*, there was no evidence of damage to, or a leak originating from, a crack on the *main.*

c. The testimony of Survey Specialist A concerning his RMLD in the Durango/Espanola alley does not support a system shut down. One of the Survey Specialists conducting the special leak survey[4] the night of February 22 (referred to as Survey Specialist A in the Operations Factual Report) stated that his Remote Methane Leak Detection unit (RMLD) picked up a "solid indication" in the Durango/Espanola alley, which he reported to the two operations supervisors on-site. In response, one of the operations supervisors ("Operations Supervisor 1") and Survey Specialist A walked half-way down the alley to determine if the RMLD could provide a good indication of a leak which they could then investigate and pinpoint with their combustible gas indicators (CGIs). According to Operations Supervisor 1, Survey Specialist A's RMLD was "making sounds" as they walked the alley, but he was unable to obtain any good indications to follow up on. Operations Supervisor 1 believed the RMLD was providing the equivalent of false positives. Operations Supervisor 1 knew this portion of the alley had been bar hole tested earlier that day and two non-hazardous leaks discovered (which at that time were being repaired). Survey Specialist A stated that he had no concerns about the integrity of the main. Had Survey Specialist A or Operations Supervisor 1 detected the presence of natural gas, they would have conducted additional bar hole testing and deployed additional resources as needed to ensure the area was safe.

d. Based on the facts known prior to February 23, an earlier system shut down was not called for. Although a number of leaks were identified, sufficient resources were deployed and the concentration of leaks over the 8 block area was not abnormal or alarming to the three supervisors, the manager, and the director who had a combined 119 years of experience operating a natural gas system. Those leaks were identified, monitored as needed, and scheduled for repair – and they did not cause the explosion on February 23. Had the main not been dented, bent, and gouged years before by a 3rd party, there would not have been a crack in the main, the leaks from February 22 would have been resolved, and this matter would not be before the NTSB.

4. **Odorant Was Readily Detectable as Confirmed by Testing and Customer Calls.**

a. Post-accident odorant readings taken near the accident site on the afternoon of February 23, 2018, witnessed by representatives of the Railroad Commission of Texas and Dallas Fire Rescue, confirmed that odorant levels were readily detectable.[5] Records from the test location closest to 3534 Espanola also show

[4] Atmos employs "special" leak surveys as a tool for operational purposes such as supplementing leak investigations. They are not intended for regulatory compliance. Accordingly, special leak surveys are permitted under conditions, such as wet weather, that would not be chosen for a compliance leak survey.

[5] *See* Post-Accident Odorization Test (TX-RRC Odorization Form PS-28) published in the NTSB docket as Document No. 28;; *see also* Area Odorant Readings Confirmed by Officials – 2-23-18 (submitted to the NTSB as AEC-NTSB-000077 but not included in documents published to the docket).

odorant concentration readings were readily detectable in the five years prior to the accident.[6]

b. Residents' statements as early as January 1, 2018 (a call from 3527 Durango Drive reported smelling gas, which was unrelated to events of February 21-23) and as late as Thursday, February 22, 2018 (a statement from a resident on Larga Drive reported smelling gas near her sidewalk) demonstrate odorant was detectable.[7] One of the survey specialists conducting the special leak survey also noted in his interview that he was able to smell gas coming from a leak he identified that night.[8]

c. Residents' statements, Atmos' operational records, and Atmos' subsequent investigations all confirmed that the natural gas odorant was readily detectable on both above-ground and below-ground leaks prior to the accident on February 23.

5. **The USACE's Geotechnical Report (USACE Report) analyzed only the block of the accident site, which the NTSB excluded from the extensive geological testing undertaken by Bryant Consultant Inc. (BCI) to validate the Preliminary Assessment.**

a. Atmos has known since early March 2018 that the crack in the damaged main was caused by third-party excavation. Atmos did not hire BCI to determine the cause of the incident.

b. Atmos engaged BCI to help identify a potential cause for the sudden and unexplained leaks in a geographical area covering over one square mile (Planned Outage Area). Atmos notified the NTSB at the time that BCI's engagement was unrelated to the accident. When BCI began taking core samples within and around the Planned Outage Area, the NTSB declined to give BCI access to the accident site.

c. The USACE investigated only the accident site and concluded "there is only one geologic formation, the Eagle Ford Shale, underlying the accident site." BCI's Preliminary Assessment does not claim two formations are under the accident site. The Preliminary Assessment states that within the one square mile area comprising the Planned Outage Area, the northern boundary of which was nearly a mile from the accident site, is the meeting point of several geological formations. Subsequent field work by BCI confirmed this and was presented to the NTSB. The USACE Report does not dispute this finding.

[6] *See* Natural Gas Odorant Test Locations Map and Associated Readings published in the NTSB docket as Documents No. 15
[7] *See* Operational Factual Report (Final) dated July 22, 2020, pgs. 26 (Durango Drive) and 34 (Larga Drive).
[8] *See* Operational Factual Report (Final) dated July 22, 2020, pg 40.

d. The USACE Report also states its purpose was to evaluate the technical accuracy of BCI's Preliminary Assessment "regarding the possible cause of the gas pipeline explosion in Dallas, TX." It is unclear why the USACE characterized the Preliminary Assessment as attempting reach a conclusion about the cause of the incident on February 23 when the Preliminary Assessment has no language suggesting the same. As Atmos Energy confirmed multiple times, BCI was not engaged to investigate, or draw conclusions, regarding the events of February 21-23, 2018, and did not perform any testing within the 3500 block of Durango and Espanola Drives. With its testing limited to the only area BCI did not review, the USACE report cannot evaluate the technical accuracy of the BCI report.

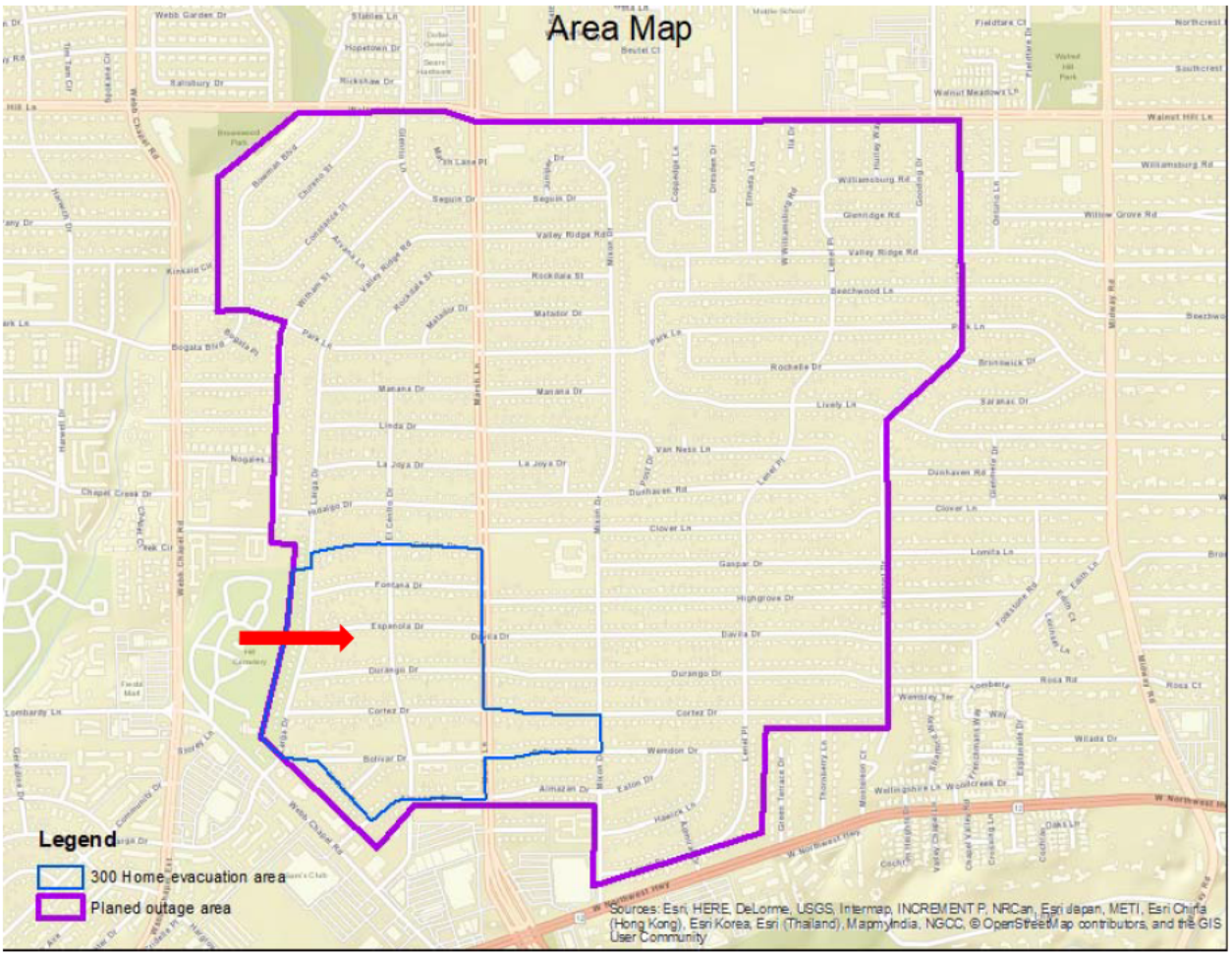


Figure 7 – Accident site at 3534 Espanola (indicated with red arrow toward bottom, left) shown relative to the much larger area Planned Outage Area where Atmos experienced an unprecedented number of leaks

e. BCI's Preliminary Report was instrumental in helping Atmos identify a potential cause of the unprecedented number of leaks experienced in the Planned Outage Area in late February 2018 and develop a response. As demonstrated in the chart

below, the rate at which leaks were discovered was unlike anything Atmos had ever experienced. In the first weeks of 2018, Atmos found an average of 9 leaks per week in a leak survey area in NW Dallas (including the Planned Outage Area).[9] In the days leading up to March 1 and through the end of March, Atmos found an average of 130 leaks per week. From April through June 2018, that average returned to normal even as Atmos continued to perform more frequent leak surveys. The information provided by BCI allowed Atmos to understand why so many leaks were developing in this particular area in NW Dallas, and develop a response which ultimately led to the difficult decision to isolate part of its system thereby interrupting service to approximately 2,800 customers. The USCAE Report not only mischaracterizes the purpose of BCI's Preliminary Assessment, but it completely discounts the importance of its findings and the positive safety impact it has had on Atmos' customers in this area.

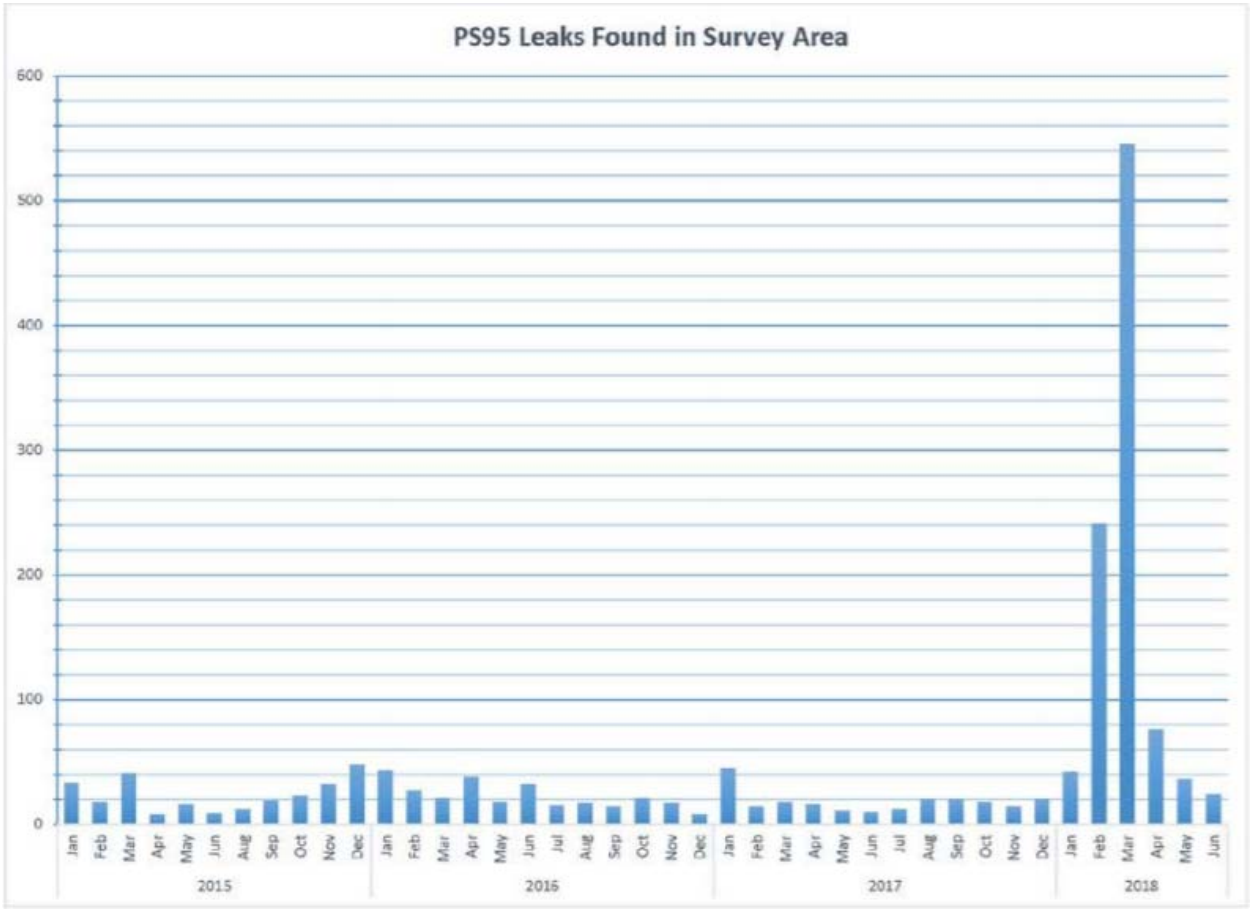


Figure 8 – Rate of leaks found in NW Dallas Area from January 2015 through April 2018 showing unprecedented leak rates in February and March 2018 (data taken from Atmos Energy's PS-95 public filing with the Texas Railroad Commission).

[9] https://www.atmosenergy.com/sites/default/files/atmos_energy_2018_accelerated_plan.pdf

6. Probable Cause

The probable cause of the explosion was the unreported damage of a 2" steel main located in the alley behind 3534 Espanola by third-party excavation during the installation of a sewer lateral in 1995/1996. Post-accident excavation confirmed the 2" main was cracked in the area it had been gouged, bent, and dented by mechanized equipment.

7. Proposed Safety Recommendations

In addition to the voluntary safety initiatives outlined below that Atmos has taken, or committed to take, Atmos recommends:

a. *Facilitating the development and integration of non-punitive self-reporting systems into state excavation damage prevention programs*

   Program integration should include awareness programs to educate excavators on the hazards of damaged natural gas lines even if no gas is released and the critical need to self-report damage or suspected damage to natural gas infrastructure.

b. *To further enhance efforts that are underway to minimize and prevent damage to underground natural gas infrastructure, Atmos recommends the commissioning of a study to evaluate and make recommendations to reduce the persistent damage issues related to:*

   i. Failure to promptly notify operators after damaging a pipeline

   ii. Failure to call before digging

   iii. Inadequate excavation practices (tolerance zone)

   iv. The study should evaluate and consider recommendations related to excavator training and certification (including directional drilling) and involve the appropriate stakeholders including those from the industry, state and federal regulators and the Common Ground Alliance.

c. *The continued investment by the natural gas industry in research and development efforts to enhance leak detection technologies for performing leak surveys and leak investigations in difficult environmental conditions (e.g., high levels of moisture, frost caps, snow, ice).*

d. *The industry's adoption of the American Petroleum Institute's Recommended Practice 1173, Pipeline Safety Management Systems.*

8. **Safety Initiatives Undertaken by Atmos**

Atmos Energy's commitment to safety is a core value, reflected in our Vision Statement and permeates our culture. It's evident in our people, practices, and procedures. We live this safety value; it is part of who we are. Our holistic approach to managing safety involves observing, evaluating, and adapting to changing and challenging conditions. We are committed to continuous improvement as we work to achieve our vision of being the safest provider of natural gas service. Our Party Submission contains a number of safety improvements that Atmos Energy has undertaken and below is a summary of a few of those:

a. Damage Prevention

Atmos Energy has been and will continue to be a champion for damage prevention. Our third-party damage rate continues to outperform the industry average. In fiscal year 2019, the number of third-party damages on our system decreased by almost 5%, even though the number of line locates increased by 9%. To further reduce third-party excavation damage, Atmos Energy:

- Audited more of our 3rd party line locating services to determine what actions can be taken to further reduce third party excavation damage.
- Strengthened our 'Watch and Care' program to require additional follow-up with excavators who have called in a line locate ticket.
- Started flagging and/or marking the location of newly installed pipe and associated facilities to bring immediate visibility to their location while our facilities map records are updated.
- Added new reporting metrics to better evaluate the performance of our damage prevention program.
- Implemented a Damage Prevention Ambassador Program that encourages employees to proactively stop by excavation sites to provide damage prevention materials to excavators and ensure proper 811 notification.
- Is on pace to complete the roll out of LocusView so that by the end of 2020 all distribution construction crews (internal and contractors) can capture and transmit detailed data on new pipe installation through a mobile app. This includes as-built maps, tracking and traceability of materials, joints and associated information. LocusView's high accuracy GPS creates as-built maps that are integrated directly into Atmos' GIS.
- Developed safety mascots and ambassadors Gus the Gopher and Rosie the Skunk to engage customers and the public in remembering to call 811 before you dig and using your senses to detect natural gas. In July of 2018, Atmos' "Gus the Gopher for Call 811" won top video in the external category of the American Gas Association Safety Awareness Video Excellence awards.

b. Risk Factors

In order to better understand and address geological and climatological threats to our operating system, Atmos retained a geotechnical engineering firm which has resulted in:

- The development and implementation of a geological risk factor that was included in the 2019 Mid-Tex division risk analysis.
- The development of a geological risk factor across the state of Texas.
- Ongoing review across all states where we operate.

c. Procedures

We regularly review and revise our procedures as we continue to learn from our own experiences and those of others in the industry. Internal subject matter experts (SMEs) participate in the review and development of these procedures. Our leak survey and leak investigation procedures have been updated to include:

- Mandatory 911 notification when a probable or existing hazardous condition is discovered and if first responders are not already on-site.
- The establishment of a Safety Perimeter when a probable or existing hazardous condition is discovered.
- Included Emergency Shutdown language to our Service Procedure that was previously in our Emergency Procedures in order to reinforce Atmos Energy's emergency responder's authority to take appropriate actions during an emergency. This includes controlling, reducing or eliminating the flow of gas to the location or area.
- Atmos Energy's emergency responders and operations leaders across all eight states were trained on the updated procedures. The training also incorporated examples of recent industry experiences.

d. Pipeline Safety Management System

In July 2015, the American Petroleum Institute (API) issued Recommended Practice 1173 (RP1173) outlining a Pipeline Safety Management System (PSMS). This is a voluntary measure, not required by code or regulation. The American Gas Association (AGA) recommended RP1173 for industry adoption in May 2019.

In 2016 Atmos Energy began working with an industry leading third-party expert to examine its practices in the context of PSMS. Atmos Energy then conducted a PSMS self-assessment and gap analysis for its Virginia operations. Afterwards Atmos Energy continued to participate in industry discussion groups and workshops to gain expertise and better understand how to develop and implement PSMS across its entire organization.

After February 23, 2018, Atmos Energy took additional voluntary and proactive measures to accelerate the implementation of PSMS. Atmos Energy updated its initial self-assessment and again engaged its industry leading third-party expert, this time to perform an enterprise wide PSMS assessment and gap analysis. Atmos Energy has developed a roadmap and PSMS program documents to allow it to reach significant and widespread maturity across all elements of a PSMS - a task that RP1173 recognizes is a journey. A Director level resource has been added in within Atmos Energy's corporate structure to support this accelerated implementation effort.

These and other efforts in support of PSMS are supported at the highest levels of the organization, with a corporate officer primarily responsible for the design, adoption, and implementation of PSMS. The corporate Risk Management and Compliance Committee is responsible for ongoing governance and reporting to the Company's Management Committee.

e. Training

Our commitment to the training of our highly skilled employees is evident and a tangible example of that is the Charles K. Vaughan Center in Plano, TX which opened in late 2010. This state-of-the art, industry leading facility, serves as the technical training location for our front-line employees from across our eight-state operation. The multi-week technical training programs are structured in a manner where the focus is on job-readiness. To help achieve this, our employees spend approximately 20% of their time in the classroom and 80% of their time performing hands-on training. As part of our never-ending pursuit to become the safest provider of natural gas services, employees in the field start each day with a safety meeting. As a company, we held over 91,000 hours of safety training in fiscal 2019.

In order to enhance our robust training curriculum and for our highly trained and qualified gas professionals and our operation leaders, Atmos:

- Developed and delivered an online leak survey refresher training for all employees with specified leak survey Operator Qualification (OQ) requirements.
- Developed and delivered a one-week leak survey refresher training class in the first half of 2019 to all employees whose primary job responsibilities are leak surveying. The training consisted of classroom instruction, a review of procedures, hands-on training by equipment vendors, discussion of weather-related conditions, and industry case studies.
- Implemented an Operations Supervisor Boot Camp at our Charles K. Vaughan training facility that allows operations supervisors to gain a better understanding of our technical training courses, processes and equipment through a one-week hands-on experience class. Every operations supervisor at Atmos has now completed the training, and all new supervisors will be required to attend future classes.

f. Leak Survey

Leak survey and detection is an important part of our safety efforts. Atmos regularly performs leak surveys at more frequent intervals than required by federal regulation. In order to enhance our leak survey program, Atmos:

- Created a dedicated work group within the Mid-Tex division to support and monitor leak survey activity.
- In 2019, completed a one-week refresher training class for all employees who perform leak surveys as their primary job.
- Continues to closely monitor our system in the Dallas-Fort Worth area through more frequent leak surveys and has employed additional third-party resources to support these efforts.
- Is conducting additional leak surveys across a broad area of the Mid-Tex system at more frequent intervals than required by federal and state regulations.
- Has purchased additional advanced mobile leak detection units within our Texas operations. These units are equipped with sensors that are 1,000 times more sensitive than traditional technologies. We plan to add additional units over time.
- Continues to implement GPS tracking functionality on leak survey equipment.

g. Quality Management

- Deployed iAuditor, an electronic inspection application, to our internal and third-party inspectors to drive consistency in inspection and quality management processes through performance reports, trend spotting, and the identification of actionable items.

- Implemented an automated interface between our Operator Qualification (OQ) program and our work management system that cross-references an employee's operator qualifications with the OQ tasks prior to assigning a work order. This new capability replaces previous manual processes.

h. Research and Development

We are always working with industry and technology partners to develop and evaluate new technologies to enhance safety. For years we have partnered with the Gas Technology Institute's Operations Technology Development (OTD) collaborative, which develops technology-based solutions for the natural gas industry. Among the efforts that Atmos supports to enhance safety through our involvement in OTD are:

- Residential methane detectors
- Leak survey/investigation sensors and technology
- Damage prevention tools and practices

i. System Modernization

Over the last 10 years, we have invested $10 billion company-wide to modernize our pipeline infrastructure, over 80% of which was allocated to safety. Over the next five years we have committee to spend $10 to $11 billion and replace approximately 5,000 – 6,000 miles of distribution and transmission pipe. We are committed to replacement of all remaining cast iron by the end of 2021. Other highlights for fiscal year 2019 (10/1/18 – 9/30/19) include:

- 890 miles of distribution and transmission pipelines replaced.
- 53,000 service lines replaced.
- 288,000 hours of safety, technical, and other training delivered

j. Data Analysis

- Implemented advanced data analytics tools which can transform, merge and analyze data sets using automated and repeatable workflows that provide faster and more precise results than manual processes.
- Implemented visualization technology tools that can provide near real-time graphical representation (dashboards, etc.) of data to assist operations and compliance leaders in their decision making.

We again send our deepest sympathies to the Rogers family, and express our appreciation for the work of fire, law enforcement, assisting emergency personnel, and our dedicated Atmos employees, as well as other party members and the NTSB in the investigation of the accident.

Atmos Energy Corporation's Proposed Findings, Probable Cause, and Recommendations to the National Transportation Safety Board dated February 28, 2020 is an integral part of this Supplement. It is included in its entirety on the following pages and intended to be read in conjunction with this Supplement.

Atmos Energy Corporation's
Proposed Findings, Probable Cause, and
Recommendations to
the National Transportation Safety Board

February 28, 2020

Docket No. PLD18FR002
Relating to Natural Gas-Fueled Explosion
3534 Espanola Drive in Dallas Texas
February 23, 2018

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PARTY SUBMISSION

Atmos Energy Corporation (Atmos), together with the Pipeline & Hazardous Materials Safety Administration (PHMSA), the Texas Railroad Commission (RRC), and Dallas Fire – Rescue continues to assist with the National Transportation Safety Board (NTSB)'s investigation into the accident that occurred in Dallas, Texas on February 23, 2018. While this Submission comments only on the NTSB investigation, this narrow focus in no way diminishes the gravity of the tragic accident and its impact on the Rogers family to whom we send our deepest condolences.

Atmos appreciates the work of fire, law enforcement, assisting emergency personnel, and Atmos employees as well as other party members and the NTSB in the investigation of the accident.

Section 49 C.F.R. § 831.14 invites parties to submit written proposed findings drawn from the evidence produced during the investigation, a proposed probable cause, and/or proposed safety recommendation(s) designed to prevent future accidents.

Atmos offers the following based on the evidence produced during the NTSB investigation. At the time of this submission, all factual reports have not been finalized. [redacted] Once all factual reports are finalized, supplemental submissions may follow.

EXECUTIVE SUMMARY

On Friday, February 23, 2018, at 6:38 a.m., a natural gas-fueled explosion severely damaged a residence at 3534 Espanola Drive, Dallas, Texas, fatally injuring a 12-year-old girl and injuring four other family members.

The probable cause of the explosion was the unreported damage of a 2" steel main located in the alley behind 3534 Espanola by third-party excavation during the installation of a sewer lateral in 1995/1996. Post-accident excavation confirmed the 2" main was cracked in the area it had been gouged, bent, and dented by mechanized equipment.

We propose the NTSB make damage prevention-related safety recommendations to encourage voluntary, and where appropriate, non-punitive reporting of damage to natural gas distribution pipelines and therefore prevent future accidents.

SCOPE

Two house fires occurred on Wednesday, February 21, 2018 and Thursday, February 22, 2018. [redacted]

FACTUAL INFORMATION

The Accident

On Friday, February 23, 2018, at 6:38 a.m., a natural gas-fueled explosion severely damaged a residence at 3534 Espanola Drive, Dallas, Texas, fatally injuring a 12-year-old girl and injuring four other family members.

Post-Accident Emergency Response/Atmos Energy's Actions

1. Emergency Personnel Responded to the Explosion

Numerous 911 calls came into the Dallas Fire-Rescue dispatch center reporting the explosion. The first unit, with two engines and one truck, arrived on scene at 6:44 a.m. and reported no smoke or fire but major structural damage. A family of five was in the house at the time, and a 12-year-old girl was fatally injured.

2. Atmos Employees Took Both Immediate and Precautionary Action to Protect Lives and Make the Area Safe

Atmos personnel were in the area working to repair a non-hazardous leak in the 3500 block of Espanola. An Atmos Operations Supervisor heard the explosion and took immediate action to protect lives and make the area safe. He directed his crew to start evacuating a two-block area, north and south of the accident house. Firefighters and Atmos crews went door-to-door advising residents to evacuate and to refrain from starting cars or switching on lights. The evacuation was completed in 12-15 minutes with the assistance of Dallas Fire-Rescue.[1] The Atmos onsite Operations Supervisor, working with the Operations Manager and the Director of Operations, coordinated the shut-down of the main line in the alley behind 3534 Espanola.

Atmos monitored the system and performed leak surveys surrounding the 3500 block of Espanola. As a precaution, Atmos decided to isolate a nine-block area through a series of staged system isolations (Figure 1). System isolation work was completed Friday evening. Atmos also evacuated 300 residences in this area, working with its public affairs team and coordinating with local officials to provide lodging and other assistance to residents in the affected area.

[1]Interview of Operations Supervisor M.R. (3.5.2018) at pg. 13

AEC-NTSB-001030

Figure 1—Map of Area Evacuated on Friday, February 23, 2018

Throughout Friday, Atmos personnel regularly communicated with Dallas Fire-Rescue. When Dallas Fire-Rescue first arrived at the scene, Atmos' onsite Operations Supervisor provided his name and contact information to the Incident Commander. Dallas Fire-Rescue initially established a command center across the street from 3534 Espanola. The Operations Supervisor advised the Incident Commander of the evacuation and system isolation plans that were known at that time.[2] Upon taking over, the Atmos relief Operations Supervisor went to the Dallas Fire-Rescue command post to introduce himself and provide his contact information. Dallas Fire-Rescue later moved their command center in a parking lot next to the Atmos command center for the continued coordinated response.

In coordination with Dallas Fire-Rescue, the evacuation of the 300 homes was lifted on Saturday, February 24 and residents could return to their homes. With gas already off the system, Atmos decided to replace the mains and service lines. Atmos arranged temporary hotel accommodations for these residents and assisted with other needs and expenses while gas service was off.

[2] Interview of Operations Supervisor M.R. (3.5.2018) at pg. 26-27

Post-Accident On-Site Excavation and Subsequent Laboratory Testing

The NTSB arrived on scene Sunday, February 25, 2018, and post-accident field work began on Monday, February 26, 2018 (Figure 2). The field work investigation included excavation and pressure testing of the 2" steel gas main (the **"Main"**) and associated service lines located in the alley of the 3500 block of Espanola and Durango in accordance with the NTSB's approved protocol. All segments of the Main passed a pressure test, except for one segment located behind 3534 Espanola Drive.

Figure 2 —Image showing accident dwelling (in yellow) relative to where damage was discovered on a portion of the Main in the alley. The location of the unrelated house fires on Wednesday (3527 Durango) and Thursday (3515 Durango) are shown in green.

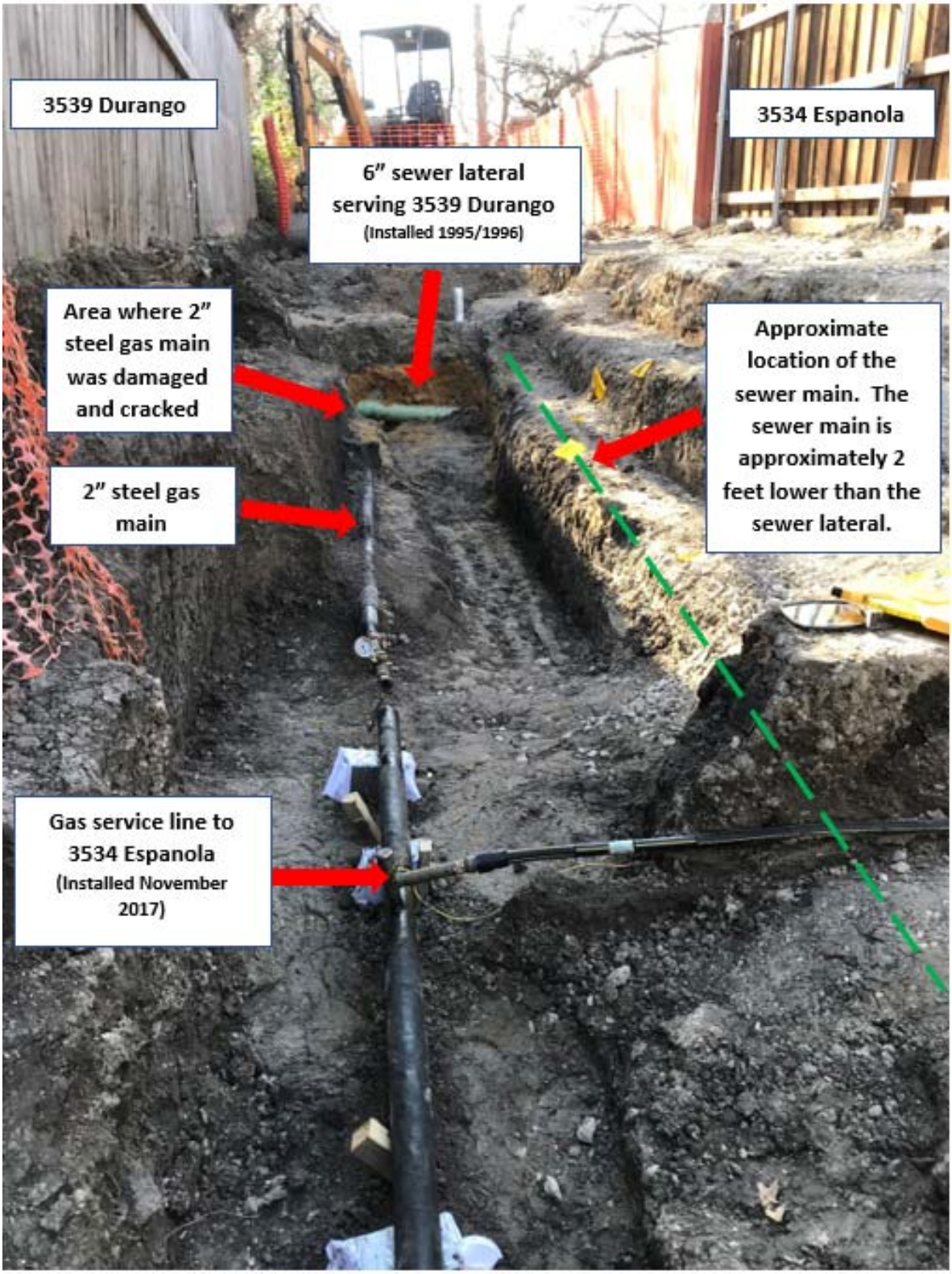


Figure 3 — NTSB field work excavation view of the alley looking west. Note the proximity of the green sewer lateral to the Main and the sand packing around the sewer lateral.

1. Field Work Revealed the Main was Dented, Gouged, and Cracked in One Section

When the Main was exposed behind 3534 Espanola Drive (Figure 3), it revealed a circumferential crack on the top of the Main (Figure 4), directly underneath a sanitary sewer lateral serving 3539 Durango Drive. The Main was also bowed downward with the crack intersecting a dent.[3] The 6" sewer lateral was approximately one and one-half inches above the top of (and perpendicular to) the Main. (Figure 5). The coating on the Main was damaged in the area directly beneath (and to both sides of) the sewer lateral. (Figure 6). A 10-foot segment of the Main containing the circumferential crack was removed and preserved for further testing and examination at the NTSB's materials laboratory (the "**Damaged Main**").

Figure 4—Damaged section of the Main relative to the sewer lateral serving 3539 Durango and the circumferential crack.

[3] NTSB Materials Laboratory Factual Report 18-067 [redacted]

Figure 5 — Separation of 1.5" between the damaged top of the Main and the bottom of the sewer lateral.

Figure 6 — Depiction of the circumferential crack and dent from the NTSB Materials Laboratory Factual Report 18-067

2. NTSB Laboratory Testing Confirmed the Damaged Main was Dented, Gouged, and Bent by Mechanized Equipment

Laboratory testing[4] by the NTSB confirmed the through-wall crack extended approximately halfway around the circumference of the pipe and intersected a large dent. There was a 20% reduction in wall thickness at the point of the dent. The deformation in the pipeline wall (Figure 7) compromised the integrity of the pipe making it susceptible to cracking and failure.[5]

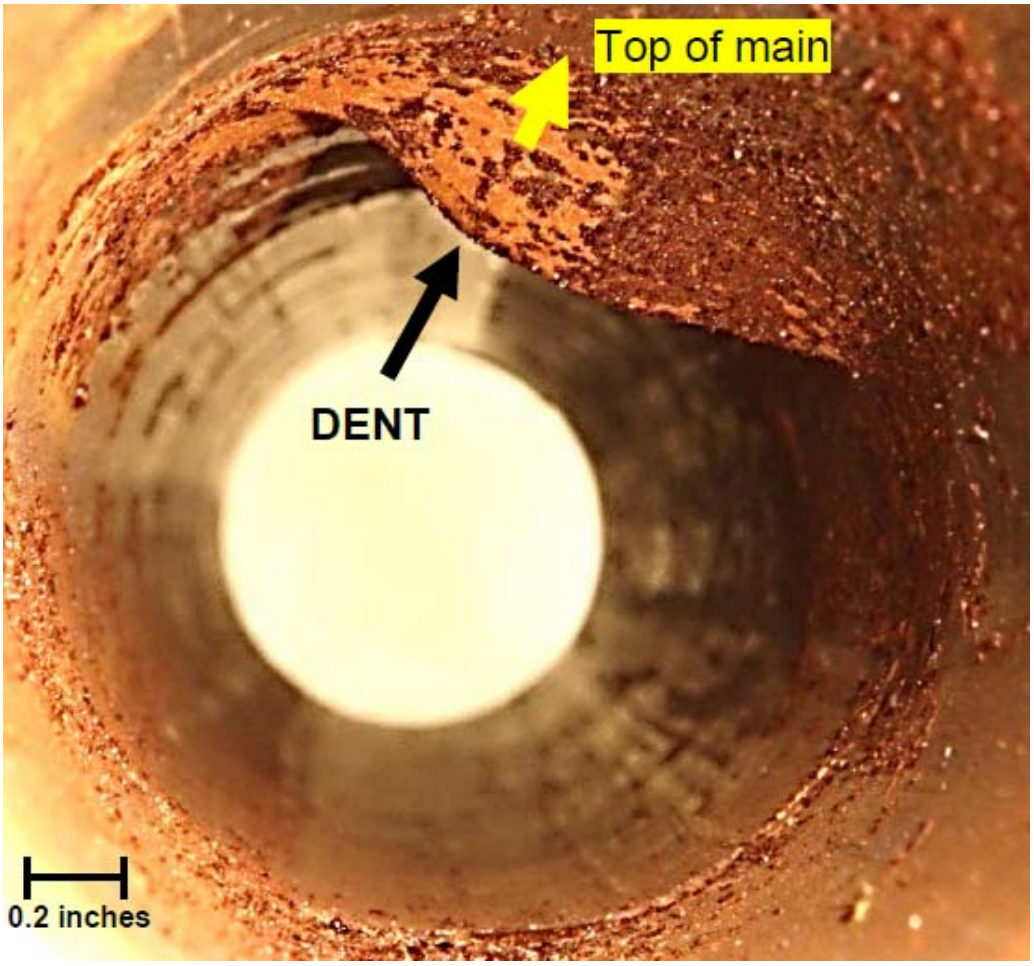


Figure 7 — Inside view of the Damaged Main and the location of the dent. The superficial oxidation occurred after it was removed from the alley and exposed to the air.

[4] The Damaged Main was examined and tested on July 17-19, 2018 at the NTSB's materials laboratory. The results of this examination are described in NTSB Materials Laboratory Factual Report No. 18-067 [redacted]. Subsequent testing was also conducted using a Scanning Electron Microscope (SEM), X-Ray Energy Dispersive Spectroscopy (EDS), Chemical Analysis, and X-Ray Diffraction (XDR) as described in NTSB Materials Laboratory Factual Report No. 19-028 [redacted] (attached as Exhibit I to the Appendix).

[5] *See* Department of Transportation, Pipeline & Hazardous Materials Safety Administration at https://primis.phmsa.dot.gov/comm/FactSheets/FSPipeDefects htm?nocache=7250

The Damaged Main was coated with a coal-tar enamel spiral wrap. This coating was damaged in four areas (on the top side below the sewer lateral) and covered in a hard, compacted, adherent deposit (Figure 8).

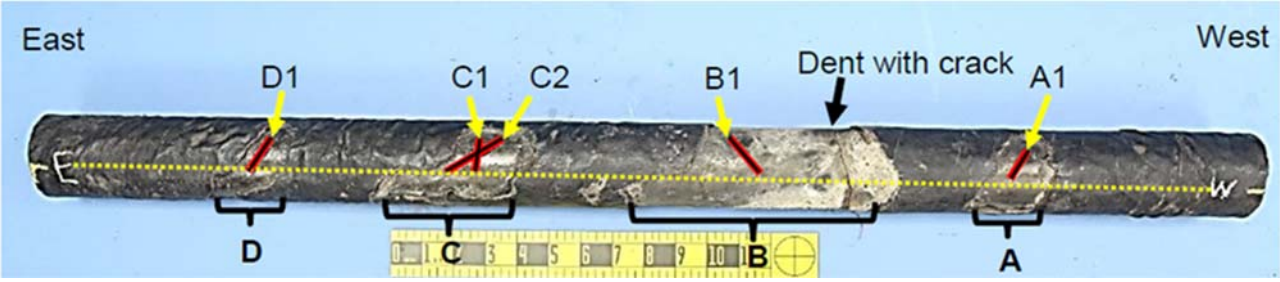
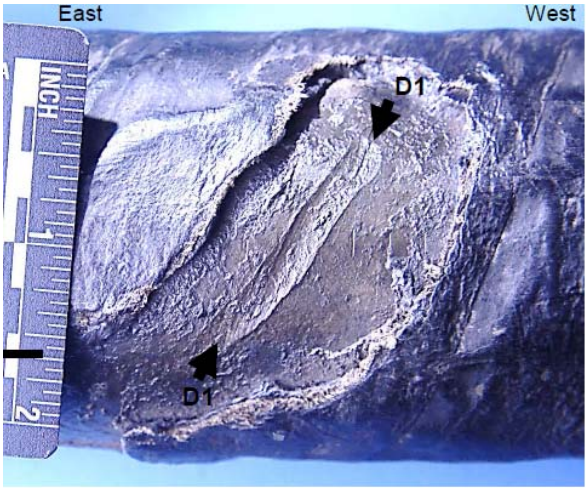


Figure 8—Damaged Main from the NTSB Materials Laboratory Factual Report 18-067 showing gouges (A1, B1, C1, C2, and D1) and location of dent and circumferential crack

Laboratory testing revealed multiple metal gouges where the pipe coating had been damaged. The damage seen on the pipe is consistent with a backhoe or other mechanized excavating equipment used to dig and install utility line and contained the hard, compacted, adherent deposits in areas were the coating was damaged. When the hard deposits were removed, each of the four areas contained at least one major gouge in the metal (Figures 9 & 10).

PHMSA explains that such gouges "usually happens when the teeth of a backhoe scrape across the pipe." [6] The sharp edges of the gouge act as stress concentrators and "pose a threat to the integrity of the pipe."[7]



Figures 9 and 10 Damaged Main—Showing gouges after removing hard deposit.

[6] *Id.*
[7] *Id.*

3. The Hard Deposit Shown in The Preliminary Report Was Not Corrosion.

The NTSB's Preliminary Report showed the circumferential crack covered in a hard, compacted, adherent deposit— not corrosion (Figure 11).

Circumferential crack in steel 2-inch-diameter pipeline.

Figure 11 NTSB's Preliminary Report

A different view from the NTSB laboratory analysis shows the hard deposit adhered to surface of the pipe and shows the dent caused by excavation damage.

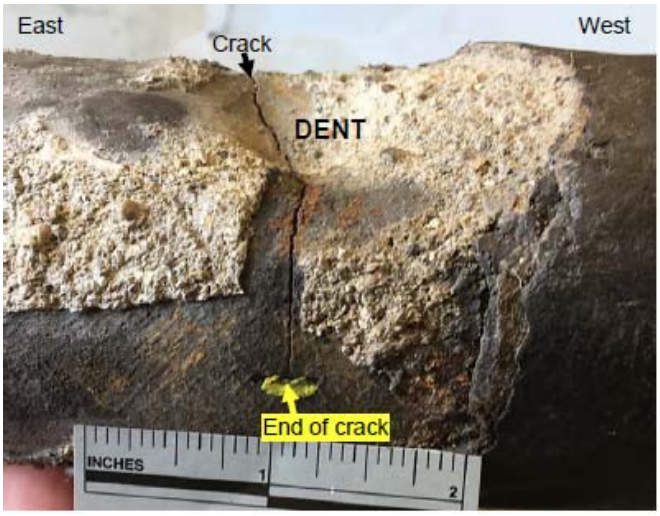


Figure 12— Showing a crack that intersected the dent with deposits removed from the areas outside the dent.

Once removed, the hard deposit was confirmed to be a buildup where external coating was damaged.

The undamaged portion of the pipe was in good condition—coated and cathodically protected. There were no other leaks in the Main, and the hard deposit was not present on any other undamaged portion of the Main (Figure 13).

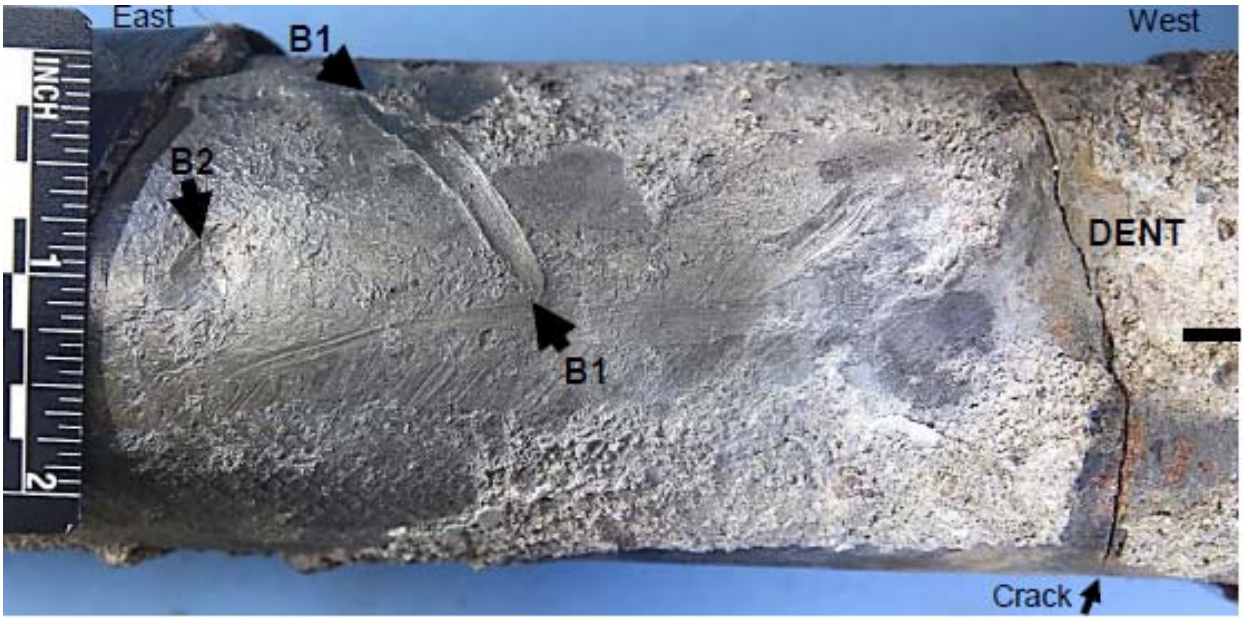


Figure 13— Showing the pipe surface after the hard deposit was removed (NTSB Materials Laboratory Factual Report 18-067)

4. Laboratory Analysis Confirmed the Crack Occurred at the Dent

NTSB investigators determined the circumferential crack— a stress-induced separation of the metal[8]— originated from the dent.[9] PHMSA explains the effect of these external stresses, "Imagine taking a piece of steel and bending it back and forth multiple [times] repeatedly. Eventually the steel will crack, or even break, at the bend."[10]

There is no evidence of corrosion in the pipe and no evidence that corrosion contributed to the pipe failure. If the pipe had not been gouged, bent, and dented, it would not have failed some time before 6:38 a.m. on Friday, February 23, 2018.

[8] NTSB Materials Laboratory Factual Report 18-067 at pg. 5
[9] *Id.* at pg. *2*
[10] *See* Department of Transportation, Pipeline & Hazardous Materials Safety Administration at https://primis.phmsa.dot.gov/comm/FactSheets/FSPipeDefects htm?nocache=7250

5. Post-Accident Field Work Detected Gas Along Sewer Lateral at 3534 Espanola

The crack on the Damaged Main occurred beneath the sewer lateral that served 3539 Durango, the house across the alley from the accident site (Figure 2 and 3). According to a representative from Dallas Water Utilities, the sewer lateral was built between October 1995 and May 1996[11] as part of a sewer replacement project for the neighborhood. There is no evidence that the excavator reported the damage to the pipe that occurred during the sewer lateral installation.[12]

The sewer system serving 3534 Espanola had been replaced during a remodeling project in 2017. During the post-accident excavation, investigators obtained gas readings in the sand surrounding the sewer lateral to 3534 Espanola.

[11] NTSB Materials Laboratory Factual Report 18-067 at pg. 2

[12] The Texas Railroad Commission adopted the Underground Facility Damage Prevention and Safety Act in 1999 to set up a notification center to receive reports of damage to facilities and impose penalties for failing to report excavation damage.

Pipeline Information and Performance Prior to the Accident

1. The Main's Performance History Showed No Evidence of Damage

The Main was installed in 1946. Its exterior coating had been spiral wrapped in coal-tar enamel. It was cathodically protected, and regularly leak surveyed and monitored. The pipeline had a maximum allowable operating pressure (MAOP) of 55 pounds per square inch gauge (psig)[13] and was operating at about 25 psig on Friday, February 23, 2018.[14] Based on detailed readings of the three closest measuring points, at no time in the three years of data reviewed did the system pressure exceed the MAOP.[15]

The leak history of the Main was also examined, and in the last 25 years, only one, non-hazardous leak (Grade 2.30)[16] was identified on this segment of main within the 3500 block of Espanola, which was permanently repaired in 1997.[17]

The cathodic protection pipe-to-soil potentials were all above the regulatory requirements for the ten years preceding the accident.

2. Odorant Was Readily Detectable as Confirmed by Testing and Customer Calls

The odorant used for the natural gas was a blend of isopropyl and tertiary-butyl mercaptan (Scentinel® O-10). Atmos' records indicate the gas was properly odorized, that the odorometer tests, which were conducted before and after the accident met PHSMA and RRC requirements, and that the odorant level was within prescribed concentrations.

a. Testing Before and After the Accident Confirmed the Odorant Was Readily Detectable

Post-accident odorant readings taken near the accident site on the afternoon of February 23, 2018, witnessed by representatives of the Railroad Commission of Texas and Dallas Fire Rescue, confirmed that odorant levels were readily detectable.[18]

Records (Figure 14) from the test location closest to 3534 Espanola also show odorant concentration readings were readily detectable in the five years prior to the accident.[19]

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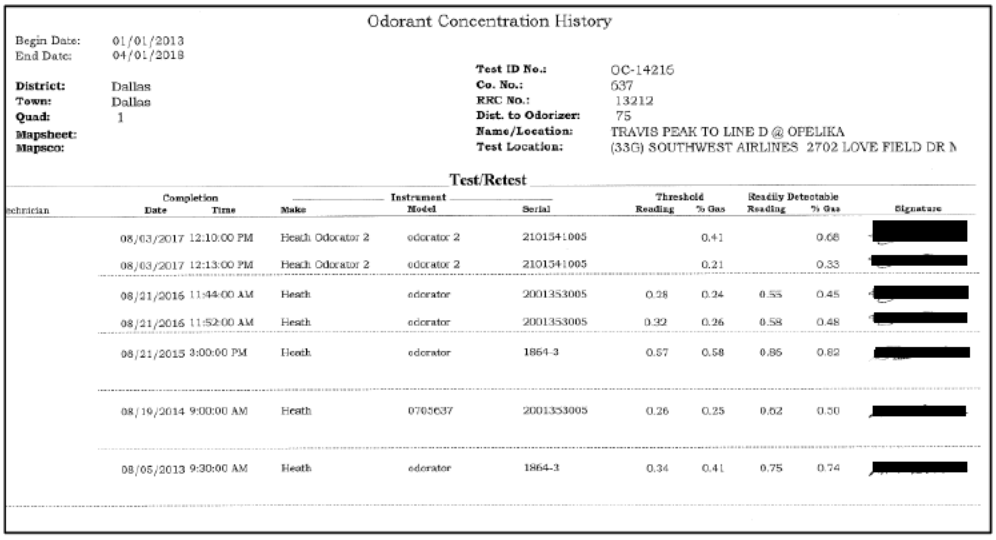
[13] NTSB Materials Laboratory Report 18-067 at pg. 1
[14] AEC-NTSB 000077
[15] NTSB Group Chairman's Factual Report of the Investigation, Operations and Integrity Management Report, [redacted] ("NTSB Operations Factual Report") at pg. 31
[16] NTSB Operations Factual Report at pg. 26, see also Title 16 Texas Administrative Code, §8.207
[17] AEC-NTSB 001873
[18] AEC-NTSB-000077
[19] AEC-NTSB-000079



Odorant Concentration History

Begin Date: 01/01/2013
End Date: 04/01/2018

District: Dallas
Town: Dallas
Quad: 1
Mapsheet:
Mapsco:

Test ID No.: OC-14216
Co. No.: 537
RRC No.: 13212
Dist. to Odorizer: 75
Name/Location: TRAVIS PEAK TO LINE D @ OFELIKA
Test Location: (33G) SOUTHWEST AIRLINES 2702 LOVE FIELD DR N

Test/Retest

Technician	Completion Date	Completion Time	Instrument Make	Instrument Model	Instrument Serial	Threshold Reading	Threshold % Gas	Readily Detectable Reading	Readily Detectable % Gas	Signature
	08/03/2017	12:10:00 PM	Heath Odorator 2	odorator 2	2101341005		0.41		0.68	[redacted]
	08/03/2017	12:13:00 PM	Heath Odorator 2	odorator 2	2101341005		0.21		0.33	[redacted]
	08/21/2016	11:44:00 AM	Heath	odorator	2001353005	0.28	0.24	0.55	0.45	[redacted]
	08/21/2016	11:52:00 AM	Heath	odorator	2001353005	0.32	0.26	0.58	0.48	[redacted]
	08/21/2015	3:00:00 PM	Heath	odorator	1864-3	0.57	0.58	0.85	0.82	[redacted]
	08/19/2014	9:00:00 AM	Heath	0705637	2001353005	0.26	0.25	0.62	0.50	[redacted]
	08/05/2013	9:30:00 AM	Heath	odorator	1864-3	0.34	0.41	0.75	0.74	[redacted]

Figure 14 — Five-year odorant concentration history

b. Recent Customer Reports Confirmed the Odorant Was Readily Detectable in January and February 2018

Two instances of customer odor complaints indicate that odorant was readily detectable in the days preceding the accident:

- On January 1, 2018, a resident at 3527 Durango reported smelling gas. An Atmos Service Technician found two non-hazardous gas leaks. These resolved leaks, which were mentioned in the NTSB's Preliminary Report, were [redacted] unrelated to the events of February 21-23.[20]

- On the afternoon of Thursday, February 22, 2018, a resident reported she had smelled gas and seen bubbles near her sidewalk on Larga Drive. Atmos responded, and the leak was resolved.[21]

Both the residents' statements and Atmos' subsequent investigation confirmed that the natural gas odorant was readily detectable on both above-ground and below-ground leaks prior to the accident.

3. Atmos Complied with Regulatory Pipeline Risk Assessment Requirements

Federal and state pipeline safety regulations require operators to develop a comprehensive process to identify threats and evaluate risks to its gas distribution system. Atmos has developed a systematic, risk-based approach to help prioritize pipeline replacement and leak survey frequency to drive risk out of its operating system and complies with federal and state pipeline safety

[20] NTSB Operations Factual Report at pg. 9
[21] AEC-NTSB 001089

regulations. This plan, known as a Distribution Integrity Management Plan (DIMP) uses internal and external data sources, operator knowledge and the professional judgment of internal Subject Matter Experts (SMEs) in conjunction with a risk assessment tool to identify, assess, validate, and rank system risk every year.

Federal regulations call for DIMP plans to be re-evaluated at least every five years, but the Mid-Tex operating division annually risk ranks the distribution operating system and evaluates it at a system and segment-based level. The annual risk analysis delivers a score for each segment of main and takes into consideration, relevant risk factors including, the number of leaks, coating condition, material, maintenance history, line pressure, population density and types of nearby structures (*e.g.*, hospitals, schools). The threshold for a segment to be identified as "high relative risk" is the mean of the risk scores of all segments plus two standard deviations. If a segment of pipe is determined to be a high relative risk, accelerated actions (*i.e.*, increased leak survey frequency or scheduled replacement) are implemented for that segment.

For the time period in question, the Main was not considered "high relative risk" and was not subject to accelerated action (*i.e.*, increased leak survey frequency or scheduled replacement).

4. Atmos Employees Were Trained and Qualified

a. Employees Are Trained and Qualified to Perform Operations, Maintenance, and Emergency Response Activities

Atmos' vision is to be the safest provider of natural gas services and training is a key part of that vision. In 2010, Atmos opened the Charles K. Vaughan Center in Plano, Texas—a state-of-the-art, industry leading facility that serves as the technical training location for front-line employees across Atmos' eight-state operation.

The multi-week technical training programs hosted at the training facility are structured to focus on job-readiness. Atmos employees spend approximately 20% of their time in the classroom and 80% of their time performing hands-on training. Following their time at the Charles K. Vaughan Center, employees continue their training and development by working with an on-the-job coach in their assigned work location.

In addition to being highly trained professionals, Atmos employees are qualified to perform operations, maintenance, and emergency response activities on Atmos' distribution and transmission pipeline system and facilities. Atmos' Operator Qualification (OQ) Program sets forth the policies and procedures for compliance with the pipeline safety regulations defined in 49 CFR Part 192, Subpart N and any applicable state specific requirements. Specifically, the OQ program is designed to evaluate the qualifications of individuals performing certain operating and maintenance functions on Atmos' natural gas transmission and distribution pipeline system and

facilities. It is the responsibility of Atmos to ensure that all individuals working within a covered task are qualified in accordance with this program. Records are maintained indicating that individuals performing covered tasks identified in this program have satisfied the requirements and are qualified.

b. Atmos Partners With and Trains First Responders

Atmos collaborates with first responders in the 1,400 communities where it provides natural gas service. Atmos conducts natural gas safety workshops for city officials, fire departments, police and other first responders. The purpose is to provide valuable natural gas safety training for an emergency response situation. The relationships and communication networks enhance the safety of the communities Atmos serves. Atmos provided training to members of Dallas Fire-Rescue and Hazmat on January 23-25, 2018, one month prior to the accident. At least one member of the HazMat team working on the accident attended this training.[22]

c. Atmos Employees Working in February 2018 Were Trained, Qualified, and Experienced.

The team of employees working before the accident drew on years of training and experience when making decisions. The Director of Operations, Operations Manager and three Operations Supervisors had over 100 years of experience with Atmos.

5. The House Fire on Wednesday, February 21 at 3527 Durango [redacted]

a. The House Fire Was Not Caused by the Damaged Main

At 5:49 a.m. on Wednesday, Dallas Fire-Rescue was notified of a fire at 3527 Durango Drive. Atmos was contacted and a Senior Service Technician arrived on site and checked in with Dallas Fire-Rescue.[23]

Although the Dallas Fire-Rescue firefighter told the Senior Service Technician she thought the fire was gas-related from inside the house,[24] Atmos' procedures are and were followed independent of initial on-scene reports regarding any possible source of gas:

[22] Interview of Hazmat Coordinator B.B. (2.27.2018) at pg. 8
[23] Interview of Senior Service Technician M.R. (2.28.2018) at pg. 9
[24] *Id*. at 28

- The Senior Service Technician began his investigation by confirming the meter was off and not damaged.[25]

- He then tested the regulator and confirmed it was working properly.[26]

- He performed a bar hole test using a SENSIT® Gold combustible gas indicator (CGI)[27] near the service riser which indicated no gas was present.[28]

- Because there was standing water in the alley behind the house, the Senior Service Technician used his CGI to survey above and on both sides of the gas main while also searching for other indications of a leak.[29] There were no indications of gas.[30]

Finding no evidence of leaks in the area or gas migrating into the residence, the Senior Service Technician concluded his investigation and then completed a service order.[31]

b. [redacted] the Fire and January 1, 2018 leaks [redacted]

The Fire Investigation Report for 3527 Durango Drive confirmed the Wednesday fire "most probably originated in, on or around the gas heater when it exploded causing major damage to the back of the house."[32] The Atmos Senior Service Technician was unable to test the house line because Dallas Fire-Rescue was in the house, and it was not safe to turn the gas back on.[33]

[redacted][34]

As mentioned previously, the Preliminary Report references leaks being detected in the neighborhood on January 1, 2018. This is a reference to an odor complaint from the resident at 3527 Durango.[35] Atmos dispatched a Service Technician the same day and found two non-

[25] *Id*. at 14-15
[26] *Id*. at 15
[27] The Senior Service Technician's CGI was properly calibrated at the time of use (see NTSB Materials Lab Report 18-096, Sensit unit #2737).
[28] *Id*. at 25
[29] *Id*. at 28. Service Technicians are trained to use all their senses to help detect leaks. The Senior Service Technician was scanning for visual indications in the standing water (i.e., bubbles) and using his sense of smell to detect gas.
[30] *Id*. His CGI did not detect gas, nor did he see bubbles or smell gas.
[31] AEC-NTSB 000131-132: "…gas lk [sic] in hse [sic] line cause of fire per investigator…"
[32] Dallas Fire Rescue Fire Investigation Report #2018047564
[33] *Id*. at 18 and 26
[34] NTSB Operations Factual Report at pg. 8
[35] AEC-NTSB 000196-000197

hazardous gas leaks — an above-ground leak at the regulator and one at the riser. The two leaks were resolved by replacing the regulator the same day and replacing the entire service line within the 30-day repair window. [redacted].[36]

6. The House Fire on Thursday, February 22 at 3515 Durango [redacted]

a. The House Fire Was Not Caused by the Damaged Main

At 10:21 a.m. on Thursday, February 22, 2018, Dallas Fire-Rescue was notified of a fire at 3515 Durango Drive after the resident reported a fire in their kitchen. Atmos was contacted around 11:30 a.m. Shortly after, an Atmos Service Technician arrived on site and met with the Incident Commander.[37] The Incident Commander and the Service Technician confirmed that Dallas Fire-Rescue had already shut off gas at the meter. The Incident Commander then told him the fire had started at the gas range[38] (boiling water, per the Dallas Fire-Rescue Fire Investigation Report[39]) and that there had also been a gas-related fire three houses over the day before.[40]

The Service Technician contacted his Supervisor to request assistance[41] and was joined by a Distribution Operator, a second Service Technician, and two Operations Supervisors.[42]

The two Service Technicians and the Distribution Operator conducted a thorough leak investigation and found no migration of gas into the residence after:

- Bar hole testing both sides of the meter to check for leaks;[43]
- Checking the sewer clean out; and[44]
- Bar hole testing around the foundation of house and along the service line.[45]

[36] NTSB Operations Factual Report at pg. 9 .
[37] Interview of Service Technician J.C. (2.28.2018), pg. 16-17
[38] *Id*. at 47-48
[39] DFR Fire Investigation Report 2018048587
[40] Interview of Service Technician J.C. (2.28.2018) at 26
[41] *Id.* at 28
[42] *Id.* at 28-30, 42
[43] *Id.* at 30, 47
[44] *Id*. at 30-31
[45] AEC-NTSB-000123-000124 and Interview of Service Technician J.C. (2.28.2018) at pg. 47

b. [redacted]

The Fire Investigation Report for 3515 Durango Drive confirmed the Thursday fire "originated in the kitchen, on or adjacent to the stove."[46] The homeowner told Dallas Fire-Rescue that he was boiling water on his stove-top when he noticed the flames from the burner were red and out of control; the burner then flashed and the homeowner was injured when he attempted to extinguish the fire. The investigation found no evidence of unmetered gas migrating to the residence. Pressure testing the house piping was impossible because of fire damage to the customer's piping.[47]

After the accident, a resident who lived on Larga Drive— blocks away from where the crack was later discovered in the alley behind 3534 Espanola— told Dallas Fire-Rescue that she had recently called Atmos because she had seen red flames on her stove.[48] The Atmos representative asked if she was experiencing issues with gas pressure or smelled gas, and she said no. After confirming there was no gas-related work going on in the area, the Atmos representative suggested that a qualified plumber check the stove. When leak surveyed on Thursday, there were no indications of a leak.

The NTSB investigators reviewed the evidence related to this Thursday house fire [redacted][49]

c. Service Technicians Continue to Monitor the Alley

Even though the investigation found no evidence of gas migrating to the residence at 3515 Durango Drive or readings in the sewer clean out, Atmos employees — exercising their commitment to safety by acting in an abundance of caution — continued monitoring the area. They checked all visible sewer clean outs along the alley for the 3500 block of Durango Drive and Espanola Drive.[50]

Atmos Service Technicians and a Distribution Operator also bar-holed tested in the alley for the 3500 block of Durango Drive and Espanola Drive as reflected in Figure 15, punching holes every five feet to check for possible leaks.[51] Bar hole testing checks for gas leaks and gas migration. There is no prescribed distance for testing— technicians are trained to bar test at least until they receive a zero reading and may continue after receiving zero readings. No leaks were identified at the Main behind 3534 Espanola (Figure 15).

[46] DFR Fire Investigation Report Incident 2018048587
[47] AEC-NTSB-000123-000124
[48] DFR Fire Investigation Report 2018048587
[49] NTSB Operations Factual Report at pg. 8
[50] Interview of Service Technician J.C. (2.28.2018) at pg. 33
[51] *Id.* at pg. 31

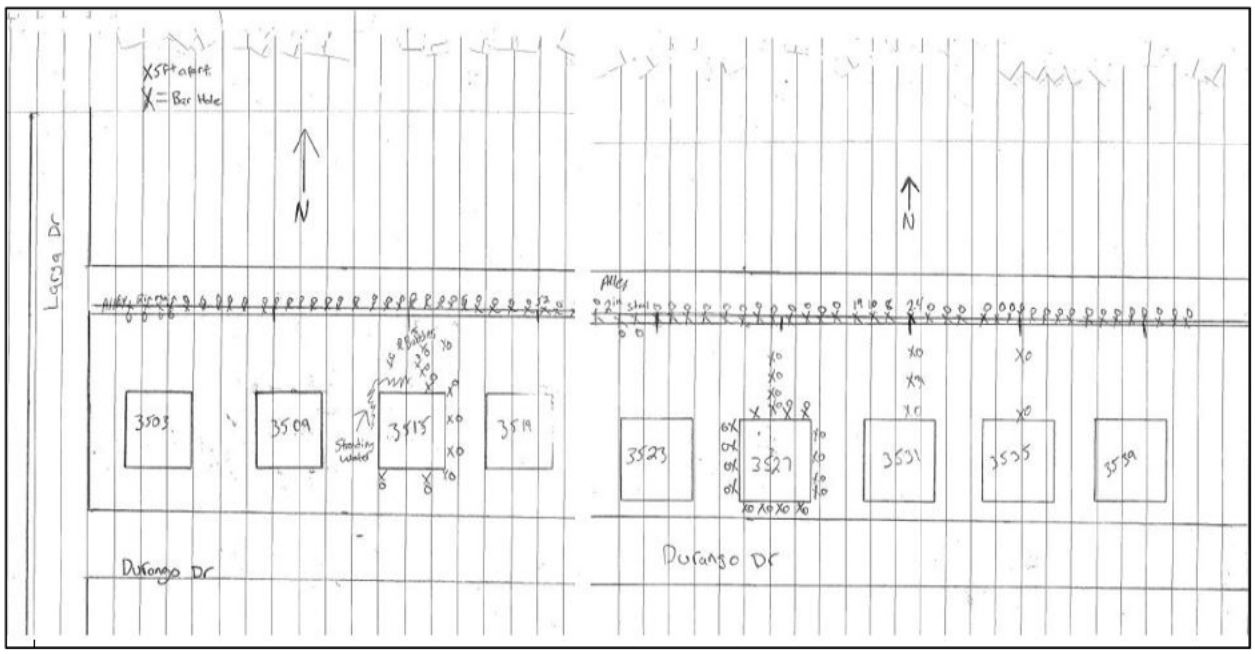


Figure 15— Bar hole testing results in the alley between the 3500 Block of Durango Drive and Espanola Drive at Thursday, February 22, 2018 (Attached as Exhibit C to the Appendix)

i) Non-Hazardous Leaks Are Identified at 3531 Durango and 3519 Durango and Called in for Repair

During the bar hole investigation on Thursday, the Service Technicians and Distribution Operator found a non-hazardous leak at both 3531 Durango and at 3519 Durango that were Graded as a 2.030 meaning that they were non-hazardous leaks that should be repaired within 30 days. A leak was also discovered in the customer-owned yard line at 3531 Durango. The meter was turned off and locked until customer repairs were made.

Company crews were called to repair the leak at 3519 Durango by exposing the main and replacing the service line. Thus, approximately five houses away from where the crack in the main was later discovered, and less than 24 hours before the accident, there was no evidence of damage on the Main or a leak at the time of the service line replacement.

ii) Company Crews Monitored and Eliminated a Grade 1 Leak at 9583 Larga

As Atmos personnel were performing the bar hole investigation in the alley on Thursday, February 22, a resident who had called Atmos about an outdoor gas odor approached a Service Technician and reported she had also seen bubbles near the sidewalk in front of her home on Larga Drive.[52] Atmos conducted a leak investigation and graded the leak as a Grade 1 leak on the service

[52] AEC-NTSB 001089

line. Figure 16 shows the approximate location of this leak in relation to the Main. The leak was monitored, and a company crew was called to eliminate the hazard by replacing the service line.[53]

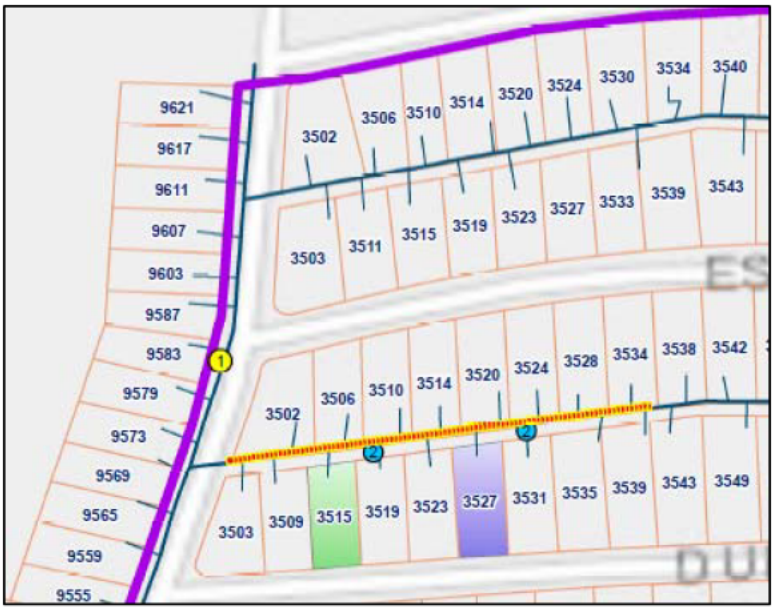


Figure 16 —Leaks as of the afternoon on Thursday, February 22. (Attached as Exhibit D to the Appendix)

d. A Leak Survey is Conducted

Atmos' Director of Operations was aware of the two Grade 2 non-hazardous leaks found in the alley and the one Grade 1 leak found at 9583 Larga (Figure 16) when, as a precaution, he called in two Leak Survey Specialists on Thursday afternoon to leak survey an approximately 8 block area.[54] He explained that it was "not uncommon at all for us to do a special survey" to respond to any number of circumstances.

The leak survey started that afternoon and continued to approximately 1 a.m. on Friday, February 23. The leak survey detected three additional Grade 1 leaks and nine non-hazardous spread over an eight-block area (Figure 17) –none of which were in the alley of the 3500 block of Espanola.

[53] AEC-NTSB 000288-000289
[54] Interview of Director of Operations K.S. (3.7.2018) at pg. 16-21

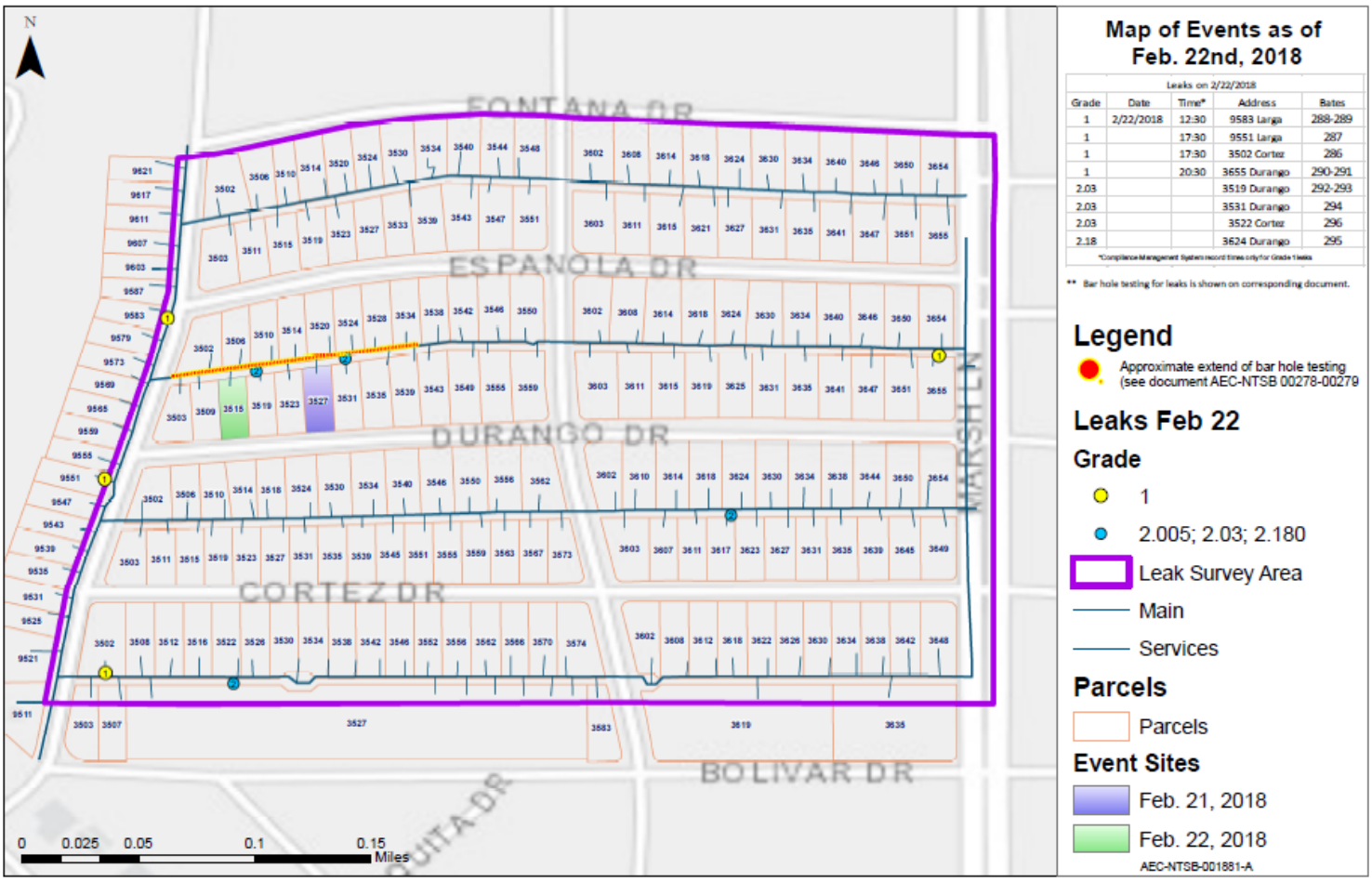


Figure 17 : Map of leak survey area and leaks on February 22, 2018 (Attached as Exhibit D to the Appendix).

As they leak surveyed, the Leak Survey Specialists took any necessary action to make the area safe. In one instance, one of the Leak Survey Specialists and a Service Technician detected gas near a garage apartment at 3655 Durango and notified the homeowner that the residents in the apartment needed to evacuate. The homeowner could not locate his key to unlock the gate separating the home from the garage apartment, so the Leak Survey Specialist used his bolt cutters to remove the lock. Employees confirmed to NTSB investigators that employees in the field have the authority to take immediate action to protect life and property including shutting in a system or evacuating a residence.[55] Prior approval is not required.[56]

Multiple construction crews were called in to repair the hazardous Grade 1 leaks as they were found. As a result, the Grade 1 leaks at 3502 Cortez and 9551 Larga were continuously monitored and repaired by 9 p.m. on Thursday, February 22, 2018. The Grade 1 leaks at 3655

[55] Interview of Operations Supervisor M.R. (3.5.2018) at pg. 42; Interview of Operations Supervisor M.R. (3.8.2018) at pg. 31; Interview of Director of Operations K.S. (3.7.2018) at pg. 25, 43
[56] *Id.*

Durango and 9583 Larga were continuously monitored and repaired before 3 a.m. on Friday, February 23, 2018 (Figure 19.)

e. Appropriate Procedures and Technology Were Used for the Bar Hole Testing and Leak Surveying

It was raining intermittently on Thursday. There was also standing water in the alleys from the historic amounts of rain that Dallas experienced that month as detailed in the Operations Report (Figure 18).[57] Employees bar hole testing throughout the day and the night made multiple holes to ensure they were able to get readings because water would quickly fill the holes. While scheduled compliance leak surveys are not typically performed in those conditions, the leak survey's results reflected the ability of the equipment to detect leaks.

Atmos' wet weather procedures call for the placement of as many bar holes as necessary, using leak detection equipment above the surface of the ground (or water), and looking for indications of gas such as bubbles and vapors.[58] The Leak Survey Specialists relied on their training and experience and used what they considered to be the best technology for these conditions: Remote Methane Leak Detectors (RMLDs).[59] RMLDs are able to detect leaks using laser technology along sight lines and, unlike other technologies, RMLDs do not aspirate air samples (which can be problematic in wet conditions). The usefulness of the RMLDs was proven by the fact that even under difficult conditions, the two Leak Survey Specialists were able to detect both hazardous and non-hazardous leaks using this technology.[60]

[57] NTSB Operations Factual Report at pg. 19-21
[58] Atmos Wet Weather Leak Investigation Procedures AEC-NTSB 000225
[59] Interview of Leak Survey Specialist J.R. (6.6.2018) at pg. 8-9; Interview of Leak Survey Specialist J.R. (6.6.2018) at pg. 16; Interview of Leak Survey Specialist G.H. (6.6.2018) at pg. 289
[60] NTSB Operations Factual Report at pg. 13

Figure 18 — showing the alley behind 3534 Espanola looking west. The fence on the right-hand side of the photo is behind 3534 Espanola.

f. NTSB Testing Confirms the Leak Investigation Equipment was Operating Properly

Laboratory testing in accordance with NTSB approved protocols confirmed that the leak investigation equipment used to conduct bar hole tests in the alley and investigate the two house fires were calibrated and operating properly. [61]

g. The Main in the Alley Showed No Signs of a Crack Early on Friday morning

By early morning Friday, Atmos had repaired the hazardous leaks detected in the leak surveyed area. (Figure 19). When asked by NTSB investigators, the Director of Operations confirmed there was no indication that any part of the system— including the main in the 3500 block of Durango Drive/Espanola Drive— should be shut down:[62] system performance was being monitored and evaluated, and the four hazardous leaks were spread out over 8 blocks. He concluded "we had a survey, we had the leaks identified, we had crews on the leaks….In fact, we had a couple of crews on the Grade 2 30s that actually we had 30 days to fix. . ." [63] Operations

[61] NTSB Material Laboratory Factual Report 18-096
[62] Interview of Director of Operations K.S. (3.7.2018) at pg. 22-23
[63] Interview of Director of Operations K.S. (3.7.2018) at pg. 22-23

Supervisors were on-site throughout the night "sending crews to keep working those leaks and making those repairs."[64]

The Operations Supervisor sufficient resources to work the leaks and make repairs.[65] "We constantly had surveyors checking, we had our crews working on our emergency leaks, we had service techs constantly checking…bar hole testing along the alley and checking sewers in and around 3531 Durango, helping with the surveys, …keeping the area safe…constantly monitoring and surveying the situation."[66] Just as in his prior experiences with working multiple leak locations in the same evening, crews had worked the Grade 1 leaks, were continuing to leak survey and monitor the area, and were planning to work on Grade 2 leaks while Service Technicians deployed to relight homes. [67]

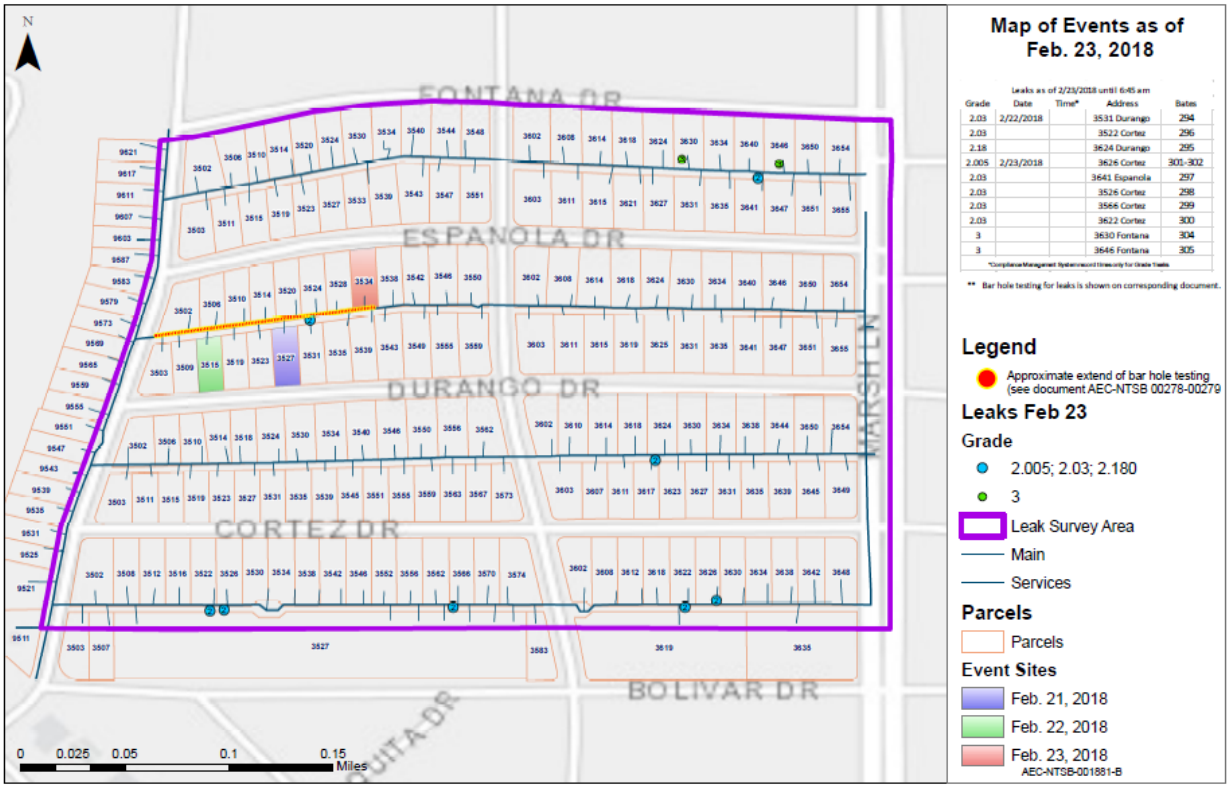


Figure 19 — Map of leak survey area and leaks on February 23, 2018 (Attached as Exhibit E to the Appendix).

[64] Interview of Operations Supervisor M.R. (3.8.2018) at pg. 27
[65] Interview of Operations Supervisor M.R. (3.8.2018) at pg. 27.
[66] Interview of Operations Supervisor M.R. (3.5.2018) at pg. 40-41.
[67] Interview of Operations Supervisor M.R. (3.5.2018) at pg. 45; Interview of Operations Supervisor M.R. (3.8.2018) at pg. 17, 21-23.

h. Recent Excavations in the Alley of the 3500 Block of Espanola and Durango Drive Provided No Evidence the Damaged Main Was Cracked or Leaking the Day Before the Accident

As set forth below, crews working to replace or install repair service lines in the alley of the 3500 block of Espanola Drive and Durango Drive exposed the main anywhere from 240 feet to just 30 feet from where the Damaged Main was discovered after the accident. Yet, there was no evidence of gas leaking from the Damaged Main during any of these excavations, including the day before the accident.

- On September 17, 2017 the service line was replaced at 3514 Espanola Drive which required excavating the main in the alley approximately 190 feet from the Damaged Main.[68]

- On November 27, 2017, the service line was installed at 3534 Espanola Drive which required excavating the main in the alley approximately 30 feet from the Damaged Main.[69]

- On January 29, 2018 the service line 3527 Durango was replaced which required excavating the main in the alley approximately 140 feet from the Damaged Main. [70]

- On February 22, 2018 the service line to 3519 Durango Drive was replaced which required excavation of the main in the alley approximately 240 feet from the Damaged Main.[71]

[68] AEC-NTSB-000012-00013
[69] AEC-NTSB-00069-1-00069-2
[70] AEC-NTSB-000052-00053
[71] AEC-NTSB- 000292-000293

PROPOSED FINDINGS, PROBABLE CAUSE, AND SAFETY RECOMMENDATIONS

Proposed Findings

The following proposed findings are drawn from the evidence produced during the investigation of the accident at 3534 Espanola:

1. **The main behind 3534 Espanola Drive ("Damaged Main") was dented, bowed, and gouged by mechanized equipment.**

    a. When the Damaged Main was exposed after the accident, it revealed a circumferential crack on top of the main, directly underneath a sewer lateral.

    b. The sewer lateral was just 1 ½ inches above the top of the Damaged Main.

    c. The Damaged Main was bowed downward.

    d. The crack on the Damaged Main intersected a large dent.

    e. The Damaged Main was coated with a coal-tar enamel spiral wrap coating that was damaged in four areas (on the top side of the main below the sewer lateral) and covered in a hard, compacted adherent deposit.

    f. The hard deposit was not corrosion.

    g. When the hard deposits were removed, each of the four areas contained at least one major gouge in the metal.

    h. The dent and gouges in the Damaged Main indicate that it had been struck by mechanized equipment.

2. **The Damaged Main was dented, gouged, and bent by a third-party excavator during the installation of a sewer lateral in 1995/1996 but the damage to the pipe was not reported.**

    a. The sewer lateral was installed by a third-party between October 1995 and May 1996 as part of a sewer replacement project.

    b. There is no evidence the damage was reported to Atmos.

    c. There is no evidence of other third-party excavation in the location of the Damaged Main after the sewer lateral was installed.

3. **Laboratory tests on the Damaged Main confirmed:**

a. The circumferential crack (a stress-induced separation of metal) originated from the dent.

b. There was a 20% reduction in the wall thickness of the Damaged Main at the point of the dent that made the pipe susceptible to cracking and failure.

c. There is no evidence of corrosion in the pipe, and no evidence that corrosion contributed to the pipe failure.

4. **The main in the alley of the 3500 block of Espanola Drive (the "Main") was in good condition and its performance history showed no evidence of damage as demonstrated by the NTSB's physical examinations, pressure tests, laboratory analysis, and historical operating records.**

a. The Main was cathodically protected.

b. The cathodic protection pipe-to-soil potentials were all above the regulatory requirements for the 10 years preceding the accident.

c. The Main was regularly leak surveyed and monitored.

d. In the 25 years prior to the accident, only one, non-hazardous leak was identified on the Main, which was permanently repaired in 1997.

e. The hard deposit found on the Damaged Main was not present on any other undamaged portion of the Main.

f. Atmos complied with regulatory distribution integrity management requirements.

g. The Main was not considered high relative risk.

5. **Odorant was readily detectable**.

a. Regularly performed testing before the accident confirmed odorant was readily detectable.

b. Testing after the accident witnessed by representatives of the Texas Railroad Commission and Dallas Fire-Rescue confirmed odorant was readily detectable.

c. Customer odor reports on January 1, 2018 and February 22, 2018 confirmed odorant was readily detectable.

6. The two non-hazardous resolved leaks identified on January 1, 2018 were unrelated to the house fires on Wednesday and Thursday and the accident on Friday.

a. The Preliminary Report states that "a review of odor reports and the activity by Atmos in the neighborhood shows that leaks were first detected on January 1, 2018." The Preliminary Report also states that Atmos "had performed various repair work prior to…the days these three incidents occurred."

b. These references in the Preliminary Report are to two non-hazardous leaks that were identified on January 1, 2018 and timely repaired.

c. [redacted]

d. No reports of odor in the 3500 block of Espanola and Durango were made after January 1, 2018, until Atmos was called by Dallas Fire-Rescue to the house fire on Wednesday, February 22, 2018.

7. Atmos conducted a thorough investigation of the house fire on Wednesday.

a. After checking in with the Dallas-Fire Rescue, the Senior Service Technician confirmed the meter was off and not damaged.

b. He tested the regulator and confirmed it was working properly.

c. He performed a bar hole test using a SENSIT® Gold combustible gas indicator (CGI) near the service riser that indicated no gas was present.

d. Because there was standing water in the alley, he used his CGI to survey above and on both sides of the gas main while also searching for other indications of a leak.

e. The Senior Service Technician concluded his investigation after finding no evidence of leaks.

8. Atmos conducted a thorough investigation of the house fire on Thursday.

a. After meeting with the Dallas Fire-Rescue Incident Commander, the Service Technician confirmed the meter was off.

b. The Incident Commander told him that there had been a gas-related fire three houses over the day before.

c. The Service Technician contacted his Supervisor to request assistance and was joined by a Distribution Operator, a second Service Technician, and Two Operations Supervisors.

d. The two Service Technicians and the Distribution Operator conducted a thorough investigation and found no migration of gas into the residence after:

1) Bar hole testing both sides of the meter to check for leaks;

2) Checking the sewer clean out; and

3) Bar hole testing around the foundation of the house and along the service line.

9. The fires on Wednesday and Thursday were not caused by gas leaking from the Damaged Main.

a. [redacted]

b. There was no evidence of gas migration from the Damaged Main to either residence.

10. Atmos expanded its monitoring of the alley out of an abundance of caution.

a. Atmos checked all visible sewer clean outs along the alley for the 3500 block of Durango Drive and Espanola Drive.

b. Two Atmos Service Technicians and a Distribution Operator also bar-holed tested along the Main in the alley as reflected in Figure 15, punching holes every five feet to check for a possible leak.

c. They found two non-hazardous leaks at 3531 Durango Drive and at 3519 Durango Drive that were graded as Grade 2.30, which means they were non-hazardous and could be scheduled for repair within 30 days.

d. Nevertheless, crews were called in to repair the leak at 3519 Durango Drive by exposing the main and replacing the service line. Thus, approximately five houses away from the location where post-accident excavation revealed

the circumferential crack, there was no evidence of damage or leak on the Main.

e. A leak was also discovered in the customer-owned yard line at 3531 Durango Drive. Gas service was turned off until repairs were made.

f. As reflected in Figure 15, Atmos bar-hole tested over the main behind 3534 Espanola Drive, the location where post-accident excavation revealed the circumferential crack.

g. As Atmos personnel continued to bar-hole test along the alley, a resident from Larga Drive who had called to report an outdoor gas odor told a Service Technician that she had also seen bubbles near the sidewalk.

h. Atmos investigated and graded the leak as a Grade 1 hazardous leak on the service line. The leak was monitored, and a company crew was called to eliminate the hazard by replacing the service line.

11. As a precaution, Atmos called in leak survey specialists to survey an eight-block area.

a. Atmos employees in the field have the authority to take immediate action to protect life and property including turning off gas, shutting in a system and evacuating residents without a prior approval from supervisors.

b. As they leak surveyed, Atmos employees took immediate action to protect life and property and make the area safe.

c. A resident was evacuated when a Service Technician detected gas near a garage apartment. The hazard was monitored until eliminated by repairing the leak.

d. The leak survey identified three additional Grade 1 leaks and nine non-hazardous leaks.

e. Crews were called in to continuously monitor and repair the three additional hazardous Grade 1 leaks.

f. By early morning Friday, Atmos had repaired the hazardous leaks detected in the leak surveyed area. None of the leaks detected by the leak survey were in the alley of the 3500 block of Espanola.

g. No hazardous leaks were detected on the Main in the days or hours leading up to the accident.

12. Appropriate procedures and technology were used for the bar hole testing and leak survey to detect leaks in wet weather conditions.

a. Atmos' combustible gas indicators used for bar hole testing during its leak investigation after the two house fires and during the subsequent leak survey were calibrated, properly operating, and appropriate for the conditions.

b. Atmos' wet weather procedures were followed.

c. Leak Survey Specialists relied on their training and experience and used what they considered to be the best technology for the conditions.

13. Atmos employees were trained, qualified, and experienced.

a. Employees were trained and qualified to perform operations, maintenance, and emergency response activities.

b. The team of employees working in the area before the accident drew on years of experience and training when making decisions.

c. Atmos employees in the field have the authority to take immediate action to protect life and property including shutting in a system or evacuate a resident without any prior approval from supervisors.

14. As reflected in Findings 4-13, there were no indications that the Damaged Main was damaged, cracked, or leaking prior to the accident.

15. The crack on the Damaged Main was the most likely source of the leak which led to the explosion at 3534 Espanola.

a. During post-accident excavation, gas readings were detected in the loose sand around the new sewer line to 3534 Espanola which could have provided an easy pathway for the gas to migrate into the newly remodeled residence.

b. There were no other leaks in the area.

c. The pipeline failure was likely rapid since there was no evidence of gas migration prior to the accident.

d. The crack on the Damaged Main (which was operating at 25 psig), could have quickly allowed gas to migrate to the residence, which had many potential ignition sources.

16. **On the day of the accident, the Damaged Main did not fail as a result of human error or excessive operating pressure.**

17. **If the Damaged Main had not been gouged, bent, and dented by a third-party excavator, it would not have failed before 6:38 a.m. on Friday, February 23, 2018.**

18. **Post explosion responses by Dallas Fire-Rescue and Atmos were prompt and adequate.**

Proposed Probable Cause

The probable cause of the gas-fueled explosion at 3534 Espanola Drive in Dallas, Texas on February 23, 2018 was the unreported damage of the 2" main by third-party excavation during the installation of a sewer lateral.

A Note on the U.S. Army Corps of Engineers Report

Atmos has known since early March 2018 that the crack in the Damaged Main was caused by third-party excavation. Atmos never claimed that the Damaged Main cracked due to heavy rains and soil composition.

Atmos engaged Bryant Consultant Inc. (BCI) to help identify a potential cause for the sudden and unexplained leaks in a defined geographical area in Northwest Dallas in the days leading up to a planned system outage on March 1, 2018. Consistent with its party representative obligations, Atmos notified the NTSB at the time that BCI's purpose was unrelated to the accident.

Although the U.S. Army Corps of Engineers issued a Government Geotechnical Report that states its purpose was to evaluate the technical accuracy of BCI's Preliminary Assessment "regarding the possible cause of the gas pipeline explosion in Dallas, TX," the NTSB's Operations Report confirmed that BCI was not engaged to investigate, or draw conclusions, regarding the events of February 21-23, 2018.[72]

BCI's analysis progressed over the months that followed its Preliminary Assessment. *See* Process Workflow attached as Exhibit F. At the NTSB's request, Atmos told BCI not to obtain core samples or conduct geological subsurface testing in the alley of the 3500 block of Espanola Drive and Durango Drive.

BCI's work helped Atmos develop a new geological risk factor into the risk model for the Mid-Tex operating system. Atmos continues to evaluate if a similar geologic risk factor should be incorporated into risk assessment models in other states where it operates.

[72] NTSB Operations Factual Report at pg. 23

Proposed Safety Recommendations

In addition to the voluntary safety initiatives that Atmos has taken, or committed to take, Atmos recommends:

1. Facilitating the development and integration of non-punitive self-reporting systems into state excavation damage prevention programs

   Program integration should include awareness programs to educate excavators on the hazards of damaged natural gas lines even if no gas is released and the critical need to self-report damage or suspected damage to natural gas infrastructure.

2. To further enhance efforts that are underway to minimize and prevent damage to underground natural gas infrastructure, Atmos recommends the commissioning of a study to evaluate and make recommendations to reduce the persistent damage issues related to:

   a. Failure to promptly notify operators after damaging a pipeline

   b. Failure to call before digging

   c. Inadequate excavation practices (tolerance zone)

   d. The study should evaluate and consider recommendations related to excavator training and certification (including directional drilling) and involve the appropriate stakeholders including those from the industry, state and federal regulators and the Common Ground Alliance.

3. The continued investment by the natural gas industry in research and development efforts to enhance leak detection technologies for performing leak surveys and leak investigations in difficult environmental conditions (e.g., high levels of moisture, frost caps, snow, ice).

4. The industry's adoption of the American Petroleum Institute's Recommended Practice 1173, Pipeline Safety Management Systems.

SAFETY INITIATIVES

Atmos Energy's commitment to safety is a core value, reflected in our Vision Statement, and permeates our culture. It is evident in our people, policies, practices, and procedures. We live this safety value; it is part of who we are. Our holistic approach to managing safety involves observing, evaluating, and adapting to changing and challenging conditions. We are committed to continuous improvement as we work to achieve our vision of being the safest provider of natural gas service.

Our focus on safety has continued throughout this investigaton. Atmos previoulsy provided a summary to the NTSB of initiatives that were underway, or ones we committed to take, to enhance safety. That summary is contained in the Operations Report, and several of the continuous improvement safety initiatives that Atmos has undertaken that relate specifically to the investiagiton are discussed below:

1. Damage Prevention

Atmos has been and will continue to be a champion for damage prevention. Our third-party damage rate continues to outperform the industry average. In our last fiscal year (2019), the number of third-party damages on our system decrease by almost 5%, even though the number of line locates increased by 9%. To further reduce the risk of third-party excavation damage, Atmos:

- Audited more of our 3rd party line locating services to determine what actions can be taken to further reduce third party excavation damage.
- Strengthened our 'Watch and Care' program to require additional follow-up with excavators who have called in a line locate ticket.
- Started flagging and/or marking the location of newly installed pipe and associated facilities to bring immediate visibility to their location while our facilities map records are updated.
- Added new reporting metrics to better evaluate the performance of our damage prevention program.
- Implemented a Damage Prevention Ambassador Program that encourages employees to proactively stop by excavation sites to provide damage prevention materials to excavators and ensure proper 811 notification.
- Is on pace to complete the roll out of LocusView so that by the end of 2020 all distribution construction crews (internal and contractors) can capture and transmit detailed data on new pipe installation through a mobile app. This includes as-built maps, tracking and traceability of materials, joints and associated information.

LocusView's high accuracy GPS creates as-built maps that are integrated directly into Atmos' GIS.

- Developed safety mascots and ambassadors Gus the Gopher and Rosie the Skunk to engage customers and the public in remembering to call 811 before you dig and using your senses to detect natural gas. In July of 2018, Atmos' "Gus the Gopher for Call 811" won top video in the external category of the American Gas Association Safety Awareness Video Excellence awards.

Figure 20

2. Pipeline Safety Management System

In July 2015, the American Petroleum Institute (API) issued Recommended Practice 1173 (RP1173) outlining a Pipeline Safety Management System (PSMS). This is a voluntary measure, not required by code or regulation. The American Gas Association (AGA) recommended RP1173 for industry adoption in May 2019. With respect to PSMS, Atmos:

- Participated in industry workshops and discussion groups to learn more about PSMS after its issuance by API in 2015.

- Engaged an industry leading third-party expert in 2016 to examine its practices in light of RP1173, and also conducted a self-assessment for one of its operating divisions.

- Continued to participate in industry discussion groups and workshops to gain expertise and better understand how to develop and implement PSMS across its entire organization.

- After February 23, 2018, accelerated the implementation of PSMS by updating its initial self-assessment and engaging its industry leading third-party expert to perform an enterprise wide PSMS assessment and gap analysis.

- Developed a roadmap and draft PSMS program documents to allow it to reach significant and widespread maturity across all elements of a PSMS - a task that RP1173 recognizes is a journey.

- Added a Director level resource to support this accelerated implementation effort.

PSMS is supported at the highest levels of the organization, with a corporate officer primarily responsible for the adoption and implementation of PSMS. Atmos' corporate Risk Management and Compliance Committee (RMCC) is responsible for ongoing governance of PSMS and reporting to the Company's Management Committee.

3. Procedures

We regularly review and revise our procedures as we continue to learn from our own experiences and those of others in the industry. Internal subject matter experts (SMEs) participate in the review and development of these procedures. Our leak survey and leak investigation procedures have been updated to include mandatory 911 notification and the establishment of a Safety Perimeter when a hazardous condition is discovered.

4. Training

Our commitment to the training of our highly skilled employees is evident and a tangible example of that is the Charles K. Vaughan Center in Plano, TX which opened in late 2010. This state-of-the art, industry leading facility, serves as the technical training location for our front-line employees from across our eight-state operation. The multi-week technical training programs are structured in a manner where the focus is on job-readiness. To help achieve this, our employees spend approximately 20% of their time in the classroom and 80% of their time performing hands-on training. As a company, we held over 91,000 hours of safety training in fiscal 2019.

In order to enhance our robust training curriculum and for our highly trained and qualified gas professionals and our operation leaders, Atmos:

- Developed and delivered an online leak survey refresher training for all employees with specified leak survey Operator Qualification (OQ) requirements.
- Developed and delivered a one-week leak survey refresher training class in the first half of 2019 to all employees whose primary job responsibilities are leak surveying. The training consisted of classroom instruction, a review of procedures, hands-on training by equipment vendors, discussion of weather-related conditions, and industry case studies.
- Implemented an Operations Supervisor Boot Camp at our Charles K. Vaughan training facility that allows operations supervisors to gain a better understanding of our technical training courses, processes and equipment through a one-week hands-on experience class. Every operations supervisor at Atmos has now completed the training, and all new supervisors will be required to attend future classes.

5. Leak Survey

Leak survey and detection is an important part of our safety efforts. Atmos regularly performs leak surveys at more frequent intervals than required by federal regulation. In order to enhance our leak survey program, Atmos:

- Created a dedicated work group within the Mid-Tex division to support and monitor leak survey activity.
- Continues to closely monitor our system in the Dallas-Fort Worth area through more frequent leak surveys and has employed additional third-party resources to support these efforts.
- Is conducting additional leak surveys across a broad area of the Mid-Tex system at more frequent intervals than required by federal and state regulations.
- Has purchased additional advanced mobile leak detection units within our Texas operations. These units are equipped with sensors that are 1,000 times more sensitive than traditional technologies. We plan to add additional units over time.
- Continues to implement GPS tracking functionality on leak survey equipment.

6. Risk Factors

In order to better understand and address geological and climatological threats to our operating system, Atmos retained a geotechnical engineering firm which has resulted in:

- The development and implementation of a geological risk factor that was included in the 2019 Mid-Tex division risk analysis.
- The development of a geological risk factor across the state of Texas.
- Ongoing review across all states where we operate.

7. Research and Development

We are always working with industry and technology partners to develop and evaluate new technologies to enhance safety. For years we have partnered with the Gas Technology Institute's Operations Technology Development (OTD) collaborative, which develops technology-based solutions for the natural gas industry. Among the efforts that Atmos supports to enhance safety through our involvement in OTD are:

- Residential methane detectors
- Leak survey/investigation sensors and technology
- Damage prevention tools and practices

8. System Modernization

Over the last 10 years, we have invested $10 billion company-wide to modernize our pipeline infrastructure, over 80% of which was allocated to safety. Over the next five years we have committee to spend $10 to $11billion and replace approximately 5,000 – 6,000 miles of distribution and transmission pipe. We are committed to replacement of all remaining cast iron by the end of 2021. Other highlights for fiscal year 2019 (10/1/18 – 9/30/19) include:

- 890 miles of distribution and transmission pipelines replaced.
- 53,000 service lines replaced.
- 288,000 hours of safety, technical, and other training delivered

Atmos Energy Corporation's
APPENDIX IN SUPPORT OF
Proposed Findings, Probable Cause, and Recommendations to the National Transportation Safety Board

February 28, 2020

Docket No. PLD18FR002
Relating to Natural Gas-Fueled Explosion
3534 Espanola Drive in Dallas Texas
February 23, 2018

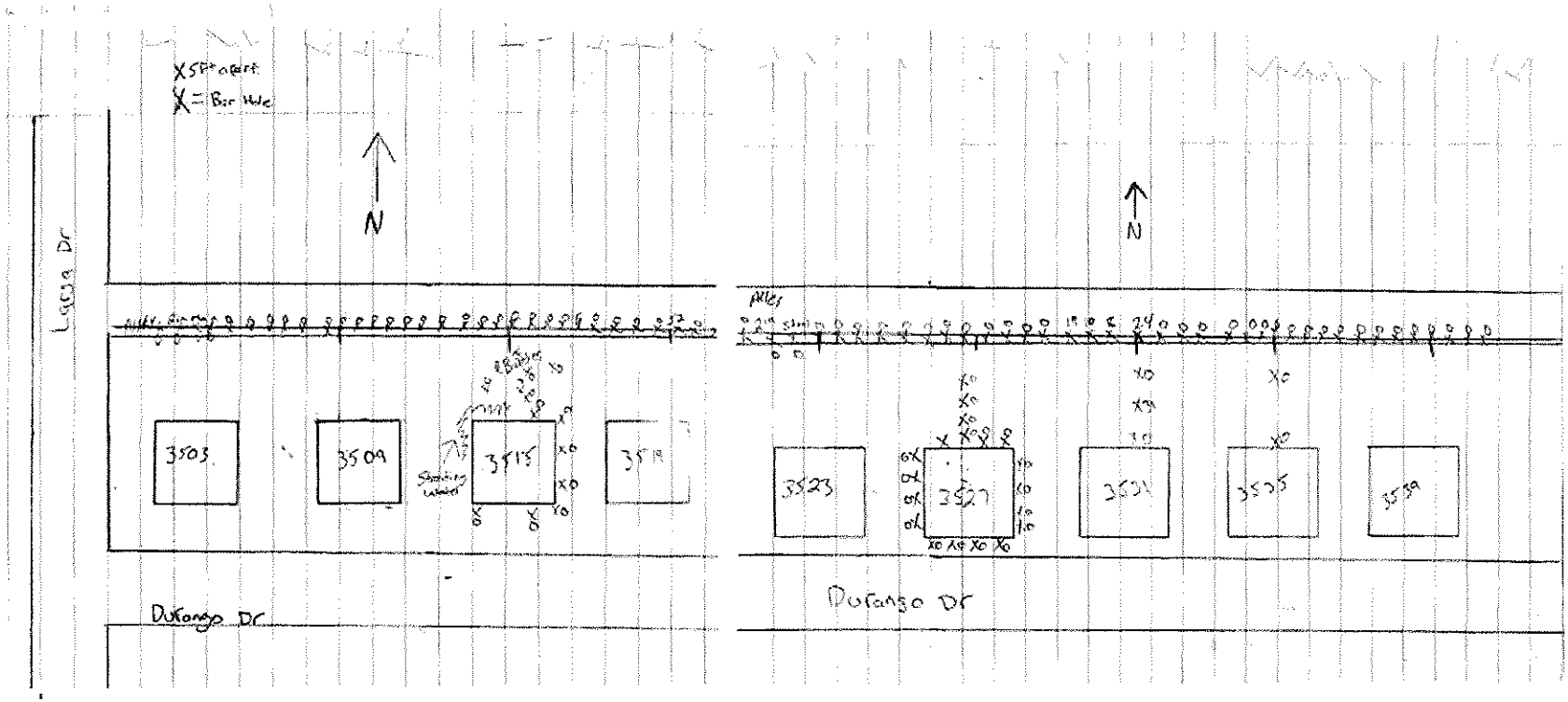
INDEX

EXHIBIT	DESCRIPTION
A	[redacted]
B	[redacted]
C	Figure 15: Bar Hole Testing in the Alley of the 3500 Block of Durango Drive and Espanola Drive at approximately 1:30 p.m. on Thursday, February 22, 2018 (AEC-NTSB-000277-000279)
D	Figure 16: Map of Events on February 22, 2018 (AEC-NTSB-001881-A)
E	Figure 17: Map of Events as of February 23, 2018 (AEC-NTSB-001881-B)
F	Bryant Consultants Project Summary (AEC-NTSB-001847-001872)
G	[redacted]
H	[redacted]
I	[redacted]

A

B

C


X = Bar Hole
N
Laguna Dr
3503
3509
3515
3523
3527
3531
3535
3539
Durango Dr
Durango Dr

D

Map of Events as of Feb. 22nd, 2018

Leaks on 2/22/2018

Grade	Date	Time*	Address	Bates
1	2/22/2018	12:30	9583 Larga	288-289
1		17:30	9551 Larga	287
1		17:30	3502 Cortez	286
1		20:30	3655 Durango	290-291
2.03			3519 Durango	292-293
2.03			3531 Durango	294
2.03			3522 Cortez	296
2.18			3624 Durango	295

*Compliance Management System record times only for Grade 1 leaks

** Bar hole testing for leaks is shown on corresponding document.

Legend

Approximate extend of bar hole testing (see document AEC-NTSB 00278-00279

Leaks Feb 22

Grade

1

2.005; 2.03; 2.180

Leak Survey Area

Main

Services

Parcels

Parcels

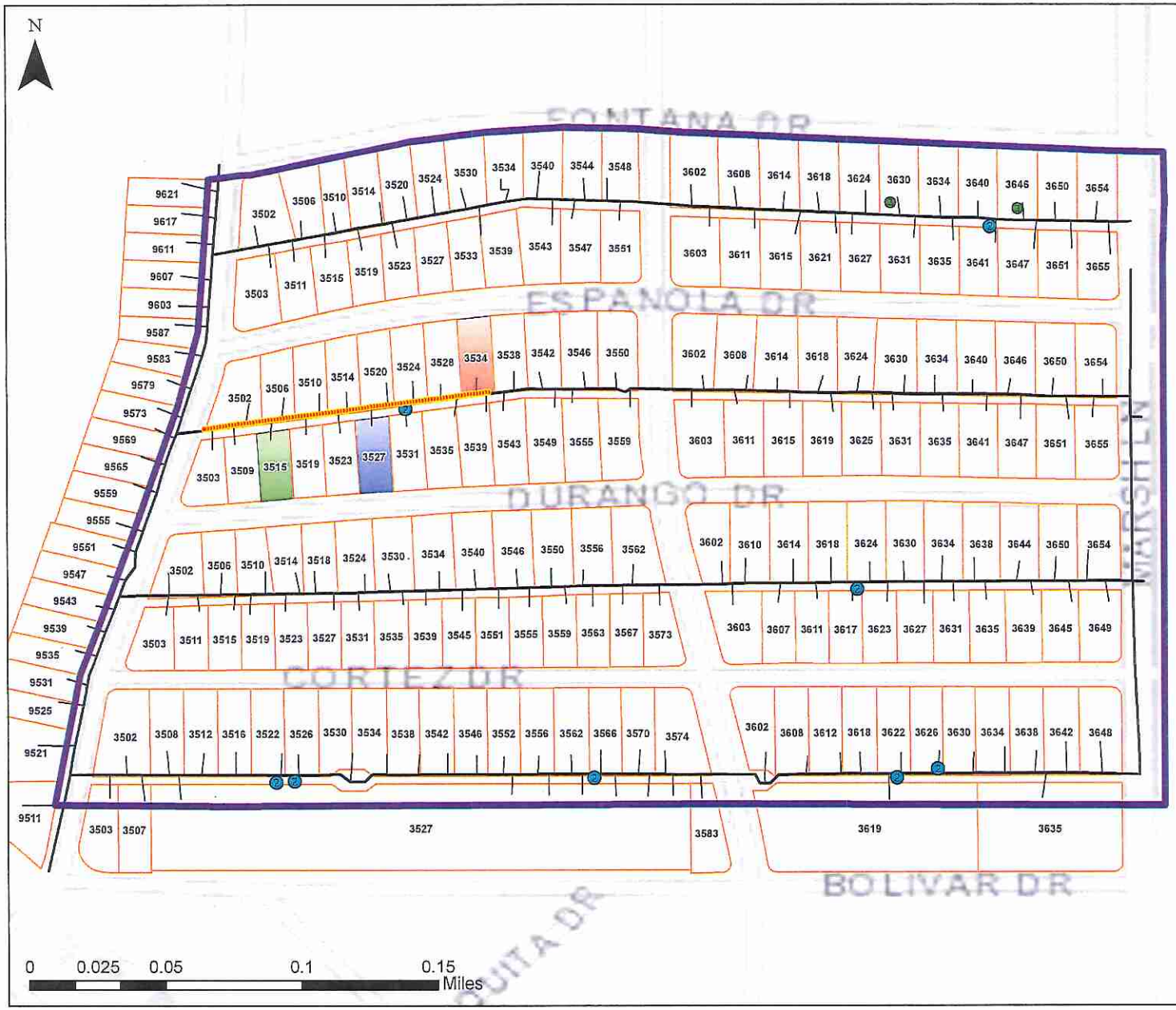
Event Sites

Feb. 21, 2018

Feb. 22, 2018

AEC-NTSB-001881-A

E



Map of Events as of Feb. 23, 2018

Leaks as of 2/23/2018 until 6:45 am

Grade	Date	Time*	Address	Bates
2.03	2/22/2018		3531 Durango	294
2.03			3522 Cortez	296
2.18			3624 Durango	295
2.005	2/23/2018		3626 Cortez	301-302
2.03			3641 Espanola	297
2.03			3526 Cortez	298
2.03			3566 Cortez	299
2.03			3622 Cortez	300
3			3630 Fontana	304
3			3646 Fontana	305

*Compliance Management System record times only for Grade 1 leaks

** Bar hole testing for leaks is shown on corresponding document.

Legend

Approximate extend of bar hole testing (see document AEC-NTSB 00278-00279)

Leaks Feb 23

Grade

- 2.005; 2.03; 2.180
- 3
- Leak Survey Area
- Main
- Services

Parcels

- Parcels

Event Sites

- Feb. 21, 2018
- Feb. 22, 2018
- Feb. 23, 2018

AEC-NTSB-001881-B

F

BRYANT CONSULTANTS

Conventional Forensic Subsea

Project Summary

Geotechnical · Geological · Structural · Civil · Geophysical · Materials · Numerical Modeling

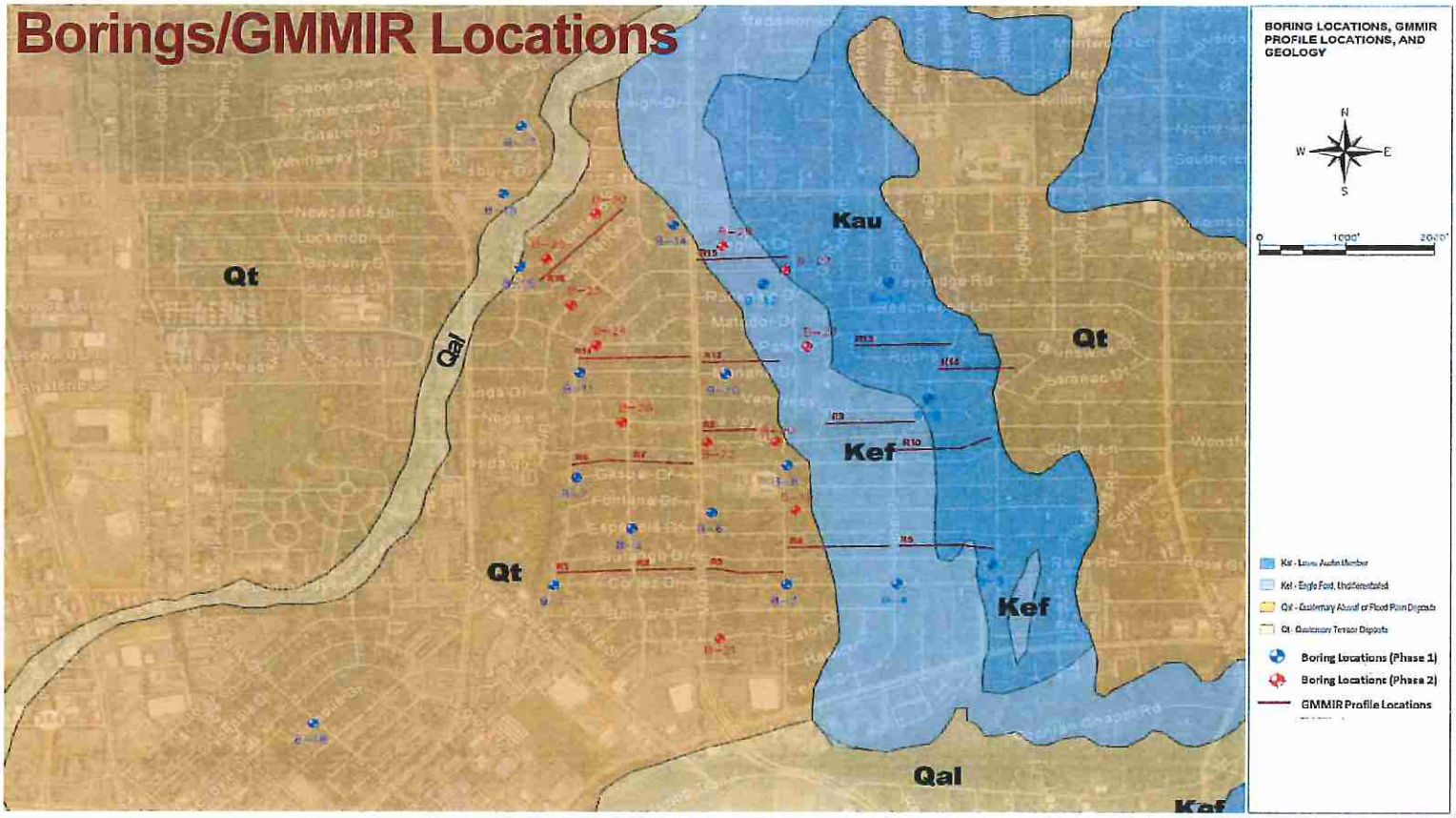
Work Flow

BRYANT CONSULTANTS
Conventional Forensic Subsea

Work Summary

BRYANT CONSULTANTS
Conventional Forensic Subsea

- 18 borings (B1 to B18) (Phase 1)
- 12 borings (B19 to B30) (Phase 2)
- 98 GMMIR® Electrical Resistivity Profiles

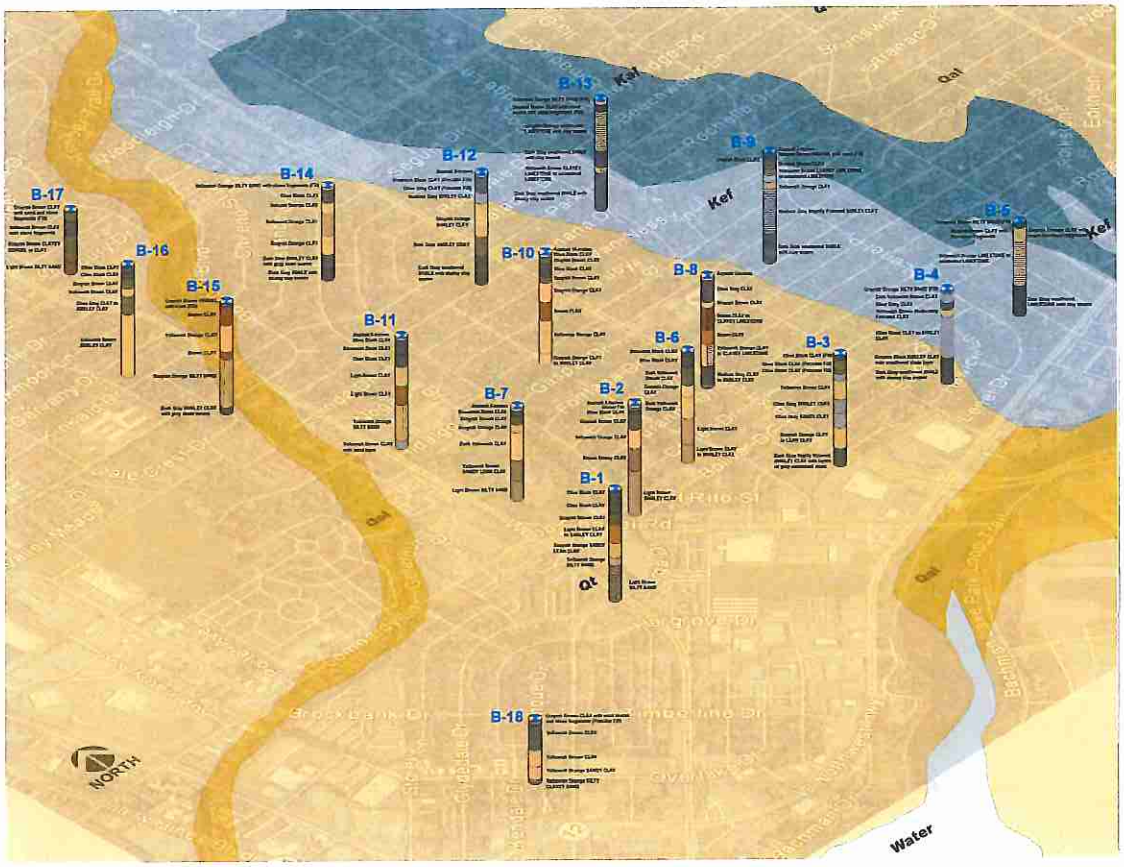


AEC-NTSB-001850

Dallas Geological Society Overlay

(2018 Phase 1 Borings)

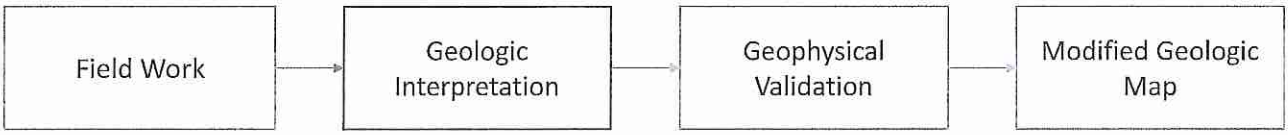
- Kal - Lower Austin Member
- Kef - Eagle Ford, Undifferentiated
- Qal - Quaternary Alluvial or Flood Plain Deposits
- Qt - Quaternary Terrace Deposits



Geotechnical

Work Flow

BRYANT CONSULTANTS
Conventional Forensic Subsea



B-5

BRYANT CONSULTANTS, INC.
DALLAS, TX

LOG OF BORING B-5

Atmos Energy Forensic Investigation
Dallas, Texas-75220
BCI-16-053
Atmos Energy

Date Drilled : 3/21/2016
Ground Elevation : Existing Grade
Casing To : NA
Drilling Method : Cont. Flight Auger

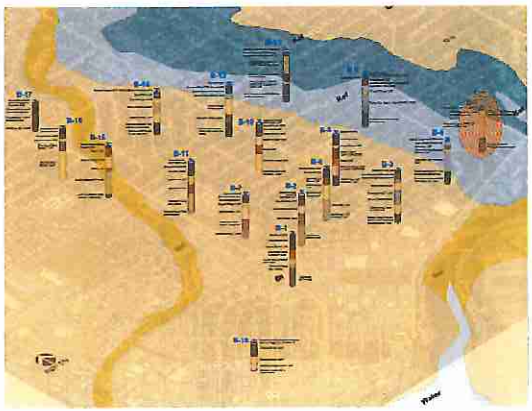
*N = Standard Penetration Test
**T = Pocketed Cone Penetration Test

Depth in feet	Soil/Rock Symbol	Sample Type	Water Level	DESCRIPTION	Moisture Content (%)	Dry Unit Weight (pcf)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing #200 Sieve (%)	Liquidity Index	Total Soil Suction (pF)	Hand Penetrometer (tsf)	Elastic Modulus (ksi/inch)	Unconfined Comp. Strength (psf)	Failure Strain (%)
0				Clay Overburden												
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15				Kal – Lower Austin Chalk												
16																
17																
18																
19																
20																
21																
22																
23																
24																
25				Boring Scheduled to and Terminated at 25 Feet.												
26																
27																

Notes:- No Seepage water was encountered during drilling. Boring remained dry and uncaved at completion.

Kal - Lower Austin Member
Kef - Eagle Ford, Undifferentiated
Qal - Quaternary Alluvial or Flood Plain Deposits
Qt - Quaternary Terrace Deposits

BRYANT CONSULTANTS
Conventional Forensic Subsea



B-11

BRYANT CONSULTANTS, INC.
DALLAS, TX

LOG OF BORING B-11

Atmos Energy Forensic Investigation
Dallas, Texas-76220
BCI-15-053
Atmos Energy

Date Drilled : 3/03/2016
Ground Elevation : Existing Grade
Casing To : NA
Drilling Method : Cont. Flight Auger

*N = Standard Penetration Test
**In Hooked Cone Penetration Test

Depth in Feet	Soil/Rock Symbol	Sample Type	Water Level	DESCRIPTION	Moisture Content (%)	Dry Unit Weight (pcf)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing #200 Sv. (%)	Liquidity Index	Total Soil Suction (pF)	Hand Penetrometer, (tsf)	Electric Resistivity (ohm-m)	Unconfined Comp. Strength (psf)	Failure Strain (%)
0				Asphalt Pavement Thickness = 8.0 inches												
1				Stiff to very stiff Dark Yellowish Brown to Dusky Brown CLAY with gravels to stone fragments (FILL)												
2																
3																
4																
5				Stiff to very stiff Brownish Black, Grayish Brown to Dusky Brown CLAY with few calcareous & iron oxide nodules and stone fragments (POSSIBLE FILL)												
6																
7																
8				Hard Grayish Black, Dusky Brown to Dusky Yellowish Brown CLAY with few calcareous & iron oxide nodules												
9																
10																
11				Clay Overburden												
12																
13																
14				Hard Light Brown, Moderate Brown to Grayish Brown to Dark Yellowish Orange CLAY with sand seams, iron oxide nodules and black inclusions												
15																
16																
17																
18																
19				Dark Yellowish Orange, Light Brown to Grayish Orange SILTY SAND with seams												
20				*N=13												
21				Qt – Quaternary Terrace												
22																
23																
24																
25				*N=24	3					4				265.3		
26																
27																
28				Moderate Yellowish Brown to Grayish Orange CLAY with sand layer,												
29				*N=18	24		50	21	29	43	0.18			0.8		
30				Boring Scheduled to end Terminated at 30 Feet.												
31																

- Kal - Lower Austin Member
- Kef - Eagle Ford, Undifferentiated
- Qal - Quaternary Alluvial or Flood Plain Deposits
- Qt - Quaternary Terrace Deposits

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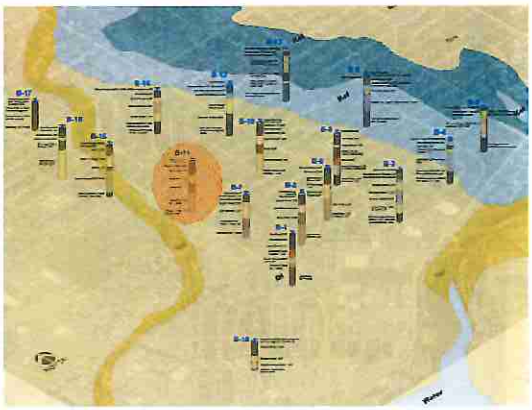
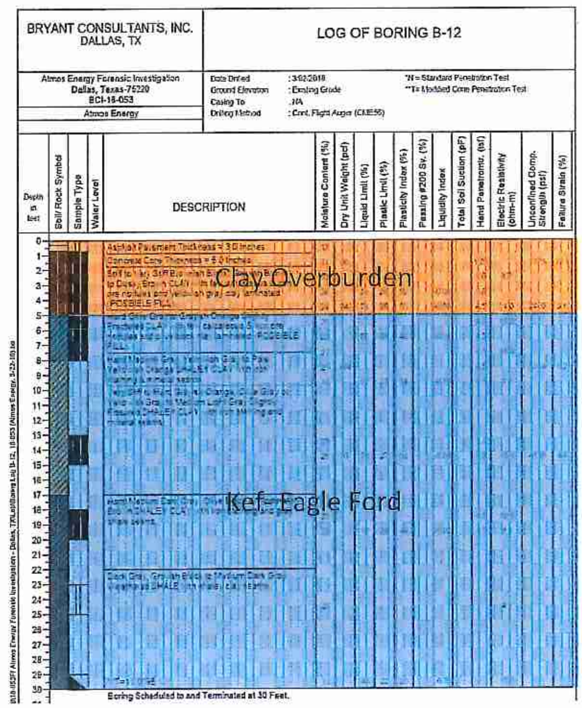
Conventional Forensic Subsea



Geotechnical · Geological · Structural · Civil · Geophysical · Materials · Numerical Modeling

B-12


BRYANT CONSULTANTS, INC.
DALLAS, TX
LOG OF BORING B-12
Atmos Energy Forensic Investigation
Dallas, Texas-75220
BCI-18-053
Atmos Energy
Date Drilled
Ground Elevation
Casing To
Drilling Method
: Existing Grade
: NA
*N = Standard Penetration Test
Depth in feet
Soil/ Rock Symbol
Sample Type
Water Level
DESCRIPTION
Moisture Content (%)
Dry Unit Weight (pcf)
Liquid Limit (%)
Plastic Limit (%)
Plasticity Index (%)
Passing #200 Sv. (%)
Liquidity Index
Total Soil Suction (pF)
Hand Penetromtr. (tsf)
Electric Resistivity (ohm-m)
Unconfined Comp. Strength (psf)
Failure Strain (%)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
Clay Overburden
Kef - Eagle Ford
Boring Scheduled to and Terminated at 30 Feet.

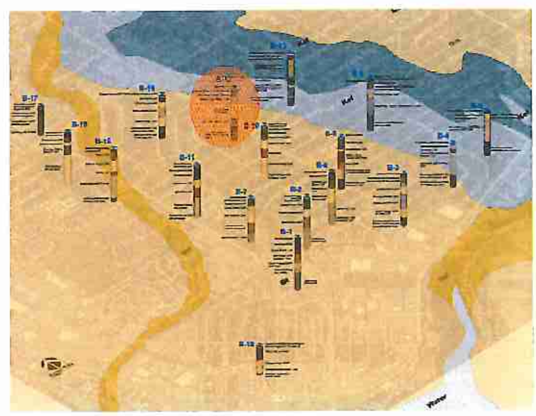
Kal - Lower Austin Member

Kef - Eagle Ford, Undifferentiated

Qal - Quaternary Alluvial or Flood Plain Deposits

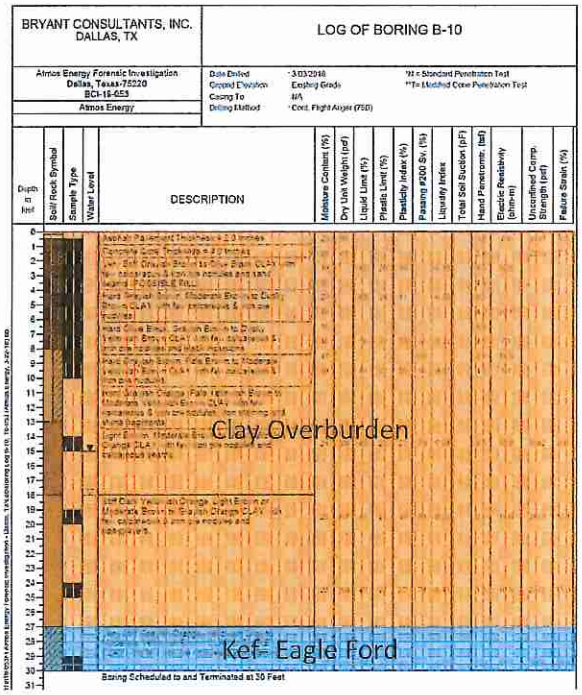
Qt - Quaternary Terrace Deposits

Conventional Forensic Subsea



Geotechnical · Geological · Structural · Civil · Geophysical · Materials · Numerical Modeling

B-10



Kal - Lower Austin Member

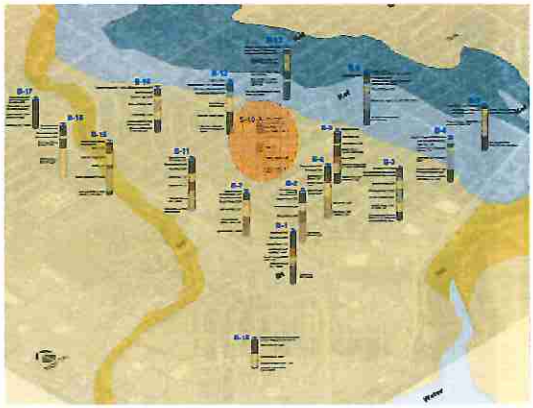
Kef - Eagle Ford, Undifferentiated

Qal - Quaternary Alluvial or Flood Plain Deposits

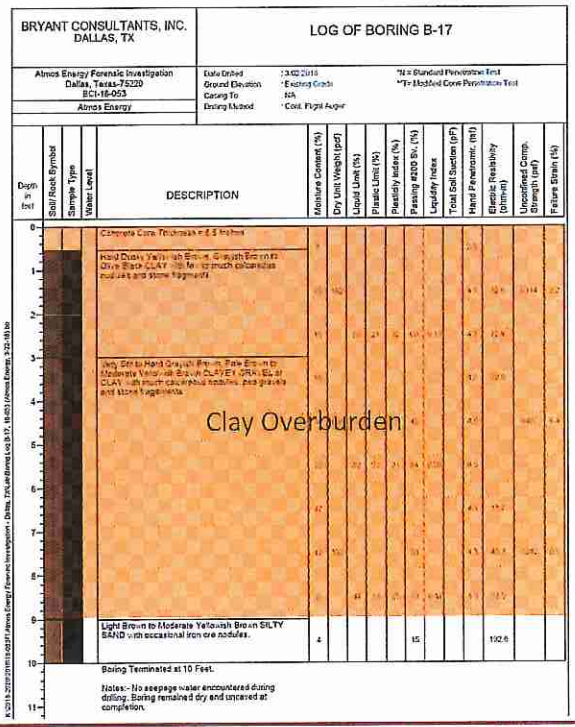
Qt – Quaternary Terrace Deposits

BRYANT CONSULTANTS

Conventional Forensic Subsea



B-17



BRYANT CONSULTANTS, INC.
DALLAS, TX

LOG OF BORING B-17

Almos Energy Forensic Investigation
Dallas, Texas-75220
EC1-16-003
Almos Energy

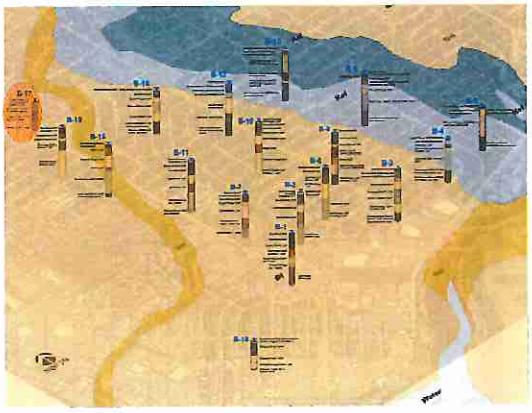
Date Drilled : 3/02/2016
Ground Elevation : Existing Grade
Casing To : NA
Boring Method : Cont. Flight Auger

*N = Standard Penetration Test
**Tv=Modified Cone Penetration Test

Depth in Ft	Soil/ Rock Symbol	Sample Type	Water Level	DESCRIPTION	Moisture Content (%)	Dry Unit Weight (pcf)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing #200 Sv. (%)	Liquidity Index	Total Soil Suction (pF)	Hand Penetromic. (tsf)	Elastic Resistivity (ohm-cm)	Unconfined Comp. Strength (psf)	Failure Strain (%)
0				Concrete Core Thickness = 6.5 Inches												
1				Hard Dusky Yellowish Brown, Grayish Brown to Olive Black CLAY with numerous calcareous nodules and stone fragments.												
2																
3				Very Stiff to Hard Grayish Brown, Pale Brown to Moderate Yellowish Brown CLAYEY GRAVELLY CLAY with much calcareous nodules, pea gravels and stone fragments.												
4				Clay Overburden												
5																
6																
7																
8																
9				Light Brown to Moderate Yellowish Brown SILTY SAND with occasional iron ore nodules.	4					15				102.6		
10				Boring Terminated at 10 Feet.												
11				Notes:- No seepage water encountered during drilling; Boring remained dry and uncaved at completion.												

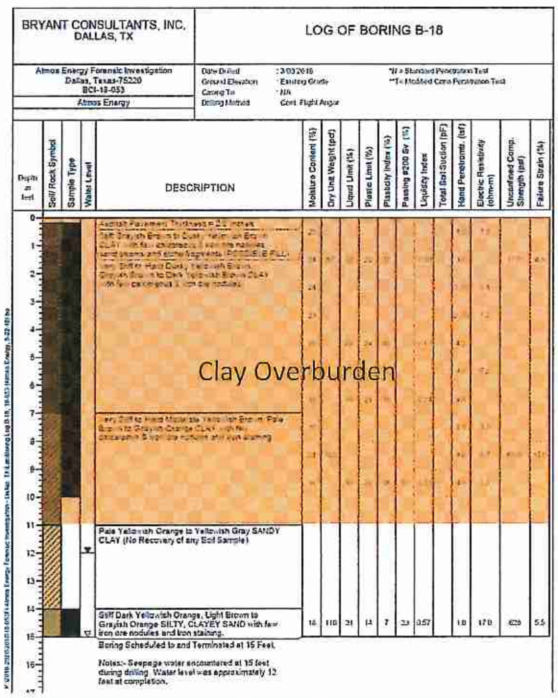
- Kal - Lower Austin Member
- Kef - Eagle Ford, Undifferentiated
- Qal - Quaternary Alluvial or Flood Plain Deposits
- Qt - Quaternary Terrace Deposits

BRYANT CONSULTANTS
Conventional Forensic Subsea



Geotechnical · Geological · Structural · Civil · Geophysical · Materials · Numerical Modeling

B-18



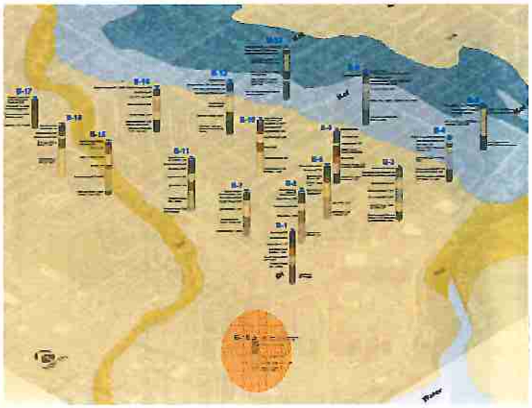
Kal - Lower Austin Member

Kef - Eagle Ford, Undifferentiated

Qal - Quaternary Alluvial or Flood Plain Deposits

Qt - Quaternary Terrace Deposits

Conventional Forensic Subsea

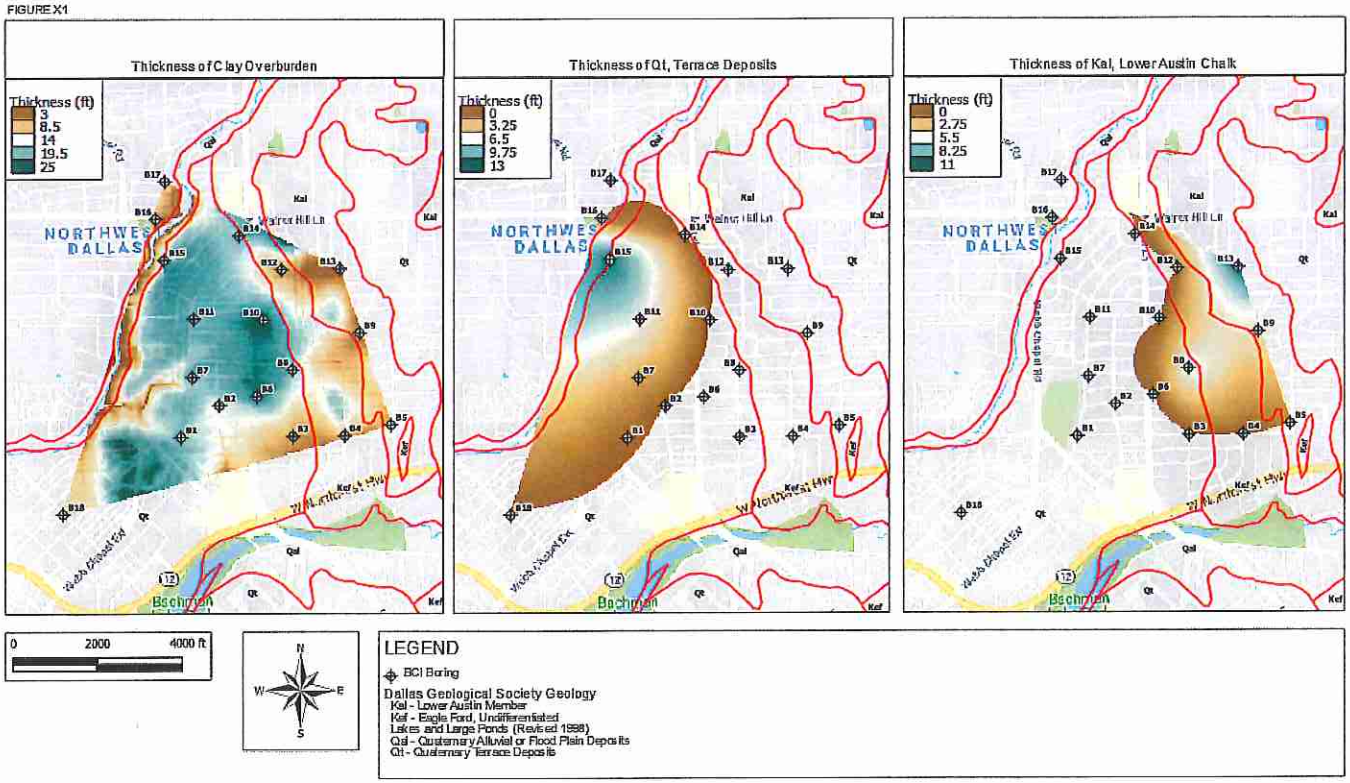


Geotechnical · Geological · Structural · Civil · Geophysical · Materials · Numerical Modeling

BCI 2018 Phase 1

Isopach Map - Layer Thicknesses

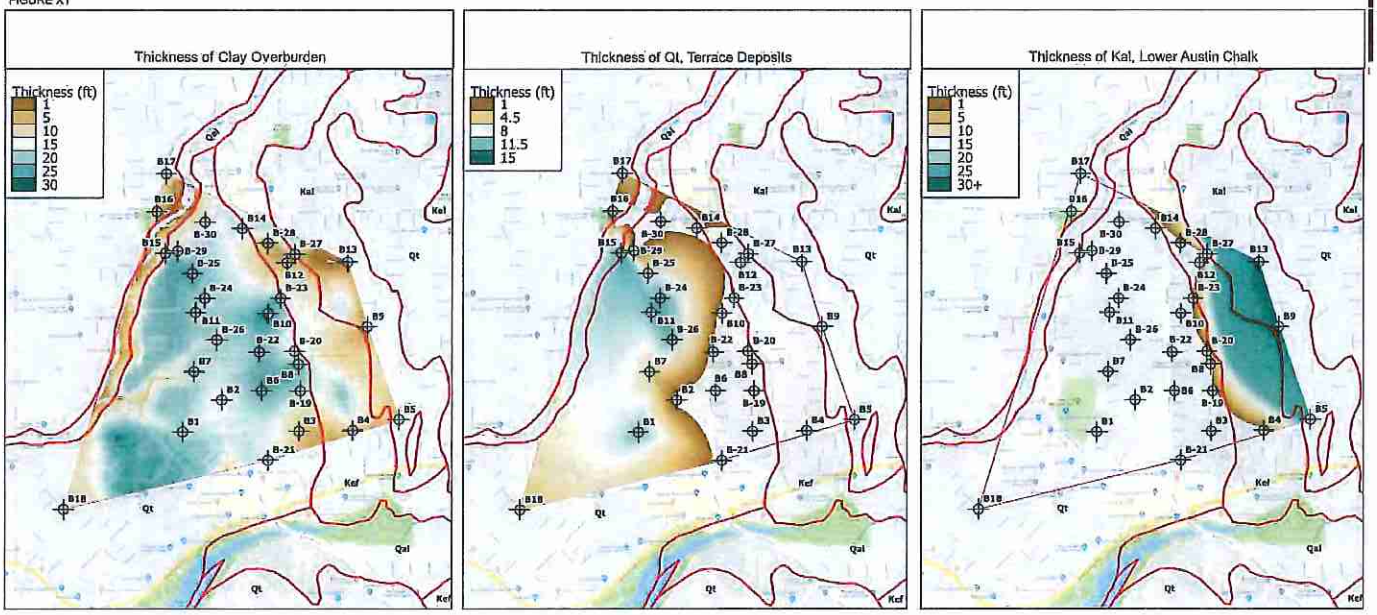
FIGURE X1



AEC-NTSB-001859

BCI 2018 Phase 1 and 2 Isopach Map - Layer Thicknesses

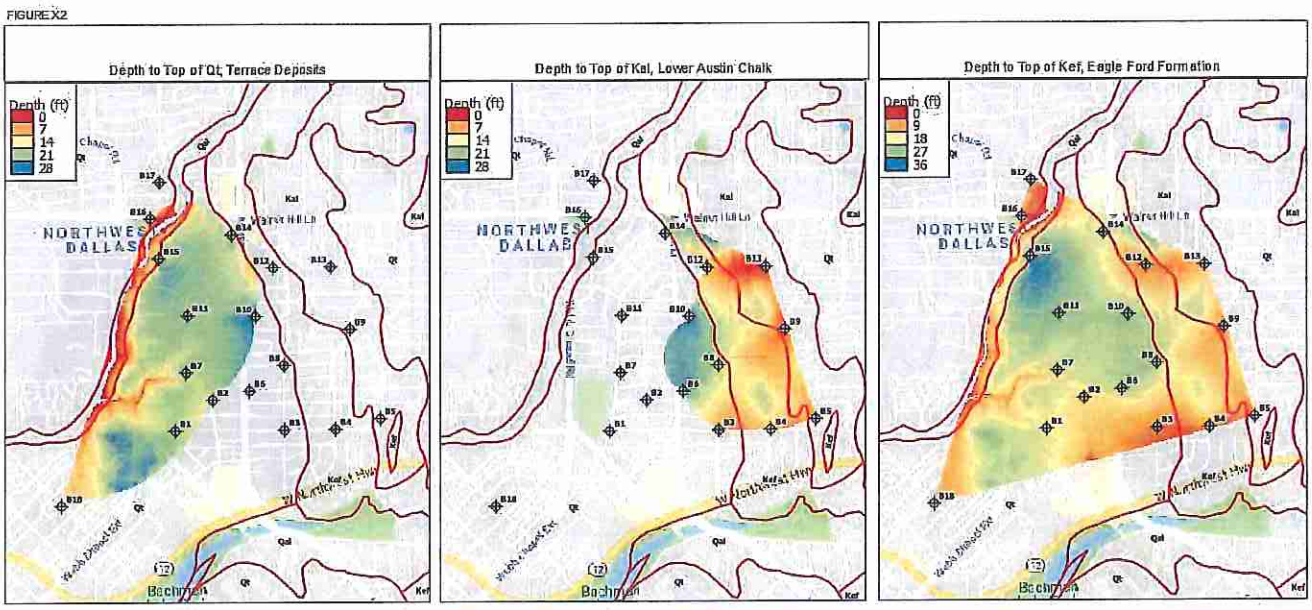
FIGURE X1



BCI 2018 Phase 1

Isopach Map - Layer Depths

FIGURE X2

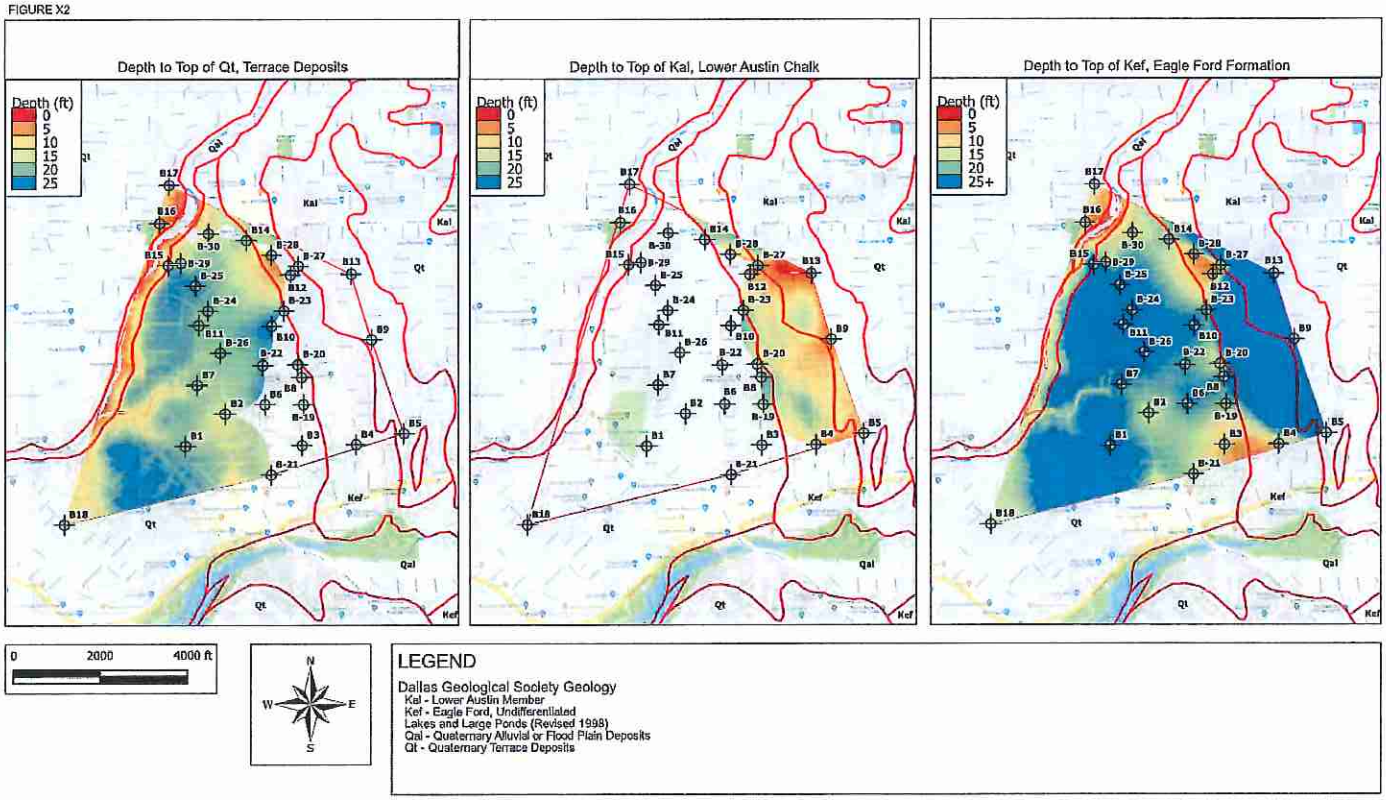


AEC-NTSB-001861

BCI 2018 Phase 1 and 2

Isopach Map - Layer Depths

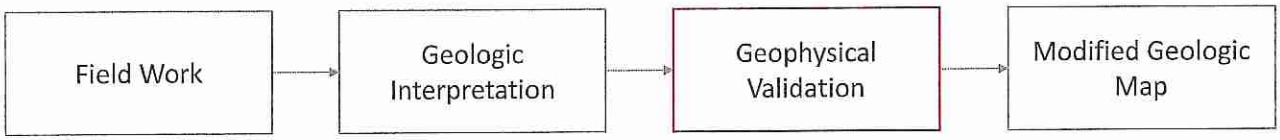
FIGURE X2

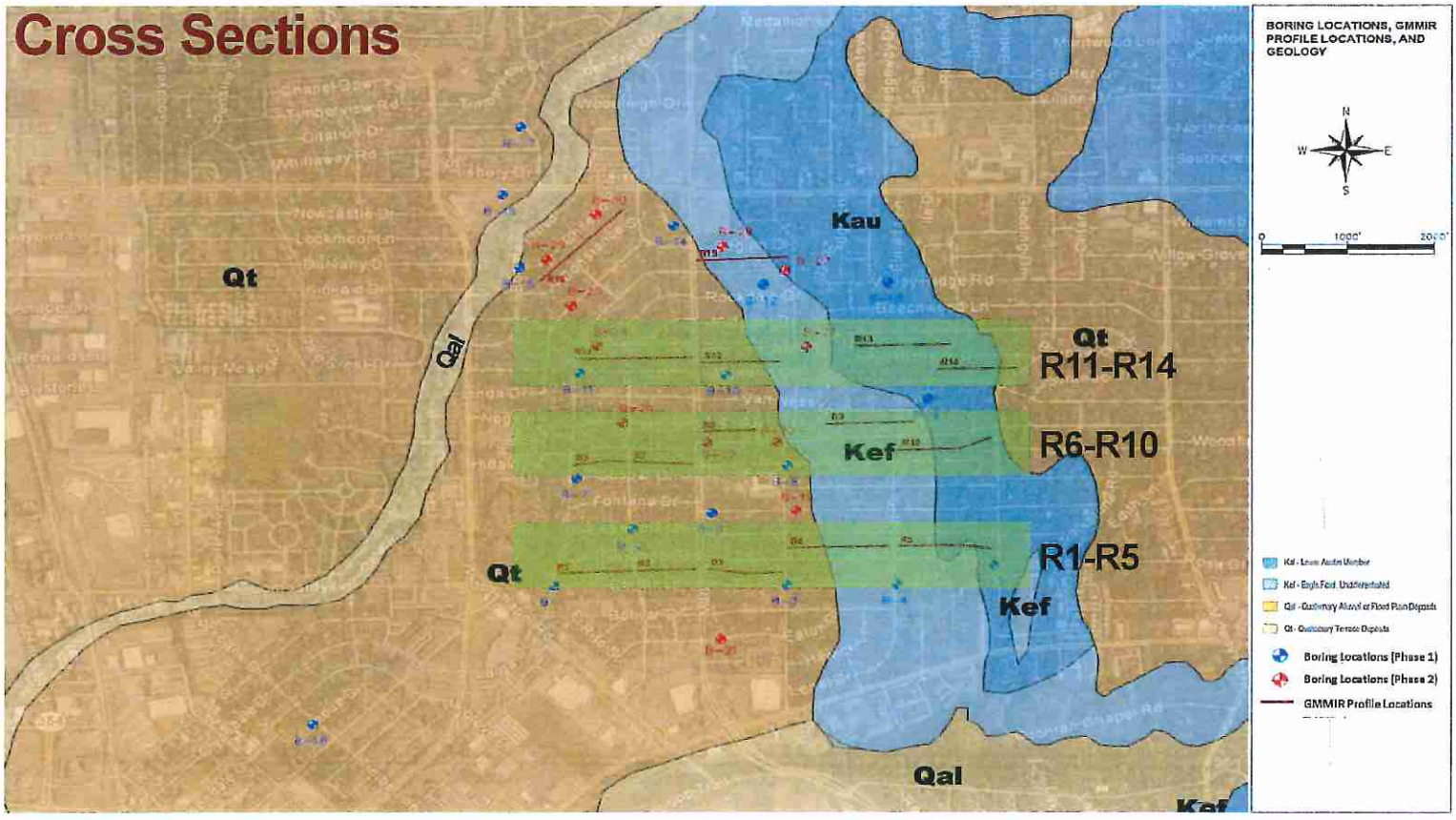


AEC-NTSB-001862

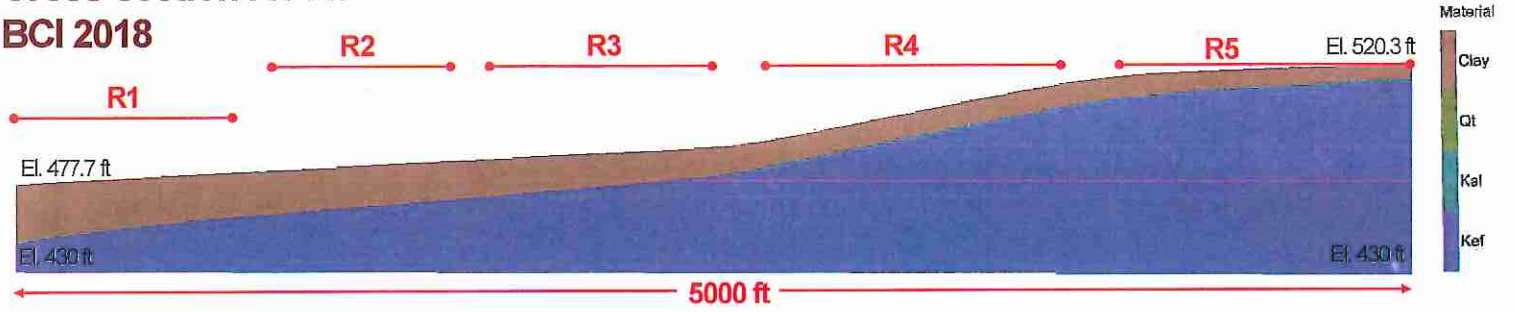
Work Flow

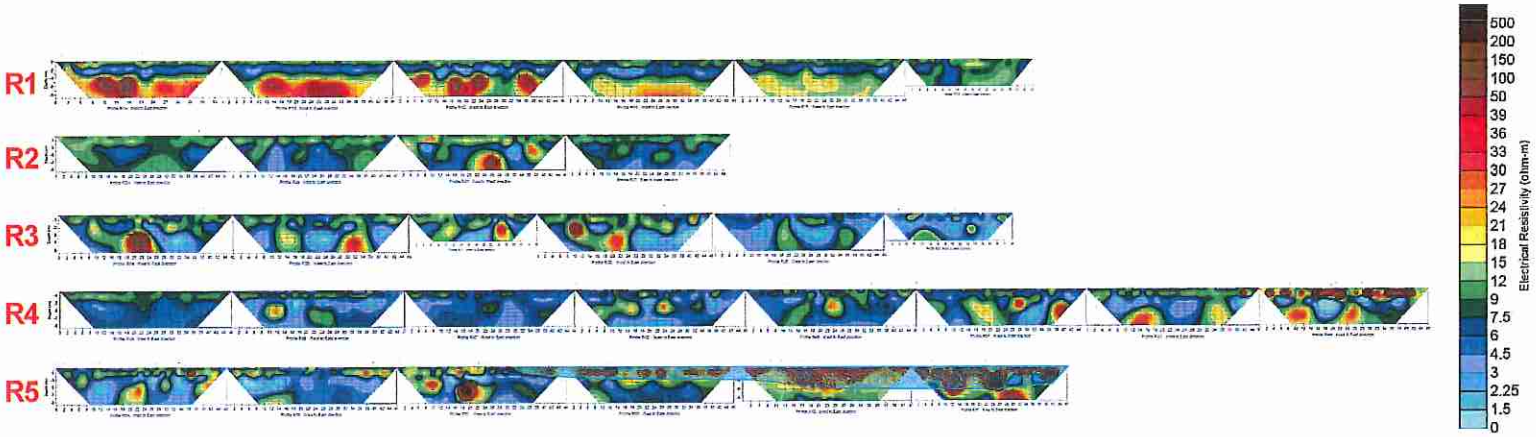
BRYANT CONSULTANTS
Conventional Forensic Subsea




Cross Sections
BORING LOCATIONS, GMMIR PROFILE LOCATIONS, AND GEOLOGY
N
W
E
S
0
1000'
2000'
Kau
Qt
Qal
Qt
R11-R14
Kef
R6-R10
Qt
R1-R5
Kef
Qal
Kef
Kef - Eagle Ford, Undifferentiated
Qal - Quaternary Alluvial or Flood Plain Deposits
Qt - Quaternary Terrace Deposits
Boring Locations (Phase 1)
Boring Locations (Phase 2)
GMMIR Profile Locations

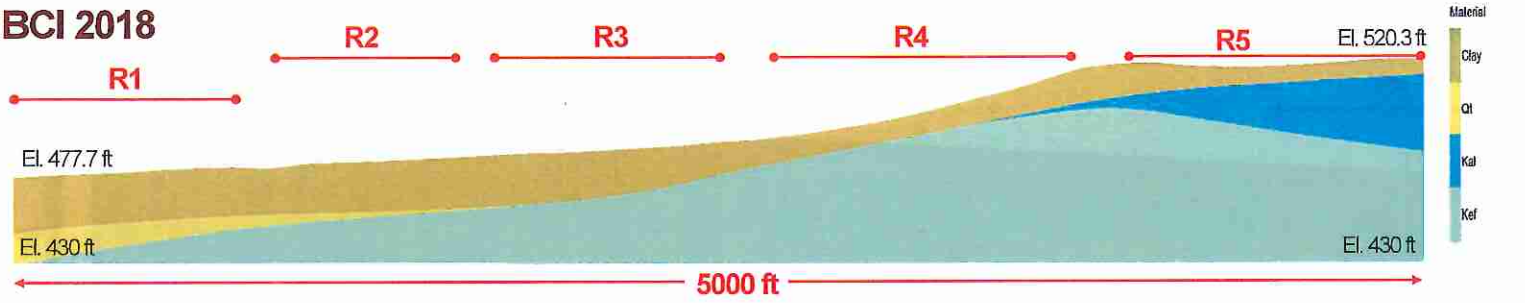
Cross-section R1-R5
BCI 2018

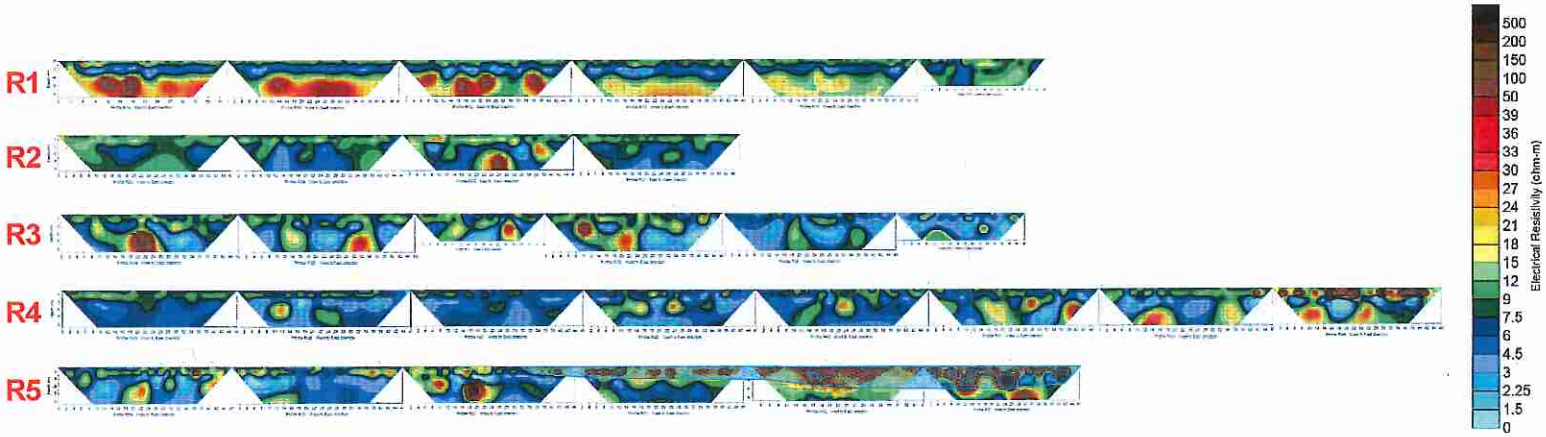




AEC-NTSB-001865

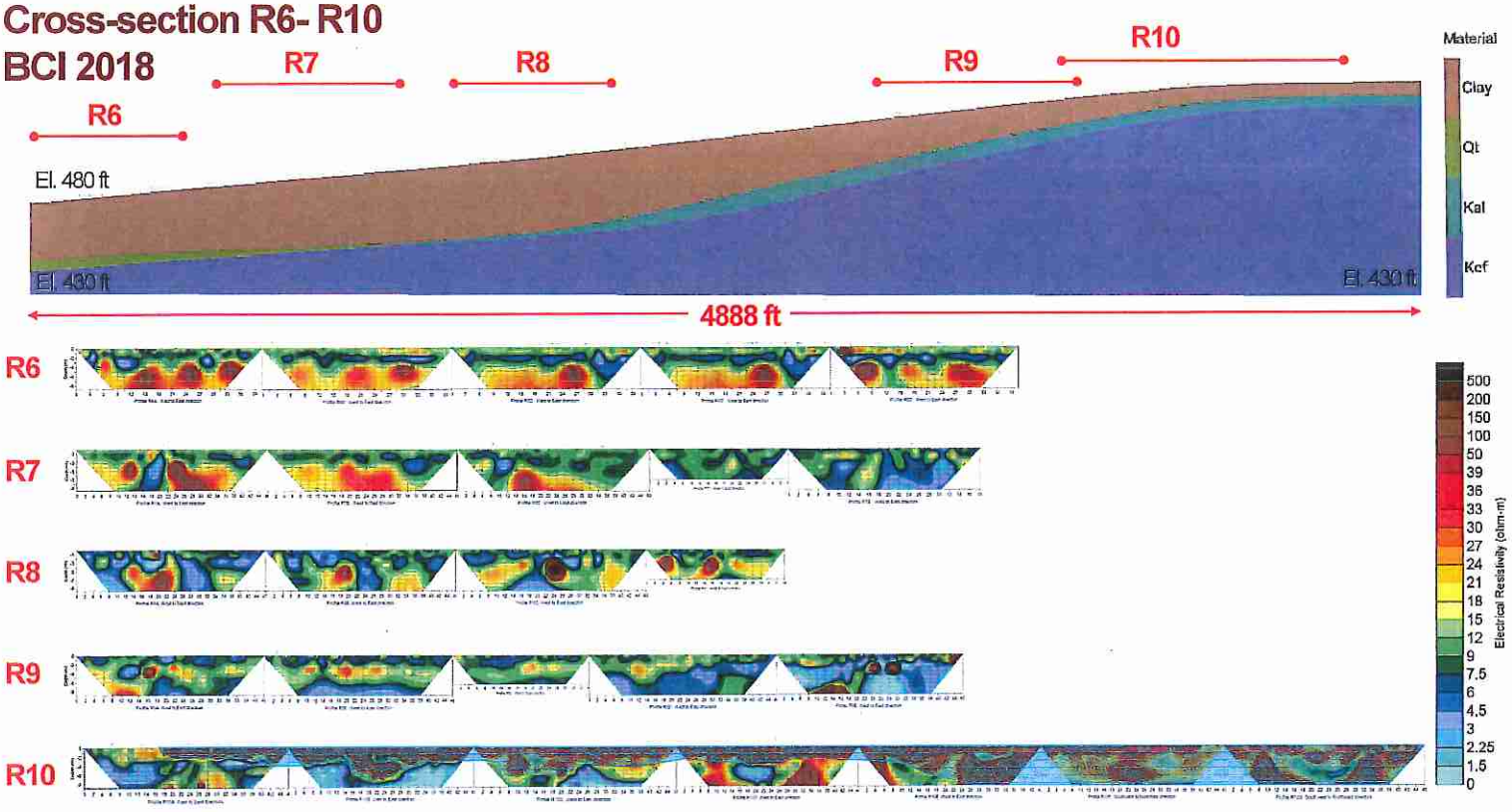
Cross-section R1-R5
BCI 2018





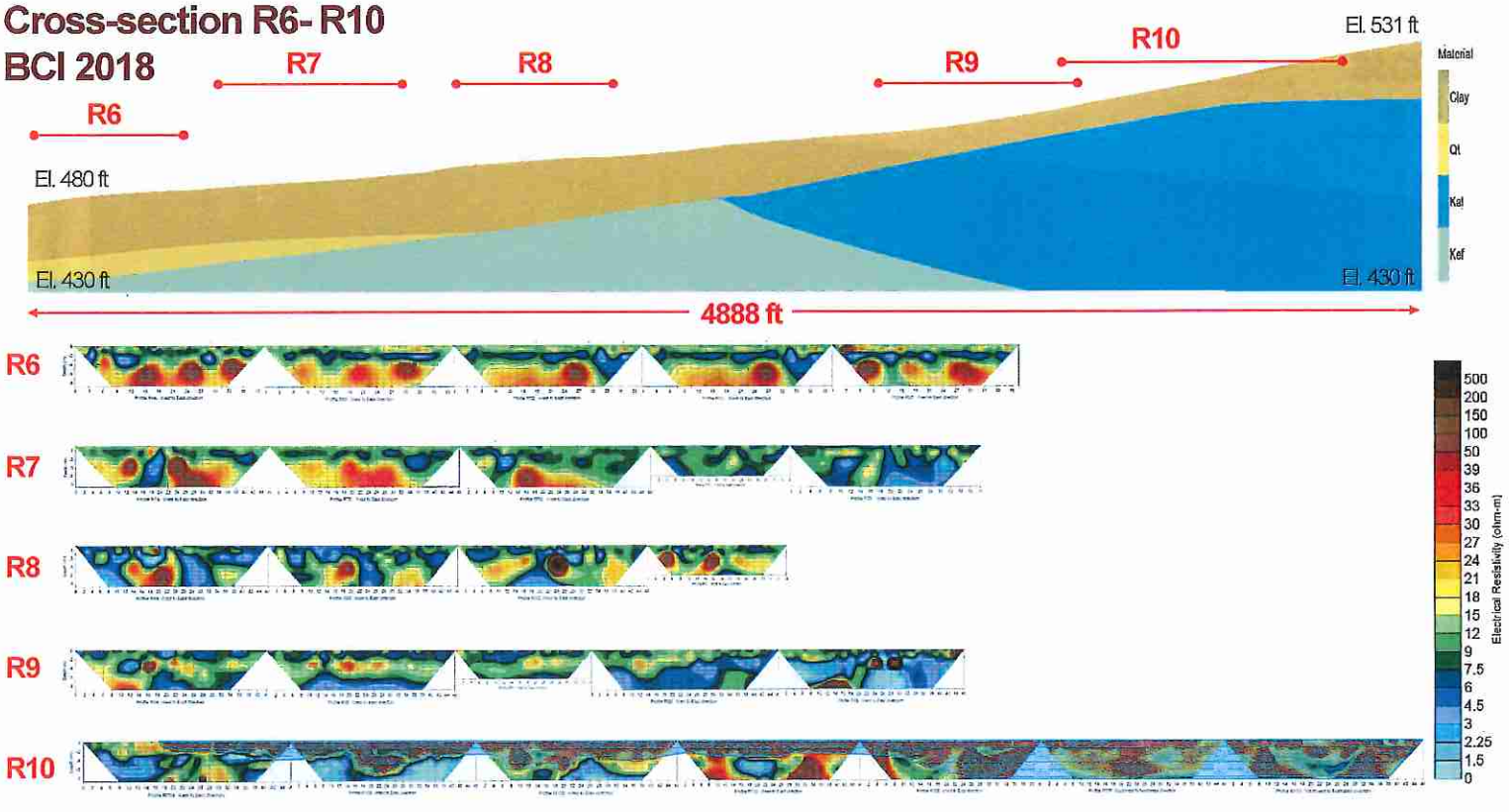
AEC-NTSB-001866

Cross-section R6- R10
BCI 2018



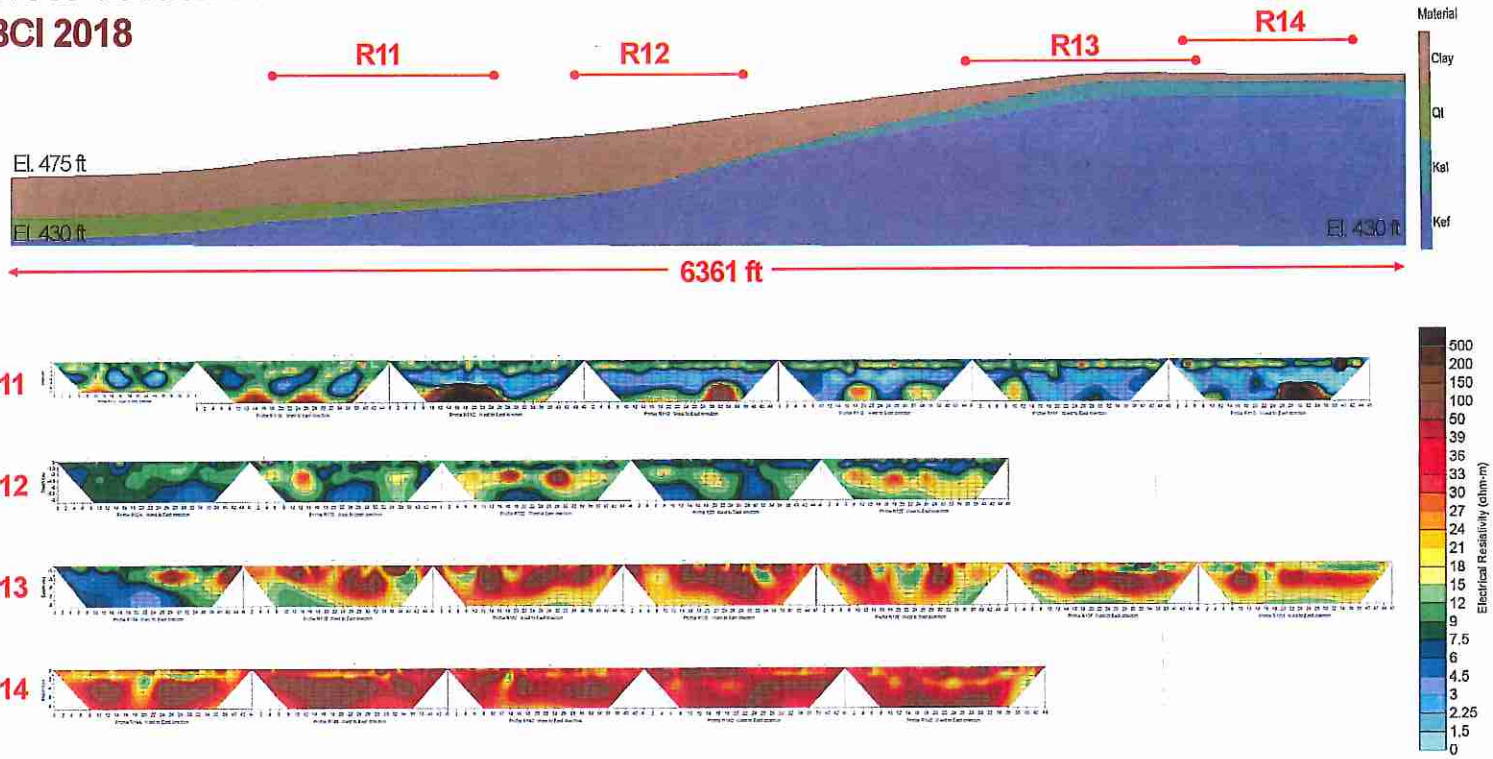
AEC-NTSB-001867

Cross-section R6- R10
BCI 2018



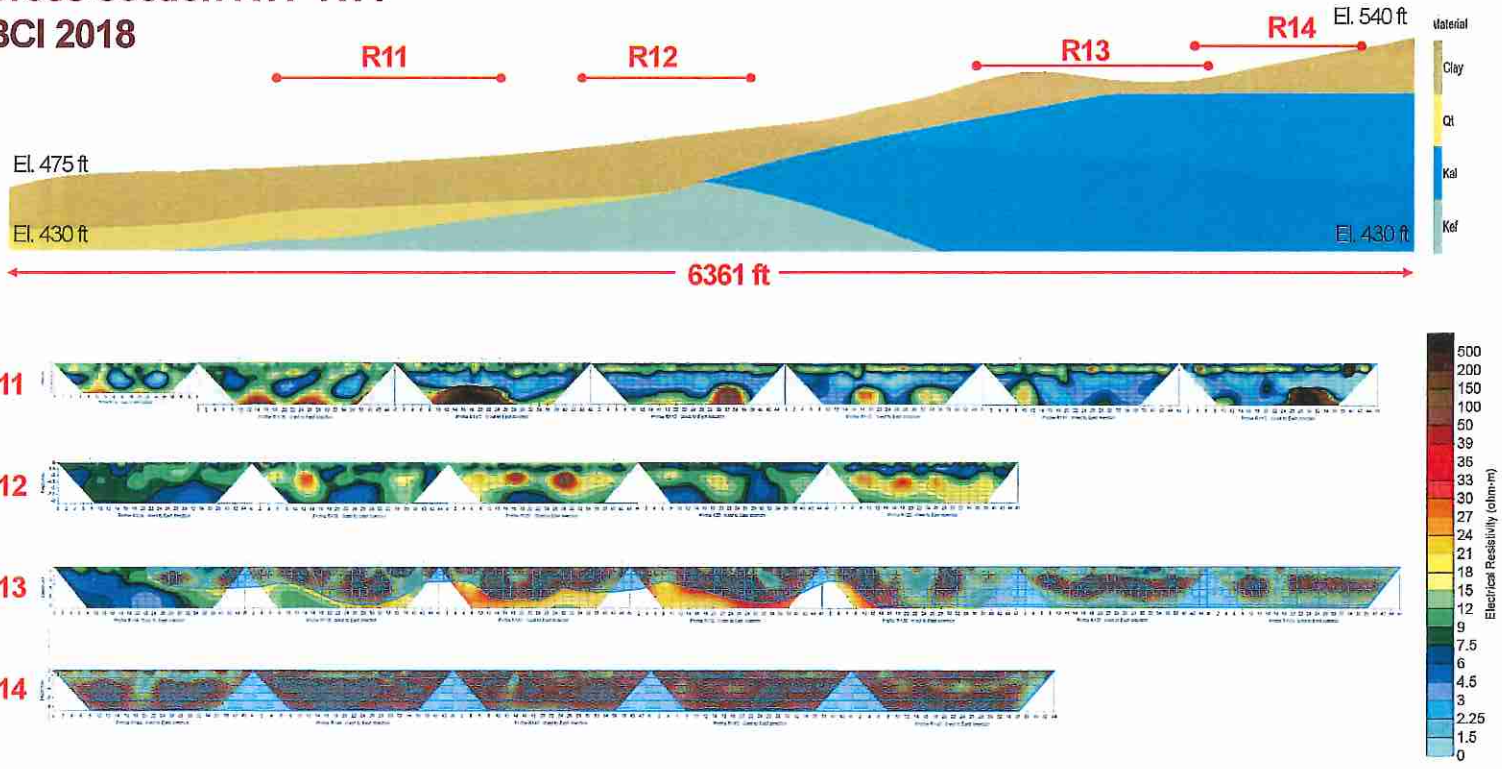
AEC-NTSB-001868

Cross-section R11- R14
BCI 2018



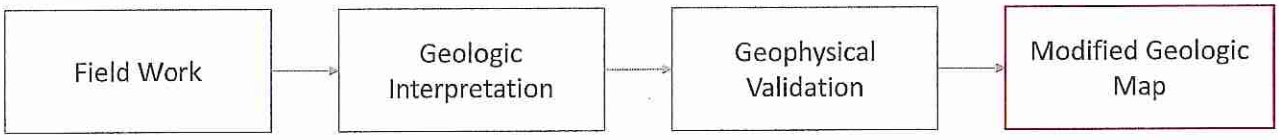
AEC-NTSB-001869

Cross-section R11- R14
BCI 2018



Work Flow

BRYANT CONSULTANTS
Conventional Forensic Subsea

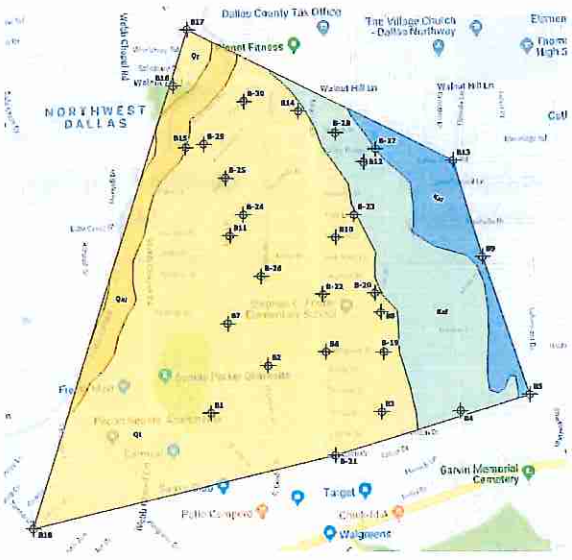


Map Comparison

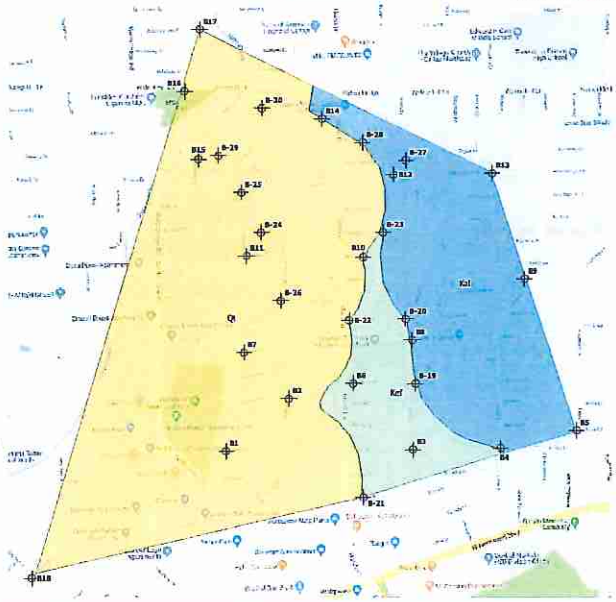
BRYANT CONSULTANTS

Conventional Forensic Subsea

Dallas Geological Society
1965, Revised 1988



BCI
2018



Geotechnical · Geological · Structural · Civil · Geophysical · Materials · Numerical Modeling

G

H