FINAL REPORT

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Evaluation of Boretrace™

Purchase Order No.:
Signed GTI Testing and Analysis Proposal/Agreement

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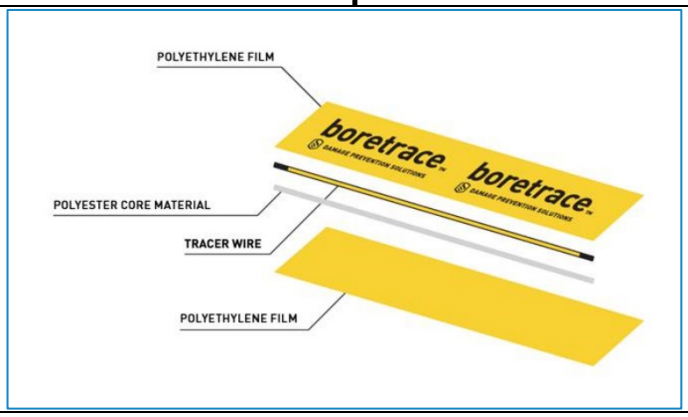
List of Acronyms

Acronym	Full Form
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
DPS	Damage Prevention Solutions, LLC
EMS	Electronic Marker System
HDD	Horizontal Directional Drilling
HDPE	High Density polyethylene
SDR	Standard Dimension Ratio

Background

Damage Prevention Solutions, LLC, henceforth referred to as DPS, submitted to GTI the electronic marker system listed in Table 1 for evaluation.

Table 1. Sample Submitted by DPS

Product	Description
Boretrace™	

Additional materials included 500-ft of 2" SDR 11 high-density polyethylene (HDPE) pipe and 12 AWG tracer wire, procured by GTI, and EMS rope provided by 3M. The pipe print line is provided below.

2" IPS SDR11 DURA-LINE POLYPIPE GDB50 GAS PE4710 PE100 CEE ASTM D2513 D06Y19NR5GD 07NOV17

Field Installations

The Boretrace™ marker system was evaluated by performing a Horizontal Directional Drilling (HDD) field installation in GTI's pipe farm, as detailed below. During the one-day installation photographs and video recordings were taken, including aerial shots taken by a drone. The layout of the field and soil types is shown below in Figure 1.

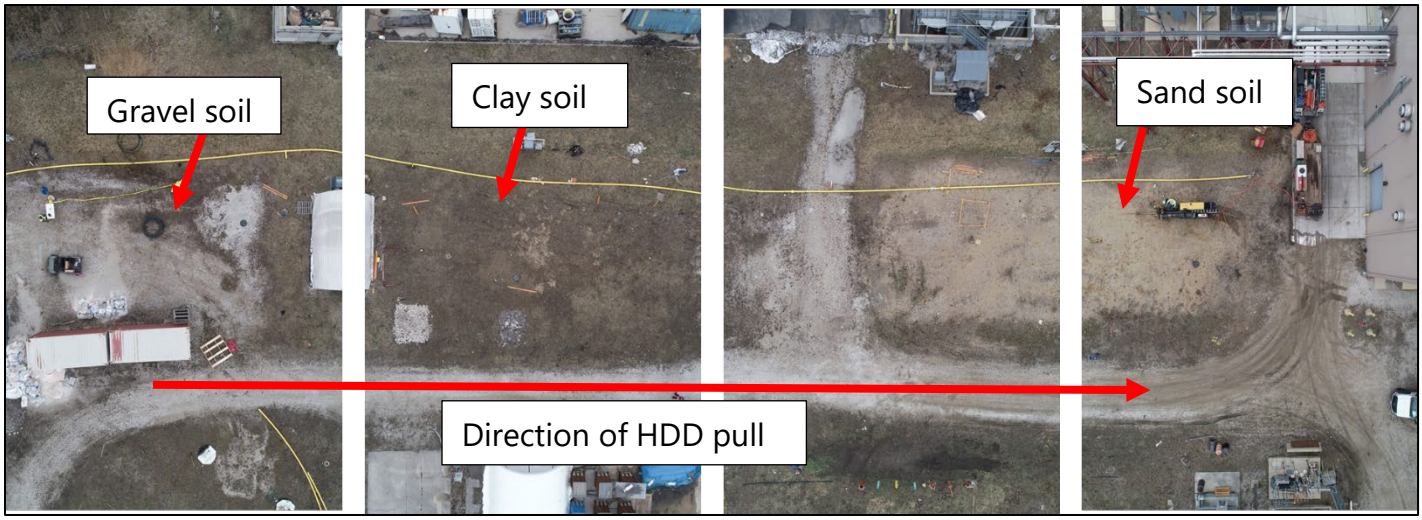


Figure 1. Approximate layout of installation and soil types at GTI Pipe Farm

HDD Pull

HDPE pipe pulled (dry pull) in with Boretrace™.

- Pulled in with 12 AWG tracer wire.
- 4.5" drill head used during pull back.
- 500' of 2" HDPE pipe pulled in through approx. 300' bore.

Boretrace™ was attached to a horizontal directional drill with 20,000 lb. of thrust and pull back capability per the attachment procedure shown in Figure 2. The HDD installation was carried out as a "dry pull", that is, no use of drilling mud, however some water was used to aid the installation. The pipe was pulled through clay soil, gravel and sand at ambient temperature and an estimated depth of 36 – 45 inches. An exemplar photograph of this installation is shown in Figure 5.

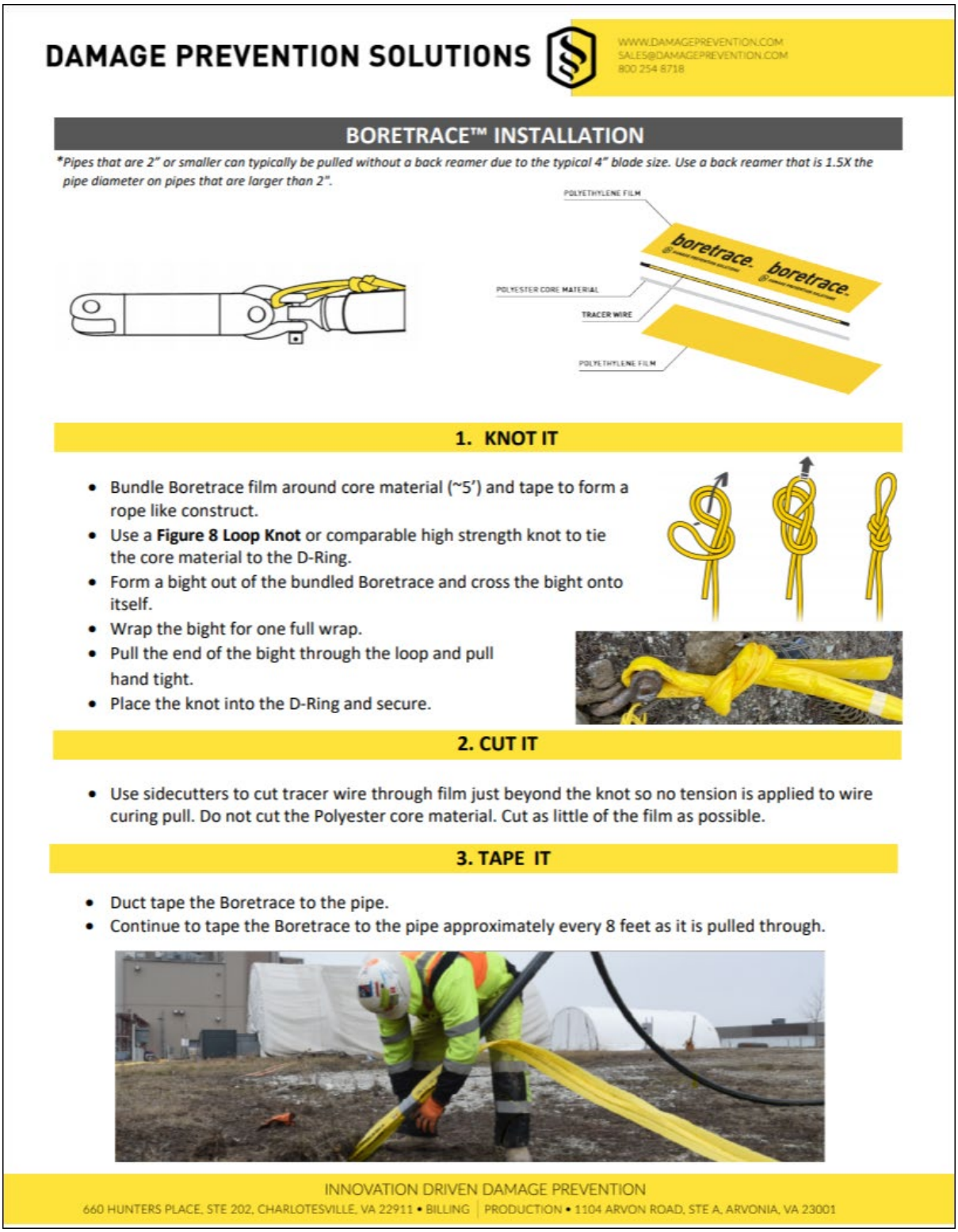


Figure 2. Boretrace™ Attachment Procedure

Both the 12 AWG tracer wire and Boretrace™ tracer wire were attached to the bore head as shown in Figure 3 below. Some abrasions were observed after removal from the bore

hole (Figure 6). However, no visible disconnections or catastrophic damage to either the traditional tracer wire or Boretrace™ product was visible. Upon laboratory inspection by DPS, some abrasions were observed on the Boretrace™ product and a single opening in the PE film exposed the tracer wire jacket, but the bare wire was not exposed. Tracer wire continuity was maintained, as described in **Marker System Evaluation**.

Figure 3. Installation attachment of tracer wire products

Figure 4. HDD Installation with Boretrace™ tracer wire

Figure 5. Overhead view of Boretrace™ tracer wire installation

Figure 6. Field observed abrasion and material removal

Marker System Evaluation

On completion of the HDD installation, Boretrace™ samples were sent to DPS for evaluation.

Boretrace™ Evaluation

The Boretrace™ tracer wire samples were evaluated by means of visual inspection and resistance measurements. The following summarizes the findings:

1) Three (3) visible film abrasion points were observed (see Figure 7 and Figure 8)
    - One (1) abrasion point where the tracer wire jacket was exposed (Figure 9)
2) No visible damage to tracer wire or abrasion to wire jacket
    - Resistance checks across length of tracer wire confirmed no open line
    - Continuity was confirmed

Figure 7. Abrasion Point (1)

Figure 8. Abrasion Point (2)

Figure 9. Abrasion Point (3) with exposed tracer wire

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END OF REPORT