Vol. 17

CGA DIRT

Damage Information Reporting Tool

2020 Analysis & Recommendations

Released, September 2021

To download or to access additional analysis, visit CommonGroundAlliance.com/DIRT.

Dear Damage Prevention Stakeholders,

On behalf of the Common Ground Alliance's Data Reporting and Evaluation Committee, I'm pleased to publish the 2020 DIRT Report, the only comprehensive resource analyzing damages to buried infrastructure in North America.

It goes without saying that 2020 was an unprecedented year, but as you will read on the following pages, the challenges facing the damage prevention industry remained remarkably consistent: Damages continued to occur, and the major root cause groupings are still roughly equal to one another. The data reinforces that we still have important work to do to drive down the estimated $30 billion dollars in societal costs that result from damages to critical underground infrastructure in communities across the country. The increased focus on the obligation of businesses to address environmental challenges through ESG programs will also drive organizations to search for ways to reduce their environmental impact. Implementing more effective education and training across stakeholder groups about the importance of adhering to damage prevention practices can potentially result in a significant reduction in damages, which means companies can reduce their environmental footprint as well as negative impacts on communities.

The impact of the global pandemic on the damage prevention industry varied by state and region (read more about state-level impacts on page 34 and in Appendix D), but it had universal effects on supply chains and labor that are reflected in the 2020 DIRT Report. While construction activity decreased in 2020 from 2019 at a national level, construction prices rose and so did one call transmissions. As one would expect, a reduction in construction activity also resulted in a reduction of damages in 2020 as compared to 2019. It is important we evaluate data in the context of 2020's environment and focus on overall damage trends: **Year over year, hundreds of thousands of damages occur, and most of them can be attributed to the same handful of persistent root causes.** With elected officials in Washington, D.C., focused on moving legislation that will result in a significant investment in our nation's infrastructure, coupled with the projected substantial increase in construction activity in the years to come, we expect the overall trend of rising damages will continue. The construction activity forecast combined with consistently static leading damage root causes makes the 2020 DIRT Report recommendations on pages 5 and 6 even more critical.

Another 2020 trend that appears to have been a constant across the country was a steep rise in locate requests submitted by homeowners. However, damages caused by occupant-excavators did not rise. This corresponds with CGA's summer 2020 public awareness research, which indicated that homeowner awareness of 811 reached an all-time high.

The 2020 DIRT Report underscores the urgency of our mission and should drive the damage prevention industry to **focus our efforts on the root causes that continue to drive the vast majority of damages.** Over the next year, I challenge each of our members – from all 16 stakeholder groups that make up the damage prevention industry – to implement the 2020 DIRT Report recommendations with a particular focus on addressing the top damage root causes responsible for nearly 70% of total damages annually. Although 2020 was certainly an anomalous year, the challenges the damage prevention industry must address remain. Over the next year, CGA will encourage each committee initiative, damage prevention partner and conversation to center around strategies for addressing persistent damage drivers. Look for our upcoming Next Practices report to do just that.

Please join me in thanking the Data Reporting and Evaluation Committee for their diligent work in preparing the important analysis and thoughtful recommendations included in this report. We'd also like to thank the one call centers that provided the information you will find in the appendix on late locates and pandemic effects. Without your valuable time and information, CGA would not be able to produce our annual DIRT Report and recommendations. In addition to the key takeaways in the 2020 DIRT Report, be sure to visit the DIRT Interactive Dashboard to explore the data that is most relevant to your organization or stakeholder group.

Be safe,

Sarah K. Magruder Lyle

Sarah K. Magruder Lyle
President and CEO
Common Ground Alliance

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CGA and PHMSA Resources

Below are links to additional CGA and PHMSA resources:

- CGA Online DIRT Dashboard:

  https://commongroundalliance.com/dirt-dashboard

- CGA Technology Advancements & Gaps in Underground Safety & Technology Collection Form:

  https://commongroundalliance.com/Publications-Media/Technology-Reports

- CGA DIRT Reports (Archive): https://commongroundalliance.com/DIRT

The following require CGA membership to access:

- Excavator White Paper:
  Data-Informed Insights and Recommendations for More Effective Excavator Outreach

- Locator White Paper:
  https://commongroundalliance.com//2020-locator-white-paper

- Next Practices Report:
  https://commongroundalliance.com/Publications-Media/Next-Practices-Initiative

- Multiple Reports of the Same Event:
  https://commongroundalliance.com/LinkClick.aspx?fileticket=ILRcB0WD6dw%3d&portalid=0

- Analysis of Near Miss Events (2015 – 2018):
  https://commongroundalliance.com/Portals/0/Library/2020/DIRT%20Reports/Near%20Miss%20reports%202015_2018_Final%20-%2004.16.2020.pdf?ver=2020-08-14-130152-903

- U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA):
  - Determinations of Adequacy of State Enforcement Programs:
    https://www.phmsa.dot.gov/pipeline/excavator-final-rule/determinations-adequacy
  - State Pages (including damage prevention information):

    https://primis.phmsa.dot.gov/comm/states.htm?nocache=4418
  - Pipeline Incident Heat Map and Other State Information:

    https://primis.phmsa.dot.gov/comm/DamagePrevention.htm?nocache=384

Executive Summary

NOTE: For a glossary of terminology used in this report, please see Appendix A.

Damages in 2020

- While U.S. damages in 2020 were down approximately 12% over 2019, the following factors and unique circumstances contributed to a more complex picture:
    - Although construction spending increased nominally in 2020, this number does not take into consideration inflation and fluctuations in the Producer Price Index for building materials and supplies dealers. A closer examination of the data indicates overall construction activity was actually down year-over-year from 2019. When comparing the trend using the value of 2020 dollars, construction spending decreased 4.2% and estimated damages per unit of construction spending were down approximately 8%.
    - Overall, locate requests increased and estimated one call transmissions were up 2.3%, but there were inconsistencies from 2019 to 2020 in how transmission data was reported that make the trend for this metric less reliable.
    - The pandemic affected many aspects of the damage prevention process, from the ability to carry out certain digging projects to increased scrutiny of on-site workers, contributing to the complexity of viewing 2020 in the context of longer-term trends in damages.
- Despite the variability of the trends in damage estimates and key metrics, an analysis of 2020 damages highlights a clear consistency in the leading root causes and contributing factors. This underscores the importance of continuing to focus on the issues that repeatedly rise to the top in the damage prevention industry: failure to notify 811, abandoned facilities, potholing and maintaining clearance, and late locates.

One Call Data and Damage Information

The damage data collected in DIRT tells us part of the story when it comes to damage prevention. In this year's report, several one call centers shared additional 2020 data and analysis surrounding two key areas: the effect of the pandemic and the increasing challenge of late locates.

- Trends in ticket volume and construction activity demonstrated the impact of the Covid-19 pandemic, showing there was a consistent trend across multiple states of increased homeowner locate requests and digging activities associated with home improvement projects.
- Late locates are consistently identified as a significant challenge by damage prevention stakeholders. One call centers supplied data from their positive response systems on late locates and the steps being taken in their states to improve the likelihood of on-time locates. Late locates are also a major contributor to near miss/downtime events. Based on the numbers provided by the one call centers, it is clear that the near misses reported to DIRT greatly undercount actual occurrences.

Root Cause Analysis

- DIRT's field form allows a user to select one root cause for each submitted damage. Of the 26 root cause options, the top five root causes for 2020 account for nearly 70% of damage events with a known root cause and look notably consistent with past analysis. Key findings include:

    - *Failure to notify the one call center/811* remains the largest individual root cause.
    - *Excavator dug prior to verifying marks by test-hole (pothole)* combined with *Failure to maintain clearance* make up the most consistent causes of damage due to excavator error in the field.
    - *Abandoned facilities* and *Locator error* together make up the greatest causes of damages due to locating issues.
- The consistency of the top contributing root causes suggests that a focused effort on the leading damage causes is warranted by all damage prevention stakeholders.
- The overall quality and completeness of data is not consistent across stakeholder groups. Of the top three sources of data (see Figure 1), natural gas and excavators have DQI (Data Quality Index) scores exceeding 80, while locators are at 49.

Enormous Societal Costs of Damages

- Damage prevention should be considered an essential component of Environmental, Social and Corporate Governance (ESG) policies. Damages to underground infrastructure have the potential to significantly impact the environment, and negatively affect communities across the nation.
- In 2019, the DIRT Report estimated the annual societal costs of damages to buried utilities in the U.S. to be approximately $30 billion. This estimate focuses on the economic impact to society and calculates direct costs (facility repair) and indirect costs (property damage, medical bills, businesses unable to operate, etc.). Expanding the view of societal impact to consider environmental and social impact will be important moving forward.

Damage Prevention Metrics

- Damages per 1,000 incoming tickets or outgoing transmissions has historically been the standard metric for the damage prevention industry. However, using this metric to compare damages across locations/industries can oversimplify a complicated picture. Appendix F traces the evolution of damages per ticket reported in DIRT over the years, and discusses recent activity by CGA's Data Reporting & Evaluation Committee to address some of the inherent limitations of this metric. To be meaningful, the denominator of any metric should remain relatively stable and correspond to or characterize the numerator. One call tickets (incoming notices or outgoing transmissions) do not always satisfy these criteria, especially when attempting to compare states and provinces.

Interactive Dashboard

- DIRT's Interactive Dashboard (https://commongroundalliance.com/DIRT-dashboard) allows users to take a closer look at the 2020 data and provides users with the opportunity to apply a range of filters to create custom data views. DIRT Explorer is the most accessed feature on the dashboard and allows users to filter data by root cause, facility affected, excavator type, state/province, etc.

Recommendations

The following recommendations highlight specific actions for industry consideration across the damage prevention process as well as opportunities to enhance data analysis moving forward.

Data Collection and Analysis

1. **Capture more granular data on reasons for not notifying 811.** DIRT has a root cause selection for *No notification made to one call center/811* but does not dig deeper into the reason for the lack of notification. With failure to notify persisting as the greatest single known root cause of damages, additional information would be very valuable in formulating strategies to change this behavior. The following opportunities can provide the industry with greater insight into the thought processes of excavators who dig without one call notification:
    - When *No notification made* is selected as the root cause, **encourage DIRT users to enter additional information into the free text comment field** such as *excavator unaware of 811*, *not digging deep enough, did not think there were buried utilities in the area*, etc.
    - Execute surveys and additional research focused on excavator and active digger behavior/reasons for not calling.
2. **Explore common data collection, reporting processes and metrics for documenting and tracking late locates through the one call centers, as well as the establishment of a baseline ticket template to use for categorizing and measuring differences in state requirements that affect ticket volume.** This 2020 DIRT Report contains an appendix (D) on late locates and damage prevention metrics which inform this recommendation. Additional features to consider include timelier (real-time) data reporting and shareability across different platforms.
3. **Improve data quality and reporting by industry.** Create messaging and targeted outreach focused on opportunities for improvement in each industry's DQI.
4. **Use the Interactive Dashboard to explore damage data specific to your industry, state, and work performed.** Reported damages from 2018 to 2020 are displayed via a PowerBI dashboard that makes it easy to drill down into DIRT data that is most applicable or actionable for your organization.

Root Cause Analysis

5. **Consider how damage prevention efforts address the leading individual root causes.** The issues that consistently rise to the top each year are (1) digging without notification to the one call center/811, (2) a combination of failure to pothole and maintain clearance between digging equipment and buried facilities, and (3) abandoned facilities leading to mismarked or unmarked buried lines.
6. **Address damages due to *Marks faded, lost, or not maintained* that occur early in a project.** Best Practices 5-17 Marking Preservation and 5-23 Locate Request Updates focus on long-term projects and marks affected by weather. An analysis of an "ideal" ticket life revealed there are a significant

number of damages due to failure to maintain marks in the early stages of digging projects which should not be overlooked.

7. **Clarify and provide more specific guidance on the use of offset marks.** In some cases, offset marks can help reduce damages caused by failure to maintain marks. Best Practice 4-8 Facility Marking mentions "offsets" but could be expanded upon to give clearer guidance.

Introduction to the 2020 DIRT Report

- **Key background information for understanding and interpreting the 2020 DIRT Report and data is included in this section, including a link to a glossary of terminology.**

Understanding the differences between reported damages, unique damages and the U.S. estimate of damages is critical to an accurate reading of the figures, tables, and graphs on the following pages. **Please review Appendix A for a complete glossary of terms used in the 2020 DIRT Report.**

Defining Damages

- **Reported events = All reports of a damage or near miss entered in DIRT**
- **Unique events = Number of unique events estimated after consolidating multiple reports describing the same event**
- **Estimate of U.S. damages = Estimate of damages based on DIRT data as well as an advanced predictive model**

Table 1—Reported events, near misses, and damages in Canada and the U.S., over time

	2018	2019	2020
Total Events Entered in DIRT	440,749	534,151	475,770
Near Misses (unique events)	4,198	2,524	2,329
Damages (unique events)	341,609	453,766	385,381

The number of events reported via DIRT for the U.S. and Canada in 2020 totalled 475,770. After consolidating multiple reports of the same events[1] and filtering out near misses, the number of unique damages was 385,381, comprised of 10,723 in Canada and 374,658 in the U.S. The DIRT Interactive Dashboard is based on reported unique damages and shows a total of 385,381 when no filters are applied. To better understand the path a DIRT report follows from event submission to presentation in the annual DIRT Report, reference Appendix B.

[1] See the supplemental report How CGA Analyzes Multiple Reports on the Same Damage Event, released on March 25, 2021, for a description of the method used to match and weight multiple reports of the same event (https://commongroundalliance.com/LinkClick.aspx?fileticket=ILRcB0WD6dw=&portalid=0)

Where Does DIRT Data Come From?

- **Locators continue to submit the majority of DIRT reports, with most of those involving telecommunications as the damaged facility.**
- **Liquid pipeline and natural gas self-submit the majority of reports about incidents to their own facilities.**

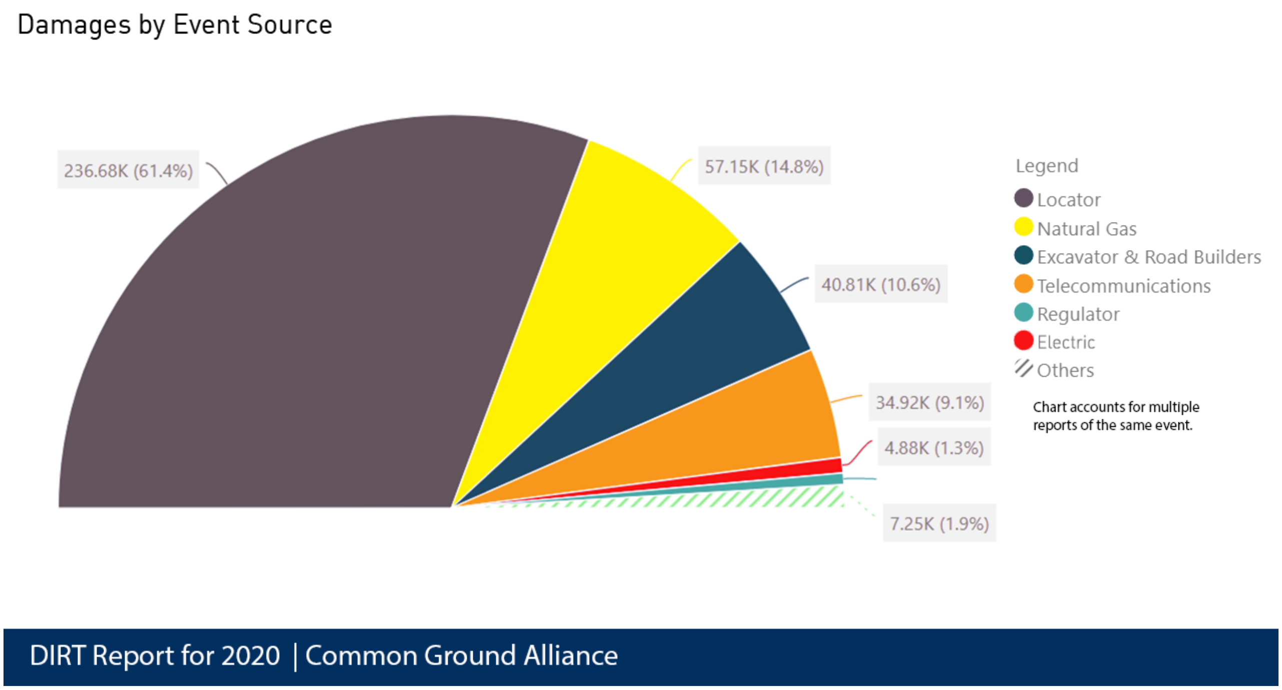

Figure 1

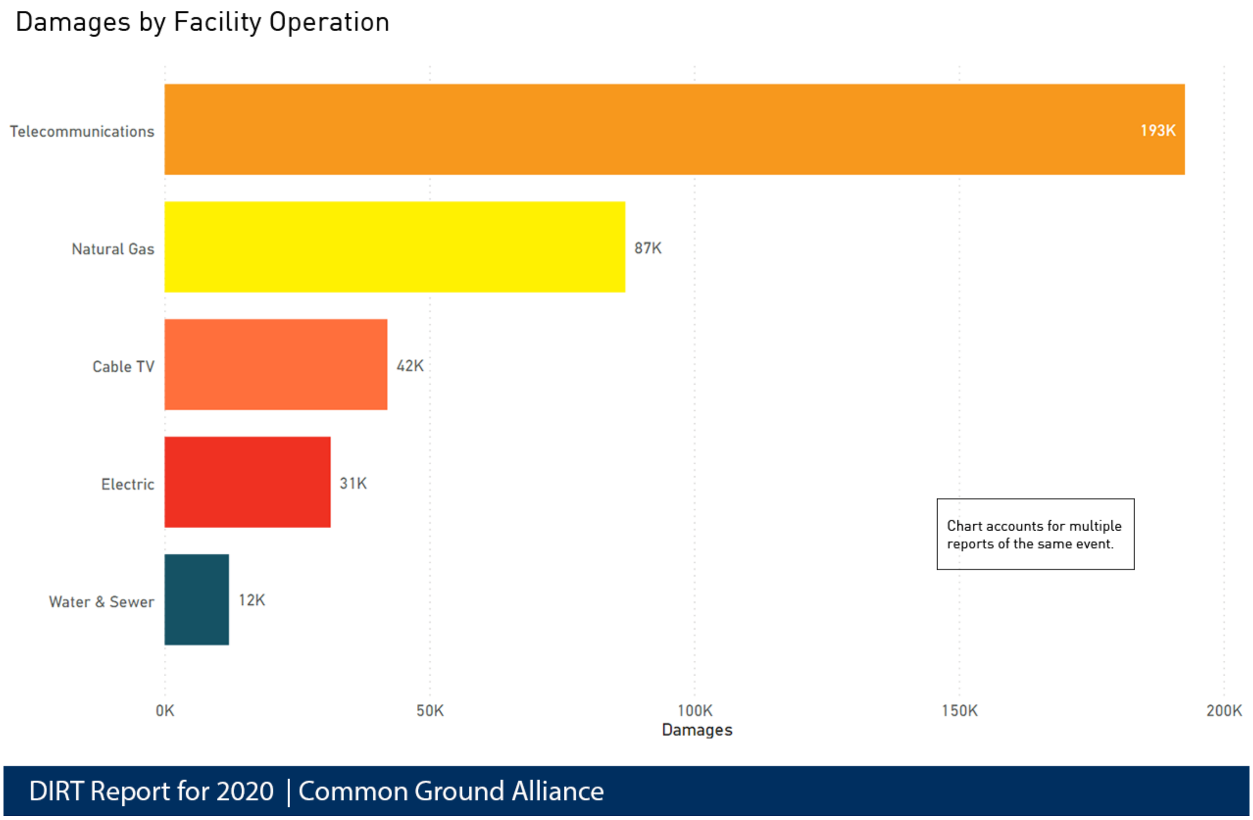

Figure 2

Taken together, Figures 1 and 2 show that locators are the leading source of all events, and telecommunications is the leading facility damaged. Table 2 shows the event sources for each type of facility damaged.[2] Consistent with Figures 1 and 2, telecom damages reported by locators is the single largest combination. Natural gas and liquid pipe operators do the most self-reporting. Regulators report mostly natural gas events, which makes sense because most federal and state regulator participants in CGA and DIRT are from the pipeline safety programs. Excavators and road builders enter reports for all types of facilities damaged.

[2] Data points with low numbers, such as steam as a facility damaged and equipment manufacturers, railroad, and engineering as event sources, are not included.

Table 2—Original Source of Event by Facility Damaged

	Original Source of Event Report							
Facility Damaged	Locator	Natural Gas	Telecom	Electric	Excavator + Road Builder	Private Water + Public Works	Regulator	Liquid Pipe
Cable TV	34,349	71	2,416	58	4,636	40	200	0
Electric	20,260	136	68	4,269	5,840	123	346	2
Liquid Pipe	0	47	0	2	36	0	4	63
Natural Gas	19,352	55,299	171	303	7,302	814	2,769	7
Sewer + Water	5,281	97	62	43	4,728	1,194	168	3
Telecom	143,003	145	32,093	179	16,001	174	197	2

Estimating Total U.S. Damages

- **While estimated damages in the United States were down 12% year-over-year in 2020 versus 2019, it is important to consider the complexities influencing 2020 data.**
- **Construction spending was up nominally in 2020 over 2019, but when expressed in 2020 dollars based on the Producer Price Index for Building Materials and Supplies Dealers, spending was actually down in 2020.[3] After adjusting for these factors, damages per unit of construction spending were down about 8% in 2020 from 2019. This metric should be considered the more reliable trend indicator, at least for comparing 2020 to recent past years.**
- **Estimated one call transmissions were up 2.3% in 2020 over 2019, and estimated damages per 1,000 transmissions were down approximately 14%. However, inconsistencies in how transmission totals are tabulated complicate the use of this metric for trending purposes.**

Estimating total annual damages to buried utilities helps the damage prevention industry understand the full scope of our challenges and successes. To generate the estimate of total U.S. damages, CGA's Data Reporting and Evaluation Committee engages a consultant (Green Analytics) to develop a statistical model predicting total U.S. damage events based on DIRT data and a number of other variables which are statistically assessed for correlation with the number of reported damages by state. Appendix C explains in detail the process followed by Green Analytics.

Table 3 presents the results of the estimation models for total U.S. damages and total one call center transmissions for the past five years.

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[3] Compared to methods used in past years, this better captures the impact of price spikes, material shortages, shipping delays etc. that occurred in 2020.

Table 3—Key performance indicators for total estimated damages in the U.S., over time

	2016	2017	2018	2019	2020
Total Estimated Damages	416,000	439,000	509,000	532,000	468,000
Lower Bound Confidence Interval for Total Estimated Damages	201,000	270,000	230,000	430,000	380,000
Upper Bound Confidence Interval for Total Estimated Damages	1,159,000	715,000	787,000	666,000	584,000
Total Estimated One Call Transmissions	221.9 M	234.9 M	244.3 M	267.6 M	273.9 M

At first glance one might assume that construction activity increased relative to 2019, based on the 2.3% increase in one call transmissions. With damages down and transmissions up, we could expect the traditional metric of damages/1,000 transmissions to make a dramatic improvement. However, as explained below, there were factors for 2020 that complicate our traditional trending methods.

The primary metric relied on in recent DIRT Reports has been damages per million dollars in construction spending, which was up nominally (i.e., not adjusted for inflation) in 2020. Again, with damages down and construction spending up, the metric will improve. However, the construction spending statistic is somewhat misleading since construction costs also increased significantly over 2019. The Producer Price Index for Building Materials and Supplies Dealers produced by the U.S Bureau of Labor Statistics shows a 10% increase in prices over 2020, which is equal to the combined percent change of 2016 through 2019).[4] To demonstrate the impact from 2020 prices, Table 4 shows the statistics using the Producer Price Index to adjust 2020 construction spending to comparable 2019 spending.

Table 4 – Total construction spending (millions of dollars) in the U.S, 2019 and 2020 comparison

	2019	2020 Nominal	2020 (Adjusted)
Annual Value of Total Construction	$1,391,039	$1,469,153 (+5.5%)	$1,333,170 (-4.2%)

In previous years, the standard Consumer Price Index was used to adjust for inflation in construction spending, which was fine for relatively stable economic periods. However, 2020 highlights the importance

[4] Source of Producer Price Index for Building Materials and Supplies Dealers: https://www.bls.gov/ppi/

of using an industry-specific price index. To get a clearer picture of the trends from a construction spending perspective, construction spending is reported in 2020 dollars based on the Producer Price Index for Building Materials and Supplies Dealers. Table 5 shows the five-year trends for damages per unit of construction spending (adjusted as explained) and per 1,000 one call transmissions.

Table 5—Estimated U.S. damages per million dollars construction spending over time

	2016	2017	2018	2019	2020
Total Estimated Damages per million dollars of construction spending (2020 dollars)	0.285	0.296	0.348	0.347	0.319
Total Estimated Damages per 1,000 One Call Transmissions	1.88	1.87	2.08	1.99	1.71

Between 2019 and 2020, damages per unit of construction spending are down 8%, and damages per 1,000 transmissions are down 14%. Figure 3 presents the data graphically.

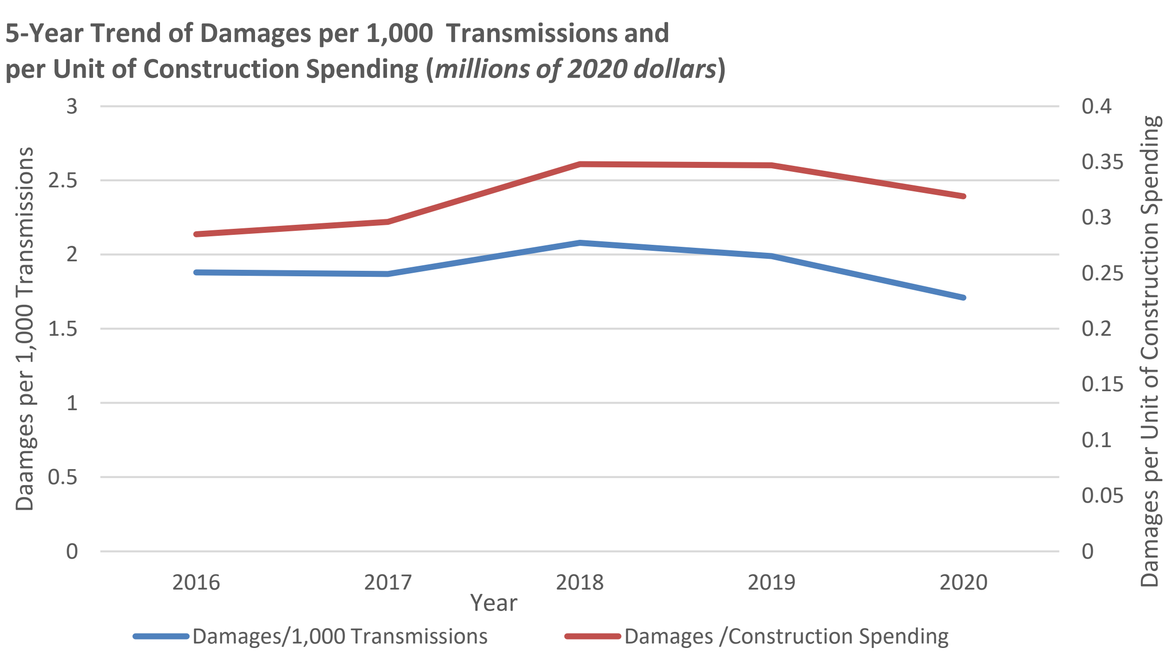

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Figure 3

The damages per 1,000 transmissions metric is complicated by a change in how MISS DIG 811 (Michigan) reports transmissions in the OCSI Data Collection Tool. The center's transmissions were approximately doubled in 2020, but its incoming ticket volume was down about 2%. If not for this change, total U.S. transmissions would have been approximately 8 million less (roughly equal to 2019) and damages per transmission approximately 1.75. In Figure 3, the gap between the orange and blue lines would have been narrower for 2020. For all the reasons stated above, damages per unit of construction spending appears to be the most reliable metric for assessing 2020 performance relative to recent years.

Figure 4 shows the trend lines for the U.S. damage estimate and DIRT-reported unique damages against construction spending. Readers should be aware that the base of the y-axis does not start at zero, so the 2019 to 2020 decrease in construction spending (4.2%) is not as dramatic as it may first appear.

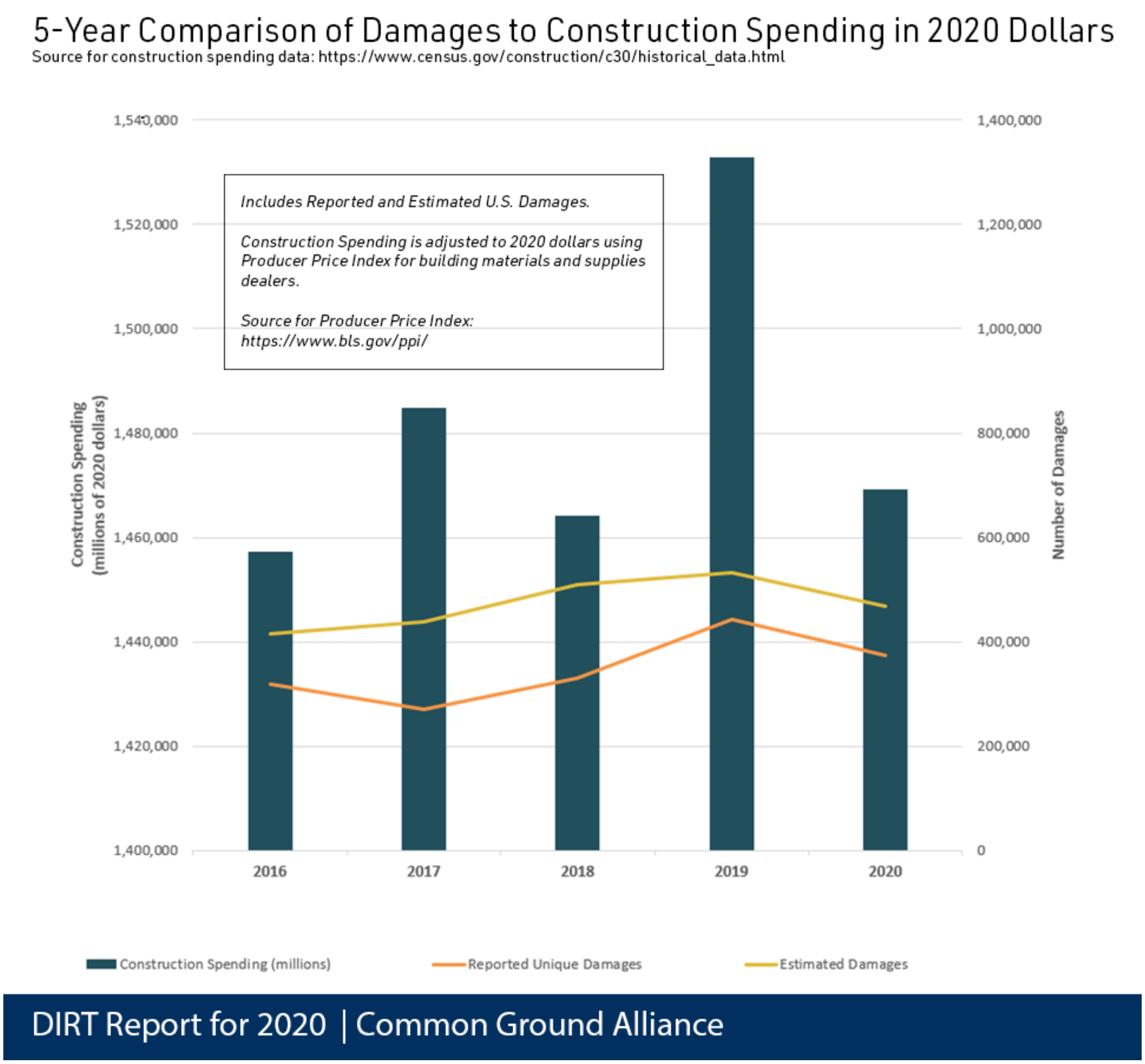

Figure 4

Using the adjusted construction spending estimate results in an 8% reduction (from 0.347 to 0.319) in damages per million dollars of construction spending. While this is less than the 12% reduction in estimated total damages, it still suggests that even while accounting for a decline in construction activity, there was some reduction damages, which differs from the experience of recent years. Overall, the change in damages per unit of construction spending has plateaued from 2016 through 2020. The slight decrease seen in 2020 damages could be affected by the following factors:

1. There is a non-linear relationship between activity and damages, meaning that when activity is higher (work is occurring at a faster pace), possibly a more crowded construction site results in more damages per unit of activity. In other words, social distancing practices during the 2020 pandemic may have been a contributing factor.
2. With the pace of construction activity slowed, job sites might have had more time to focus on safety measures and less worker fatigue overall resulting in lower damages per unit of activity.

It remains to be seen if the improving trends in 2020 were unique due to the effects of the pandemic, or if they resume their upward trajectory as construction activity returns to normal or even increases due to a national focus on infrastructure.

Damages to Buried Utilities Cost the U.S. Approximately $30 Billion Annually

- **Excavation damages have a significant economic impact on the U.S., with an estimated $30 billion in annual societal costs, which includes direct (facility repair) and indirect (property damage, medical expenses, business closures, etc.) costs.**
- **Damage prevention can be considered an essential component of Environmental, Social and Corporate Governance (ESG) and will require an expanded view of societal impact moving forward.**

Societal Cost of Damages

The 2019 DIRT Report included an estimate of the economic impact of damages in the U.S. and detailed a modeling approach to arrive at the estimate of $30 billion. Although the estimate will not be calculated annually, we can use the $30 billion as a baseline to broaden the focus of societal impact. Publicly available data from PHMSA was used as one data point for the 2019 estimate, and in Table 6 we have included a year-over-year comparison of PHMSA incident reports from natural gas distribution companies with a root cause of excavation damage.

Table 6—Extracted data from PHMSA data for natural gas distribution pipeline incidents

Natural Gas Distribution Incidents (PHMSA)	2019	2020
# Reported Incidents	52	47
$ Property Damage Total	29,069,002	13,432,316
$ Property Damage Max Single Incident	20,004,078	2,239,804
$ Emergency Response Total	1,857,122	1,333,775
$ Emergency Response Max Single Incident	450,000	135,698
Lost Product MCF (1000 cubic feet)	11.6991	40.8437
Lost Product MCG Max Single Incident	7.1516	5.7266

Table 6 is based on incidents as defined by federal pipeline safety regulations (49 CFR 191.3) that meet certain threshold reporting criteria such as injury, death, property damage and product released. Matches were found for the majority of these reports in the DIRT data, but these incidents are on the more severe end of the spectrum. The 2020 DIRT dataset had 87,022 reports with natural gas as the affected facility, the vast majority falling below the PHMSA reporting criteria.

Within the PHMSA data there is often one or a handful of significant events each year that can skew the cost data. For example, in 2019 one natural gas distribution incident out of 52 made up about 69% of the property damage cost (20,004,078 /29,069,002). Table 7 presents similar information for hazardous liquid pipelines, for which PHMSA also collects environmental costs. Again, single incidents each year have a disproportionate impact on the total costs.[5]

[5] It is not always the same incident with the maximum costs for property damage, emergency response, product released or environmental.

Table 7—Extracted data from PHMSA data for hazardous liquid pipeline incidents

Hazardous Liquid Pipeline	2019	2020
# Reported Incidents	10	12
$ Property Damage Total	26,167,029	10,952,341
$ Property Damage Max Single Incident	9,491,125	2,979,300
$ Emergency Response Total	8,290,295	2,067,163
$ Emergency Response Max Single Incident	6,032,793	965,206
$ Environmental Cost	8,744,302	181,850
$ Environmental Cost Max Single Incident	4,500,000	75,000

Considering Social Costs

The 2019 DIRT report cited a 2015 paper[6] from a group of United Kingdom researchers and academics as the basis for a 29 to 1 ratio of indirect to direct costs associated with excavation damage. In 2018, the same researchers published a follow-up paper[7] that attempts to "put forward explicitly a methodology for cost estimating through case studies the full economic impact of utility strikes – that is, the sum of DCs, ICs (if any) and SCs (if any) that are a by-product of a utility strike incident." Below are a few excerpts from that paper that are most relevant to this discussion (DC = Direct Costs, IC = Indirect Costs, SC = Social Costs):

> *When a utility strike incident happens, the utility owner often incurs the direct construction costs of the strike incident – that is, planning, supervision, material, design and labor costs (Goodrum et al., 2008; Metje et al., 2015). However, there are ICs, additional costs associated with the contracts incurred by the utility company and third parties due to, for example, loss of business income (Bernold, 2003; Gilchrist and Allouche, 2005). SCs are those which are a result of the street works, but which are* ***borne by society and the environment*** *instead of the utility companies and include costs to other businesses, increased levels of air pollution as well as noise, damage to the environment and traffic delays experienced by road users due to the additional*

[6] Makana, L., Metje, N., Jefferson, I., & Rogers, C. (2016). What do utility strikes really cost? University of Birminghman: Birmingham, UK

[7] Makana LO, Metje N, Jefferson I, Sackey M and Rogers CDF (2020) Cost estimation of utility strikes: towards proactive management of street works. Infrastructure Asset Management 7(2): 64–76, https://doi.org/10.1680/jinam.17.00033

> *works, which are paid for by society (McMahon et al., 2005). When combined, these DCs, ICs and SCs are the 'true costs' linked to utility strike incidents.*
>
> *…citizens would almost certainly welcome a small extra cost invested to reduce greatly the likelihood of utility strikes rather than paying the far larger ICs and SCs of the consequences of not doing so.*

This illustrates why damage prevention can be considered an essential component of Environmental, Social and Corporate Governance. Still, the thousands of small "routine" regulated pipeline incidents impose cumulative costs on society, and the possibility is ever present that one could turn into a major PHMSA-reportable-level event. Beyond immediate human safety concerns, there are often environmental consequences. Natural gas damages often result in releases of the product into the atmosphere. Natural gas is mainly methane, a greenhouse gas. Hazardous liquid pipelines can transport a variety of products such as oil, gasoline, liquid propane, jet fuel, etc., which can cause environmental damage, especially if released into bodies of water. Damages to wastewater and sewer pipes can release sewage in natural areas or drinking water sources causing significant environmental damage. Finally, water distribution pipe damage can result in the loss of extremely valuable drinking water supplies – a risk that can be compounded by prolonged drought conditions. For instance, any loss of water supply in the Southwest U.S. is a major environmental and human health concern.

There are no PHMSA-equivalent data sources for other industries such as telecommunications, electric, water, sewer, etc. Potential environmental impacts from damage events can vary significantly depending on facility type impacted and the severity of the damage event. In all cases, when a damage event occurs, the dig project uses extra resources to repair the damages. Depending on the context, this could mean using more fuel than would otherwise have been used, a bigger excavation footprint, or more equipment and materials needed to repair damage. Depending on the specifics of the damage event, extra excavation and equipment traffic could temporarily damage sensitive natural areas which could lead to:

- Disruption of existing vegetation
- Disruption to rare/endangered species
- Change in habitat type and composition
- Introduction of invasive species
- Additional soil erosion
- Additional soil compaction
- Additional soil profile disruption

Figure 5 depicts some consequences of a typical gas distribution system damage event. Not everything depicted will occur for every event, while there could be other consequences not depicted.

Gas Distribution System Damage – Potential Impact

Incident Responders

- **Emergency Services (Fire/Police):** Command of scene, traffic control, evacuations, fire suppression.
- **Gas Company:** Isolate system, assess and repair facility.
- **Locator:** Complete emergency locate for critical repair work.
- **State Enforcement Agency:** Conducts investigation of incident.

Immediate Impact

Incident Site and Surrounding Area

- Excavator on site suspends work.
- Buildings evacuated and business interrupted.
- Injuries and property damage.
- Gas vents to atmosphere until controlled.
- Potential damage to other facilities during repair.
- Gas service interrupted.

Community

- Traffic and pedestrian detours and delays.
- Emergency services pulled from other duties.
- Municipal staff pulled from other duties.
- Gas company pulled away from routine jobs.
- Locator drops planned route delaying other excavators.

Ongoing Impact

Restoration

- **Roads:** May require weeks to make permanent repair to roadway requiring ongoing detours and disruption.
- **Pedestrian Traffic:** Temporary fix may not be suitable for use by people with disabilities. Pedestrian detour could be needed.
- **Landscaping:** Ongoing repair and restoration of trees, shrubs, grasses and irrigation.
- **Gas Service:** Gas company employees require access to all affected buildings to restore service.

Additional Costs / Enforcement

- Roadway repairs and service life of the roadway are impacted adding to taxpayer costs.
- Repair bills from gas company to excavator (if at fault).
- Enforcement action by regulatory agency.
- Civil lawsuits for injuries and property damage.
- Insurance claims.

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Figure 5

Examining Root Causes

- **The top five root causes in 2020 account for nearly 70% of damage events with a known root cause and look notably consistent with past analysis. Focusing on the leading root causes will provide the greatest results in reducing damages.**
    - ***Failure to notify the one call center/811*** **remains the largest individual root cause.**
    - ***Excavator dug prior to verifying marks by test-hole (pothole)*** **combined with** ***Failure to maintain clearance*** **make up the most consistent cause of damages due to excavator error in the field.**
    - ***Abandoned facilities*** **and** ***Locator error*** **together make up the greatest cause of damages due to locating issues.**
- **DIRT root cause groups are roughly equal in terms of their contributions to the total number of damages, indicating that systemic improvements need to occur across each part of the damage prevention process.**

Root Cause: Individually and by Group

DIRT has 26 individual root causes to choose from, including *Root cause not listed or Unknown/Other*. The Data Committee sorts related individual root causes into groups to provide a higher-level snapshot of what went wrong in the damage prevention process. *No Locate Request* and *Unknown/Other* are groups of one individual root cause each. *No Locate Request* stands alone because it is the first step in the one call ticketing process, has historically been the single leading root cause, and because it is the focal point of 811 and call-before-you-dig awareness. *Unknown/Other* is intended to be used when none of the other choices apply. When the term "known data" is used in report text, a figure or exhibit, it means *Unknown/Other* has been filtered out.

Following is a description of each root cause group:

- ***No Locate Request*** represents damages caused by the failure to provide notification of intent to dig to 811/one call center.
- ***Invalid Use of Request by Excavator***[8] captures situations where the excavator invalidates the ticket by commencing work too early or digging beyond the expiration date or outside the work area described on the ticket. It also covers scenarios where the excavator provided incorrect information to the one call center in the initial notification.
- ***Excavation Issue*** captures damages where something went wrong in the physical digging process.
- ***Locating Issue*** captures damages caused by inaccurate or uncompleted marking.
- ***Miscellaneous*** captures damage causes that do not fit into a notification, locating or excavating category. These consist of deteriorated facilities, previous damage and one call center error and typically account for around 1% of damages combined.
- ***Unknown/Other*** captures damages where the root cause was not collected or none of the available choices fit. When this is selected, the DIRT system requires[9] the user to also provide a free-text comment. Ideally, this would include relevant and useful information, providing some indication of what caused the damage and why none of the available root cause choices fit.

There are different schools of thought on whether *Invalid Use of Request by Excavator* should be a separate group. The individual root causes could be included with the *Excavation Issue* group, as they are the responsibility of excavators. A case could be made that they go with *No Locate Request*, because an invalid one call ticket is equivalent to "no one call ticket." But as indicated above, there are reasons for *No Locate Request* to stand alone. From the individual root causes in the *Invalid Use of Request by Excavator* group, since a locate request was made it can be inferred that the excavator was at least aware of 811, even if less aware of the nuances that follow notification. The intent of a separate group for *Invalid*

[8] In DIRT reports up to and including 2018, these were referred to as "*Other Notification Practices*."
[9] Filling in this comment field is optional when any other root cause is selected.

Use of Ticket by Excavator is to distinguish root causes relating to the physical digging activity (Excavating Practices) from those relating to having a ticket that is **valid** for the time and location of the activity.

Table 8 lists the 25 known individual root causes for 2020 damage events sorted high-to-low and color-coded to match subsequent figures based on root cause groups. The **% of Total** column in Table 8 excludes reports with *Unknown/Other* root causes (118,436) filtered out of the denominator.

Table 8—Reported damages by root cause for 2020 (color coded by root cause group)

Reported Damages by Root Cause for 2020

Coded by Root Cause Group

Root Cause	Reports	2020 % of Total	2019 % of Total
No Notification made to one call center / 811	84,918	31.81%	29.10%
Excavator dug prior to verifying marks by test-hole (pothole)	41,446	15.53%	1.94%
Facility marked inaccurately due to abandoned facility	20,569	7.71%	7.29%
Facility not marked due to locator error	17,539	6.57%	3.56%
Excavator failed to maintain clearance after verifying marks	17,128	6.42%	16.70%
Facility marked inaccurately due to locator error	15,163	5.68%	10.57%
Improper excvavation practice not listed elsewhere	13,444	5.04%	4.97%
Site marked but incomplete at damage location	8,551	3.20%	0.41%
Excavator dug before valid start date/time	7,851	2.94%	9.78%
Facility marked inaccurately due to incorrect facility record/map	7,006	2.62%	2.16%
Excavator dug after valid ticket expired	5,713	2.14%	1.91%
Facility not marked due to no response from operator/contract locator	5,330	2.00%	1.27%
Facility not marked due to unlocatable facility	4,615	1.73%	1.44%
Marks faded, lost or not maintained	4,343	1.63%	1.49%
Excavator failed to shore excavation/support facilities	3,087	1.16%	3.90%
Facility not marked due to incorrect facility record/map	2,729	1.02%	0.74%
Facility marked inaccurately due to tracer wire issue	2,664	1.00%	0.14%
Excavator dug outside area described on ticket	1,489	0.56%	1.51%
Facility not marked due to abandoned facility	1,369	0.51%	0.14%
Excavator provided incorrect notification information	726	0.27%	0.25%
Previous damage	555	0.21%	0.11%
Facility not marked due to tracer wire issue	263	0.10%	0.06%
Deteriorated facility	251	0.09%	0.36%
Improper backfilling	157	0.06%	0.04%
One Call Center error	38	0.01%	0.17%

Legend

- Excavation Practices
- Invalid Use of Request by Excavator
- Locating Practices
- Miscellaneous
- No Locate Request

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One Call Center Error is at the bottom of the 2020 individual root cause list (Table 8). In 2019 it was sixth from the bottom (590). It is intended for errors by, or at, the one call center. The DIRT Users Guide material for *One Call Center Error* states:

- **One Call Center Error:** Includes issues with One-Call-Center-entered data and includes online tickets only if they were intercepted and approved by One Call Center staff. Please select *"Notification Issue - Excavator provided incorrect notification information"* for errors by online users not intercepted by One Call Center staff. Please select *Miscellaneous root causes - Root cause not listed* for ticket transmission and receiving site equipment failures.

It appears this root cause is sometimes misunderstood by DIRT users unfamiliar with the guidance. Facility operators and locators apply it when it really should be *No notification made to one call center/811* or one of the *Invalid Use of Request by Excavator* root causes, or excavators mistakenly think the centers schedule and perform the locates when they really should be choosing a *Locating Practices* root cause.

In the 2020 dataset we've adjusted the root cause selection where the intent can be gleaned from the free-text comment field (ex: changed "*One Call Center error*" to "*Excavator dug outside area described on ticket*") based on a free-text comment like "*dug outside stated work area*"). Overall, these damage events account for negligible number of damages when compared to other root causes.

Root Cause and the Pareto Principle

The distribution of DIRT known root causes fits a pattern known as the Pareto Principle, which is found in many aspects of business (20% of customers lead to 80% of profits), management consulting (20% of employees cause 80% of personnel problems), sports (20% of a team's players receive 80% of salary), and so on. The general principle is that often a small percentage of inputs lead to a large percentage of outputs. It then follows that **addressing the "vital few" produces the most results**. This accurately describes the root causes of damages for 2020. Almost 70% of damages were attributed to one of the top five root causes of damage with each of the major DIRT root cause groups represented.

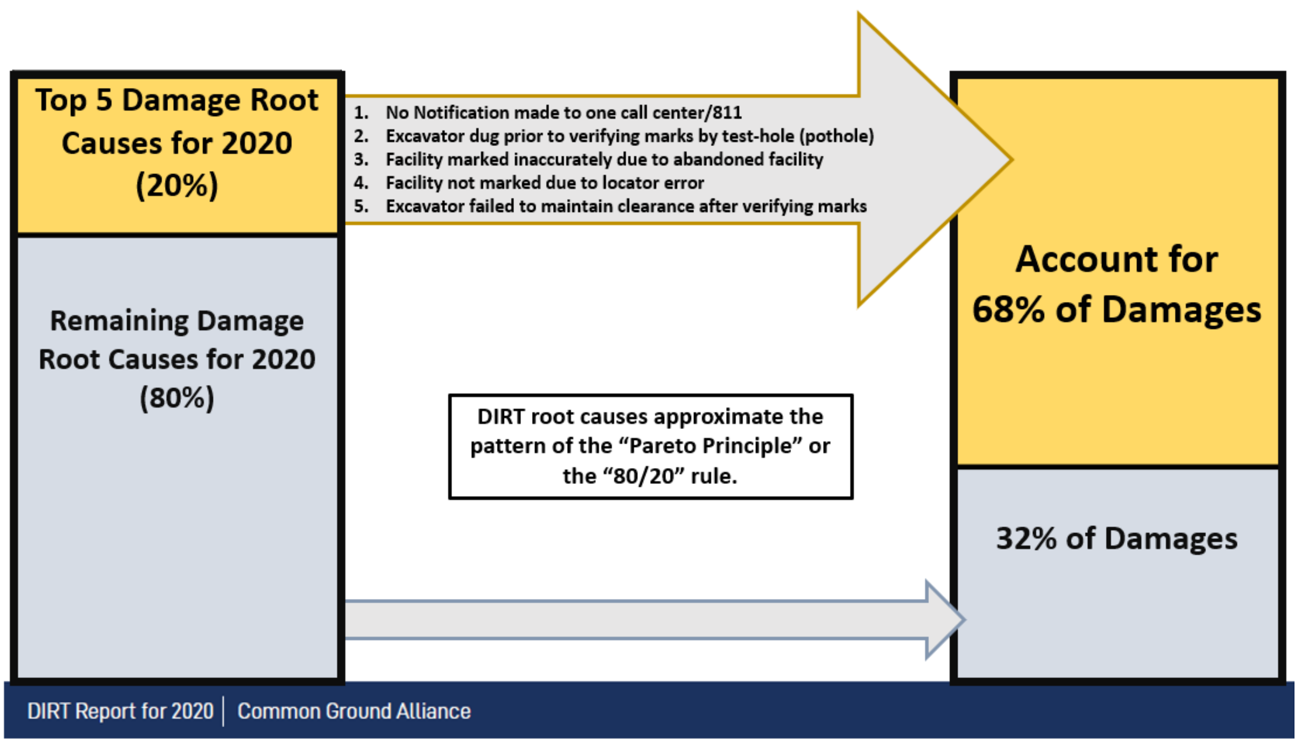


Figure 6

Figure 7 shows the major root cause groupings for 2016 through 2020, excluding unknown root causes. Figure 8 shows the same information for 2020 only. Beginning in 2019 and continuing in 2020, the "big-three" root cause groups – *No Locate Request*, *Excavating Issues* and *Locating Issues* – are approximately equal.

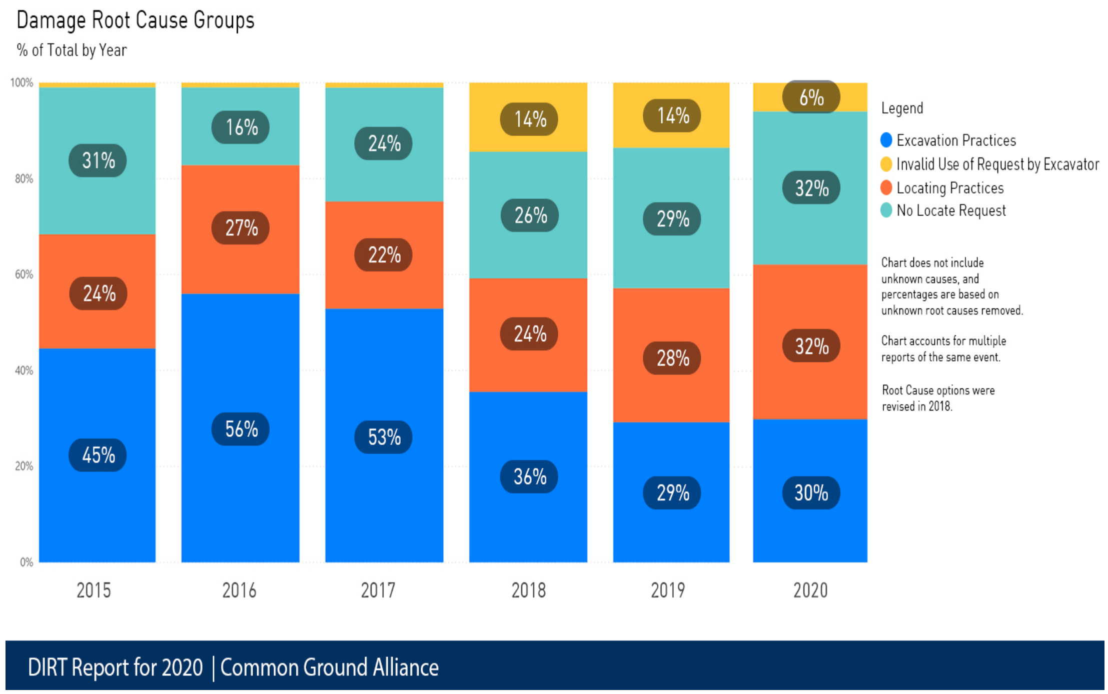


Figure 7

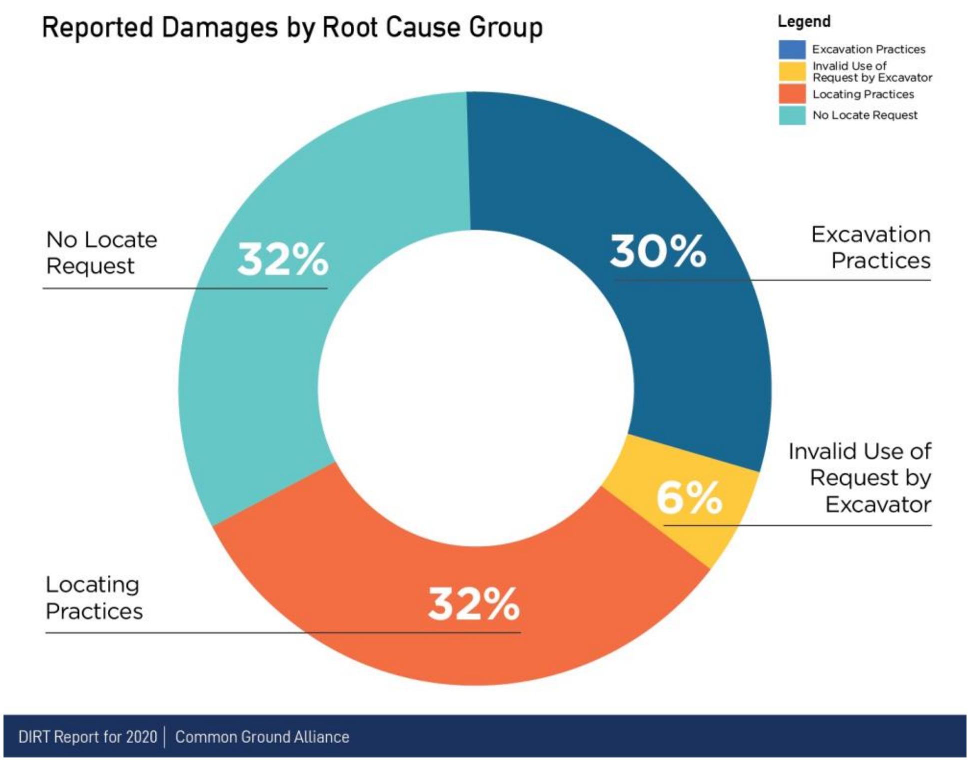


Figure 8

Next, we will evaluate at trends within each of the damage root cause groups over recent years.

No Locate Request

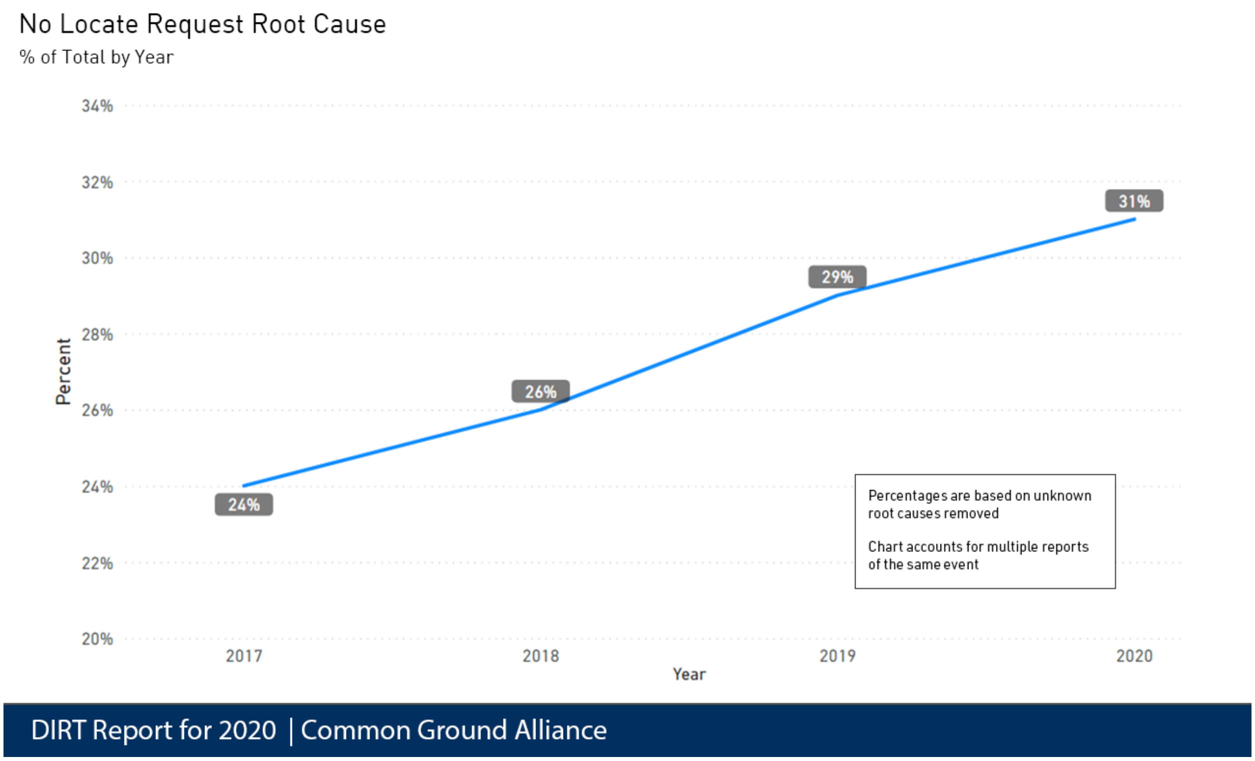


Figure 9

The percentage of damages due to *No Locate Request* has been trending upward for four consecutive years, reaching 31% in 2020.[10] However, the increase in 2020 may not be as alarming as it first seems: Since the slices of the root cause pie chart must always add to 100%, the increase in *No Locate Requests* can be attributed to decreases in the other root cause groups.

All of the one call centers that contributed information on the pandemic effect (see Appendix D) reported significant increases in homeowner tickets, some as much as 40%. Table 9 contains two key points of comparison between 2019 and 2020 damage events involving occupant-excavators.

[10] It is 31% in Figure 9 versus 32% in Figure 8 because *Miscellaneous* is included in the denominator.

Table 9

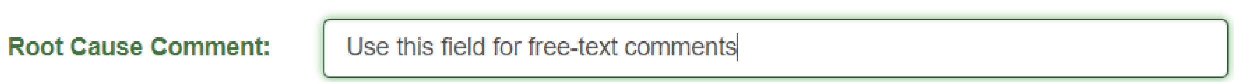
	2019	2020	% Change
Total Damages: occupant-excavator	14,125	12,616	-10.7%
No Locate Request Damages: occupant-excavator	7,331	7,459	+1.7%

Total damages involving occupants were down slightly, while the *No Locate Request* damages were up slightly. However, these shifts are much lower proportionally than the increase in homeowner locate requests. That increase may be an indication of improved general awareness of call before you dig services, and greater willingness to actually apply that awareness by contacting 811 before starting a digging project. This is supported by CGA's most recent 811 general awareness survey (July 2020). Below are a few points from the Executive Summary portion of the survey report:

> **Awareness of 811, both aided and unaided, increased in 2020 and reached the highest point to date. General awareness of call-before-you-dig remained relatively consistent (50%, +2 points).** The increase in awareness of 811, aided (43%, +7 points) and unaided (10%, +3 points), indicates the 811 brand is continuing to grow.
>
> **Seven-in-ten (70%) respondents say they are likely to contact 811 before starting a digging project in the future.** Respondents who are planning a digging project are most likely to contact the service (92%), an increase of 9 to 13 points respectively since 2018. This important finding illustrates the value of 811 is recognized by those who need the service.

Given the significant increase in homeowner digging activity, many damages were avoided that might otherwise have occurred if not for the increased usage of 811 by homeowners. This is the desired result, although damages avoided cannot be counted like actual damages can.

Some stakeholders have asked about data on why excavators do not notify one call centers/811. The Excavator White Paper contains information gleaned from surveys and focus groups, but DIRT currently does not have root causes that dig deeper than *Notification not made to one call center/811.* This information would obviously be valuable. In an effort to capture this data, the Data Committee encourages DIRT submitters to use the Root Cause Comment field in DIRT.[11] This free-text field is required when *OTHER (root cause not listed above*) is the chosen root cause but can still be filled in when other root causes are chosen.



[11] For bulk uploads by Excel CSV file this is column AK, DAMAGE_OTHER_DESC.

Officially adding new root causes to DIRT would require software development work to update all the data entry methods (single report, Excel CSV, JSON, XML, SOAP). Entering comments in the free-text field can be implemented immediately and if it gains traction the Data Committee could consider updating DIRT in the future.

Some suggested standard phrases are offered below. These would assist the Data Committee in filtering and sorting the data:

- Unaware of one call center/811
- Thought they were exempt
- Thought it only applied to professional excavators
- Not digging deep enough
- Did not want to wait for marks
- Did not think there were buried utilities in the area
- Thought they knew where buried lines were located
- Previously dug in the area without problems

Invalid Use of Request by Excavator

Due to the vagueness of the root cause descriptions available prior to 2018, DIRT users were often categorizing situations as *Improper excavation practice not listed elsewhere* or *Root cause not listed elsewhere*.[12] The revised root causes give DIRT users clearer options for situations that are now grouped under *Invalid Use of Request*, but complicate trending across the 2017-2018 transition period. Instead, we show the three years following the transition in Figure 10. *Digging before the valid start time* remains the leading cause within this group, but it dropped to about half. This is followed by *Digging on an expired ticket* and *Digging outside the work area described on the ticket.*

[12] Based on comments in the free-text field for unknown/other root causes.

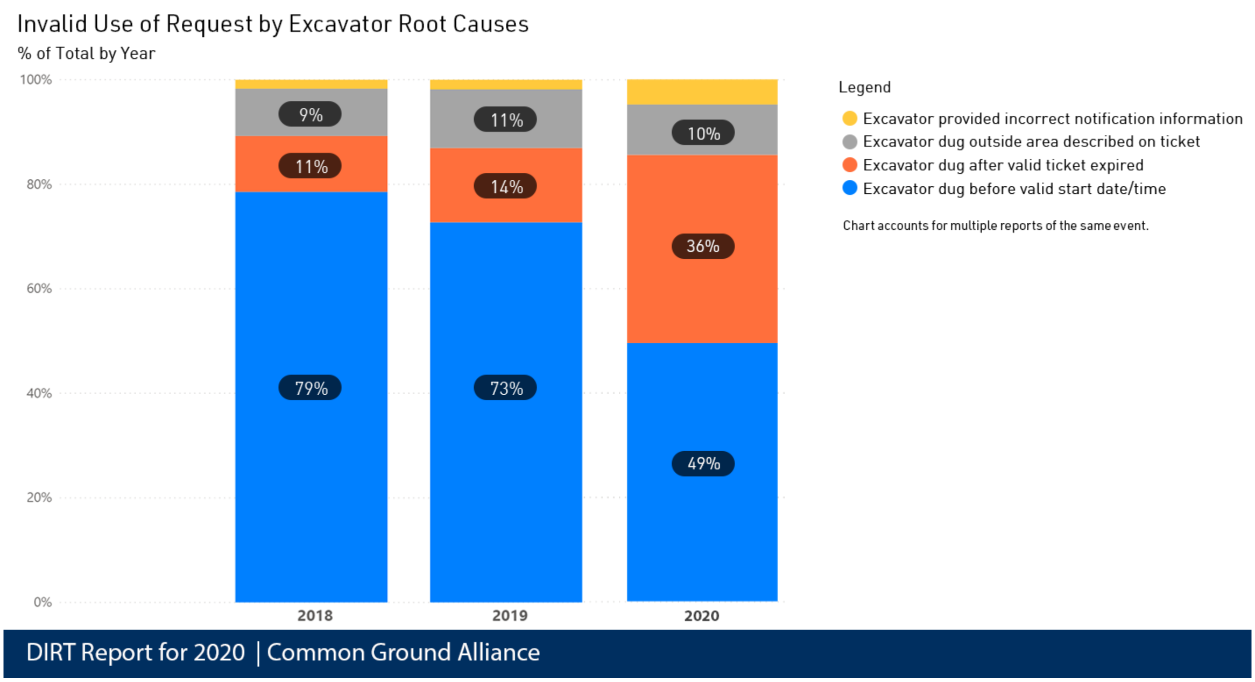


Figure 10

Excavating Practices Root Cause Group

The individual root causes that make up the *Excavating Practices* group are depicted in Figure 11. The combination of *Failure to pothole* and *Failure to maintain clearance* continue to make up the greatest percentage of known root causes within the Excavating Practices group. These causes combined reached 74% in 2020.

Analysis indicates some DIRT users shift back and forth between utilizing *Failure to pothole* and *Failure to maintain clearance.*[13] Some DIRT users utilize their damage/repair claims information as their DIRT data source and look for the closest match between their internal codes and the DIRT choices. The main purpose for claims codes is identifying who will pay for repairs, not what would have avoided the damage—which is a more accurate reflection of the root cause. If 811 notification was made and marks were completed accurately and on time, that may be the extent of an investigation.[14] Looking at trends in data reporting, inconsistencies can be seen in how companies map their claims codes to root causes.

To streamline the fluctuations among these individual root causes, Figure 11 combines them (*Clearance/Pothole*), where it continues to constitute the largest segment. This highlights the contribution of these root causes to total damages and indicates they should be addressed as a package.

[13] See from Table 8 how failure to pothole went from 1.94% in 2019 to 15.53% in 2020, while failure to maintain clearance went from 16.70% to 6.42%.

[14] See the section from the 2019 DIRT report on "The Importance of Separating Liability from Root Cause in DIRT Data" (p. 15).

The 2019 DIRT Report suggested several "Update Opportunities" for the relevant Best Practices (5-18, 5-19, 5-20). The Best Practices Committee has formed a working group to address the recommendations.

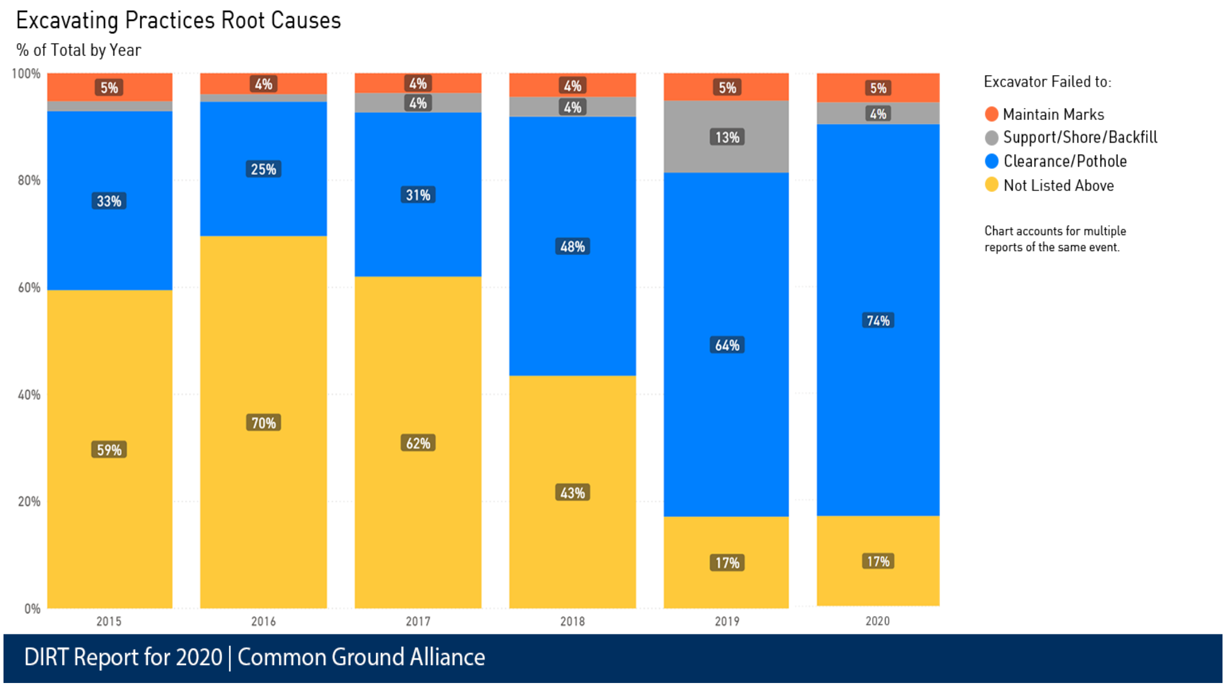


Figure 11

When selecting a root cause, the use of *Not listed above* has decreased from over half to less than 20% of the root causes provided. This is a positive trend toward higher quality data. *Not listed above* is intended as a catch-all when a more specific excavating root cause is not captured. The individual root causes in the *Excavating Practices* group for 2020 are shown in Figure 12.

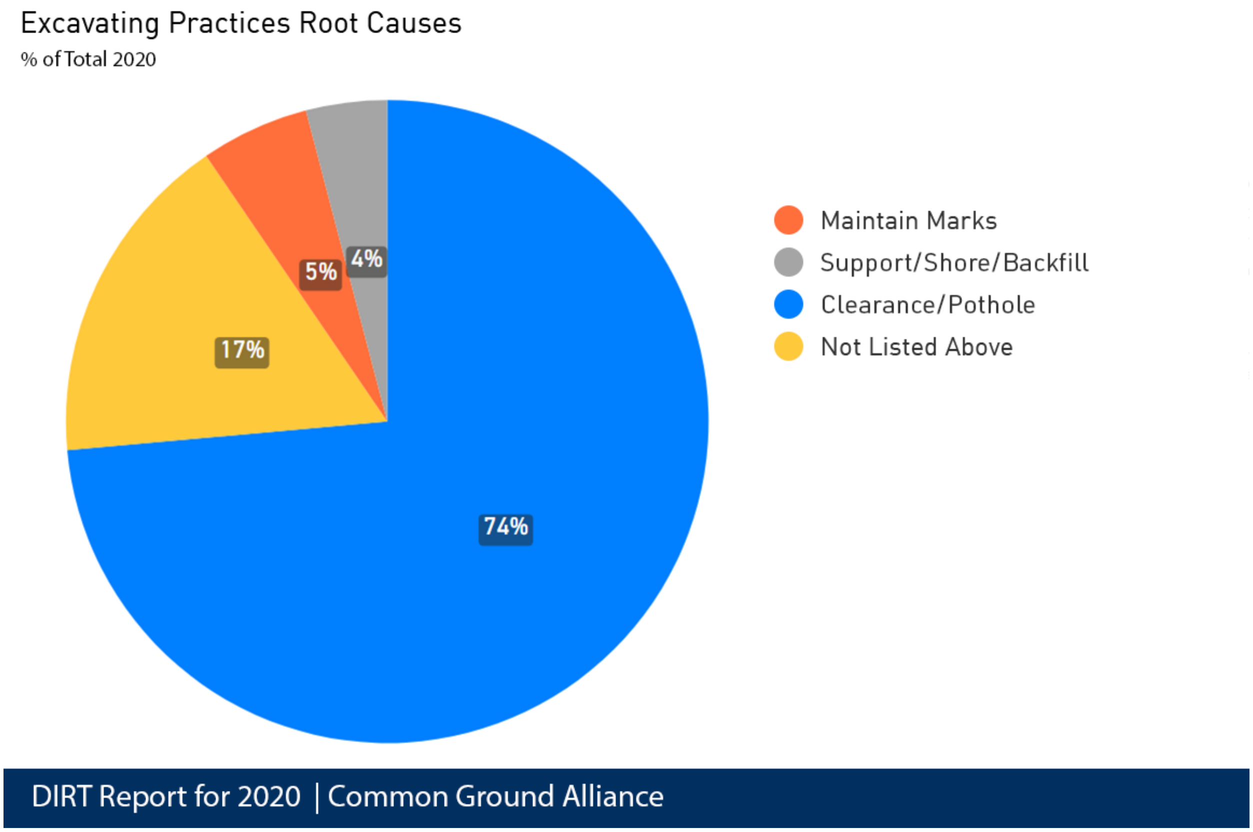


Figure 12

Locating Practices Root Cause Group

DIRT has eleven possible locating root causes. Two new root causes involving locator error were introduced in 2018: *Inaccurate* and *Not marked*. These are intended as a catch-all for when a more specific root cause is not known. For example, an excavator may only know that marks are inaccurate, while a locator or facility operator may be able to determine if it was a mapping, tracer wire or abandoned facility issue. There may be damages related to mapping, tracer wire and abandoned facility hidden in the *Locator Error* category. Therefore, such errors should not always be interpreted to conclude that the locate technician is the responsible party. Inaccurate maps, broken tracer wire, abandoned facility, etc. could lead to an inaccurate locate even if the locator followed all proper procedures.

Figure 13 shows the five-year trend for the *Locating Practices* group.

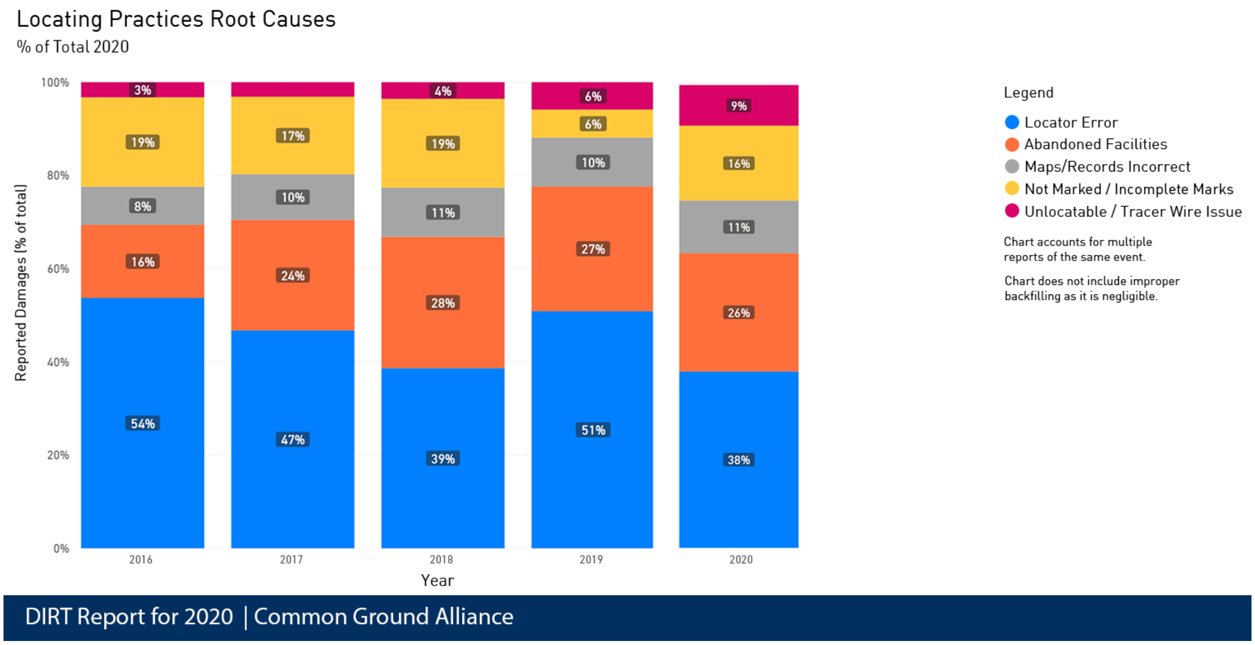


Figure 13—Locating root causes for 2016 to 2020

Although down from 2019*, Locator Error* continues to be the leading locating root cause for 2020. As discussed above, it likely includes some combination of other more specific locating root causes. The increase in *Not marked/incomplete* offsets the reduction in *Locator Error*, while the other three remain relatively consistent. The stacked bar for 2020 is very similar to 2018. Because *Locator Error* can encompass a variety of issues, *Abandoned facilities* could be considered the largest single segment of the *Locating Practices* group. Abandoned facilities was identified in the Next Practices Report to the Industry as a leading inefficiency in the damage prevention process:

> **Abandoned lines impact the accuracy of locating.** Abandoned lines present a serious and persistent problem for locators and excavators. Locators and excavators can "do everything right" and still damage a live utility due to confusion between abandoned (absent from facility maps) and live lines.
>
> **Abandoned lines impact excavators' ability to verify marks by potholing**. Again, excavators can attempt to follow each step in the damage prevention process, including potholing, and still cause a damage due to the presence of abandoned facilities that are mistaken for live ones and vice versa.

Figure 14 shows the individual locating root causes for 2020.

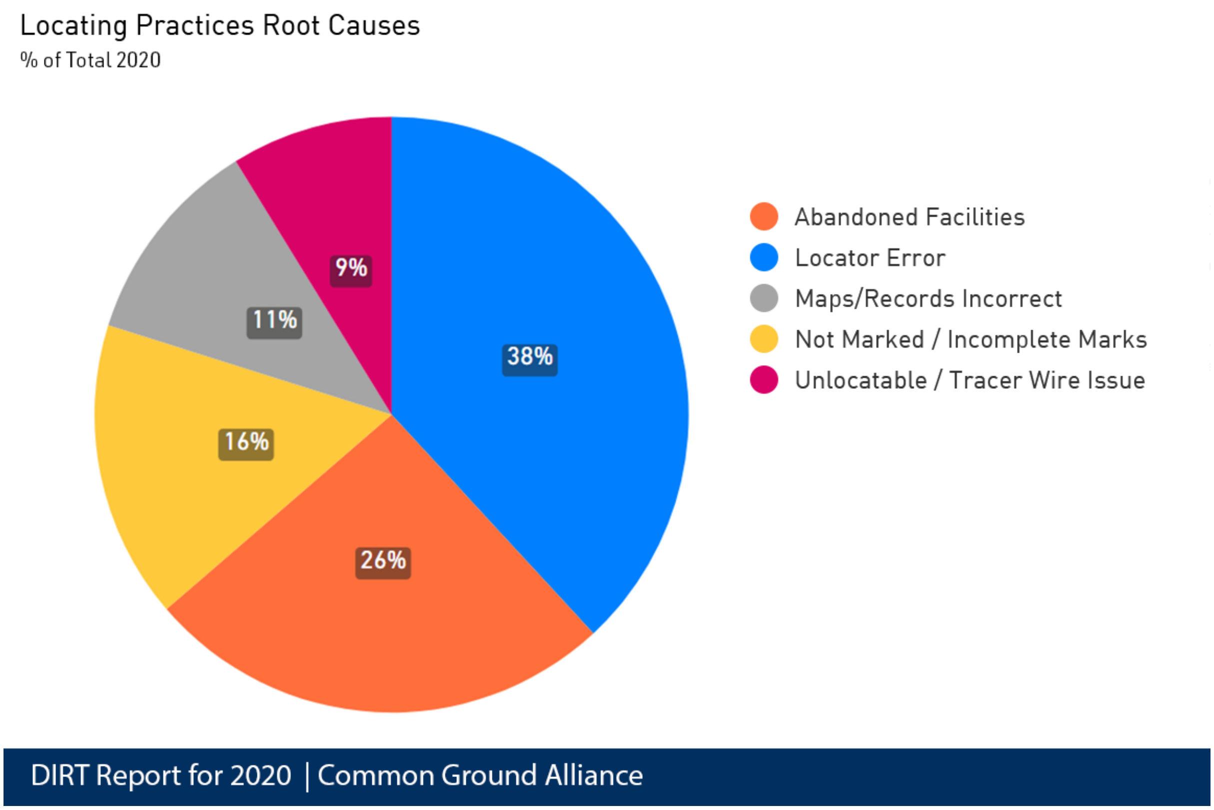


Figure 14

Root Cause Group by Event Source

Significant differences in the root cause group percentages by event source are seen in Figure 15. The "Other" bar consists of Equipment Manufacturers, Railroad, and Engineer/Design stakeholders, all of which historically have had very small numbers. In 2020, reports from Engineer/Design increased dramatically; they make up about 98% of the "Other" group. Engineer/Design firms likely have characteristics and concerns similar to Excavators/Road Builders, which would likely lead to a similar event distribution, with a large emphasis on Locating.

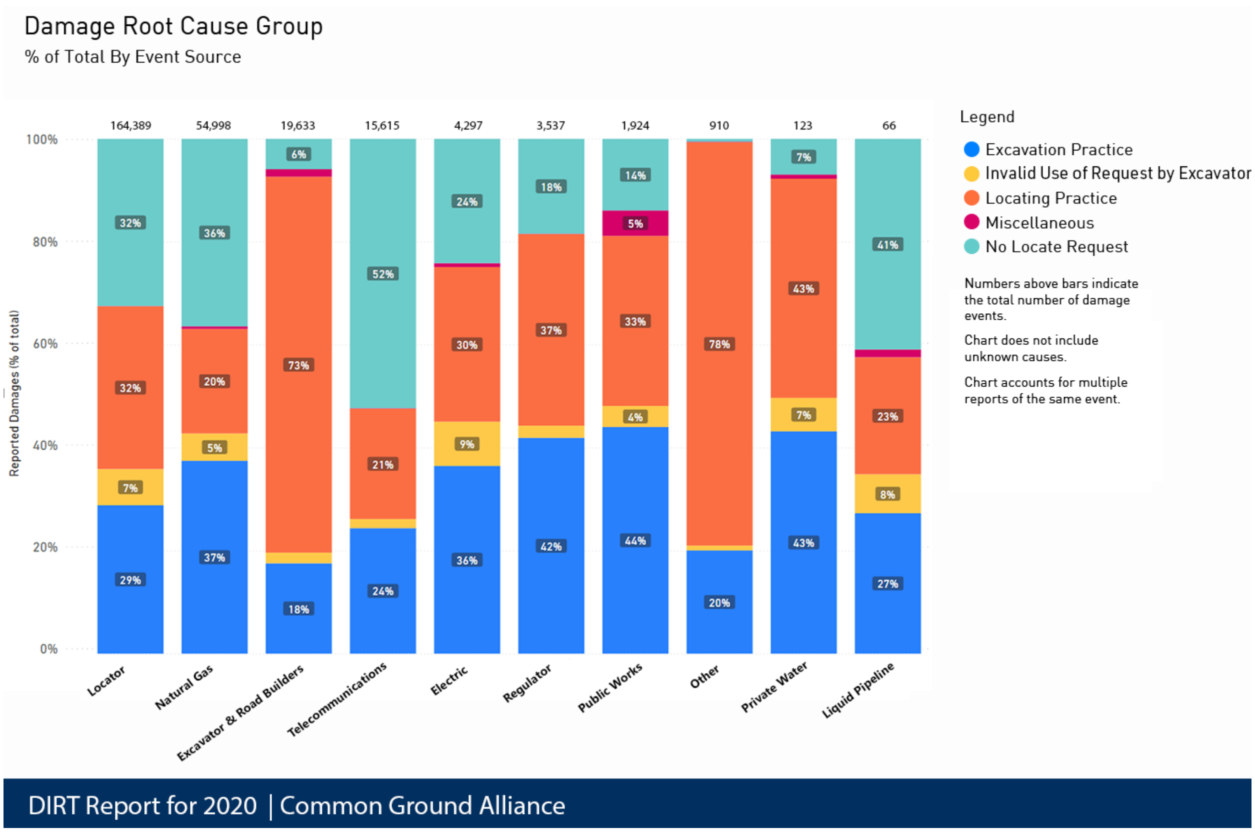


Figure 15

Excavator Type by Root Cause

Figure 16 shows root cause groups by type of excavator involved (not necessarily *caused by*). As is the case in most years, occupants and farmers have high percentages of *No Locate Request*, while for most other excavator types, locating and excavating practice-related issues dominate.

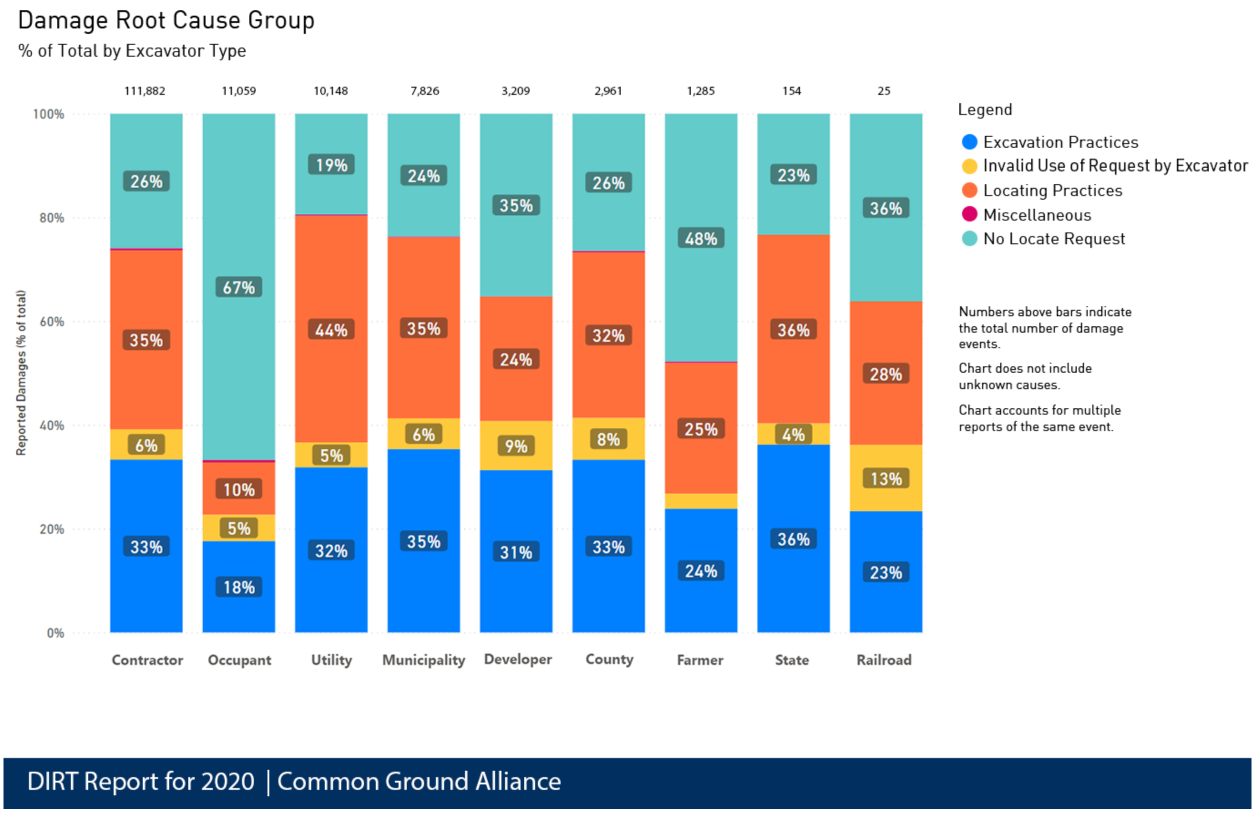


Figure 16

Facilities Damaged by Root Cause

Figure 17 demonstrates the relationship between damaged facilities and root cause.

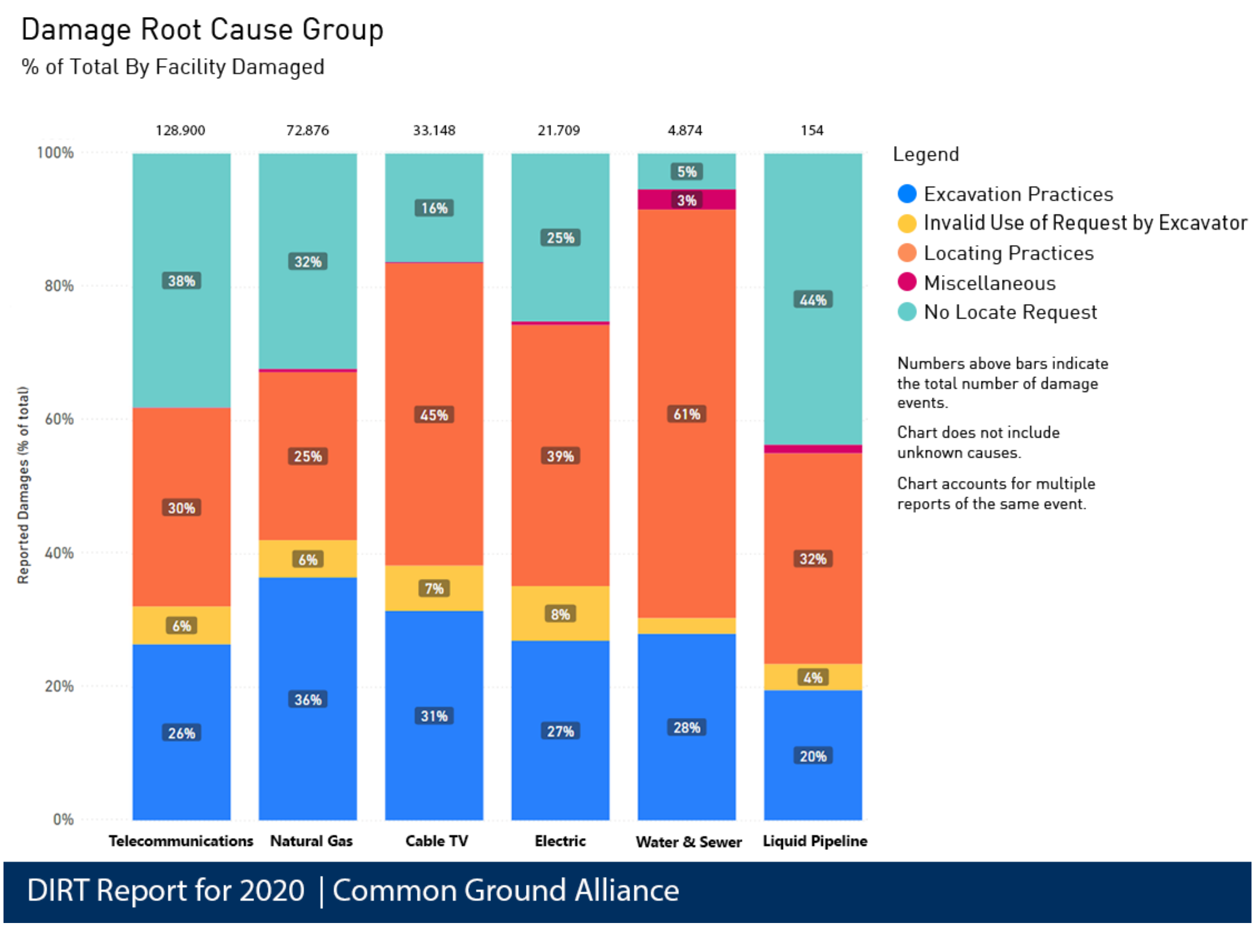


Figure 17

Supplemental One Call Center Data & Analysis

- **Increased homeowner locate requests in 2020 were reported by multiple one call centers.**
- **Positive response systems provide one call centers with additional data points for late locate analysis.**

Damage and near miss DIRT data tell us part of the story when it comes to damage prevention. In this year's report, several one call centers shared additional data and analysis surrounding two key areas for 2020: the effect of the pandemic and the increasing challenge of late locates. **Appendix D presents the information provided by the one call centers in more detail, along with additional commentary and analysis**.

Pandemic Effect

To assess the impact of the Covid-19 pandemic on damage prevention, centers provided information on 2020 trends in ticket volumes and construction activity. There was a consistent trend seen across multiple states of increased homeowner locate requests and digging activities associated with home improvement projects, whether by homeowners or professional contractors. Despite the increase in homeowner digging activity, damages involving occupants did not increase, which is likely due to strong awareness of 811 and call before you dig services among those most likely to need the service.

Late Locates

Late locates are consistently identified as a significant challenge by damage prevention stakeholders. Late locates are not among the leading causes of damages, but they can be a source of great frustration for excavators that often leads to loss of confidence in the damage prevention system. Several one call centers provided data from their positive response systems on late locates and the steps being taken in their states to improve the likelihood of on time locates. Late locates tend to be more of a near miss/downtime issue, as opposed to driving actual damages. Based on the numbers provided by one call centers, it is clear that the instances where late locates prompt near miss reports to DIRT greatly undercount actual occurrences of late locates.

Thank you to the following one call centers that contributed to this supplemental analysis:

- Arizona 811
- Colorado 811
- MISS DIG 811 (Michigan)
- North Carolina 811
- Pennsylvania 811
- South Carolina 811
- Virginia 811
- USA North 811 (Northern California and Nevada)

Reference Appendix D for one call center data and analysis.

Root Causes and Best Practices

- **The Best Practices Committee took action to address all recommendations outlined in the 2019 DIRT Report, establishing five new working groups.**
- **Analysis of 2020 data suggests additional recommendations related to practices 5-23 Locate Request Updates, 5-17 Marking Preservation and 4-8 Facility Marking.**

The CGA Best Practices manual includes more than 160 practices that cover all phases of the 811 process, agreed to by each of CGA's 16 stakeholder groups. All practices go through a seven-step process that includes review by a task team, the full Best Practices Committee, and finally the CGA Board of Directors. Two fundamental principles must apply for a Best Practice to be adopted by CGA—it must: (1) actually be in use somewhere, and (2) achieve consensus from representatives of all CGA Stakeholder groups.

A description of the process can be found here: https://bestpractices.commongroundalliance.com/1-Introduction/14-Best-Practices-Process.

The 2019 DIRT Report included a section relating leading damage root causes to corresponding Best Practices and offered suggestions on how some might be strengthened. CGA's Best Practices Committee has formed working groups to review the suggestions and follow the established process. There is one suggestion from 2019 we'd like to revisit this year—Best Practice 5.23 Locate Request Updates.

> *5.23 Locate Request Updates* ***(emphasis added):***
> **Practice Statement:** The excavator calls the one call center to refresh the ticket when excavation continues past the life of the ticket (sometimes, but not always, defined by state/provincial law). This recognizes that it is a best practice to define ticket life. If not currently defined in state/provincial law, **ticket life is ideally 10 working days but does not exceed 20 working days.** Original locate request tickets are generated so that the minimum number of locate request updates are necessary for the duration of a project. After all the excavation covered by a locate request is completed, no additional locate request updates are generated. Communication between excavation project planners, field personnel, and clerical personnel is essential in accomplishing this task.

The 2019 DIRT Report focused on the "ideal" ticket life of 10 working days, pointing out that there is only one jurisdiction with a 10 working-day life-of-ticket, Saskatchewan, and that short ticket lives may impose burdens on facility owner/operators and contract locators with little corresponding safety benefits. The 2019 suggestion was to *retain and promote a Best Practice establishing a ticket life, but not to define an "ideal" ticket lifespan.*

The Best Practices Task Team referred the matter back to the Data Reporting & Evaluation Committee asking for *analysis of ticket life review with respect to volume and other factors*.

The Data Committee does not have data on ticket volumes handled by locators or facility operators, or how often tickets are updated. Through the OCSI Data Collection tool, the Data Committee has access to totals of incoming locate requests and outgoing transmissions, but nothing more granular than annual volume. Nevertheless, we approached the concept of an "ideal" ticket life by asking: What can we glean from available data to show at what point marks should be refreshed often enough to prevent damages, but not so often that facility operators/locators are wasting resources? To answer that question, we examined (1) damage root causes most likely impacted by a ticket-life rule, and (2) time elapsed between date of 811 notice and damage.

To simplify the analysis, states were sorted into five groups based on roughly equivalent working-to-calendar days, as shown in Table 10. "No rule" means no specific number of days, although the state may have something like "until no longer needed for safe excavation" or "as long as equipment remains on site."

Table 10—U.S. state life-of-ticket data

Group	Working Days	Calendar Days	# of States	States
A	10	14 -15	6	KS MN MS TN TX UT
B	12 -15	20 -21	15	AZ DC IA ID IN KY LA MD MI NC ND NM SC VA WY
C	20 -21	28 -30	13	AL AR CA CO CT FL GA HI IL NH NV SD VT
D	45	60	4	ME NJ RI WA
E	No rule	No rule	13	AK DE MA MO MT NE NY OH OK OR PA WI WV

Root Causes Affected by Ticket Life

As indicated earlier, Saskatchewan was the only location that specified 10 working days. Table 10 is based on U.S. states and Washington, D.C. only,[15] and all in the A Group are based on calendar days. The root causes most likely to be affected by ticket life are *Failure to maintain marks (EXMARKS)* and *Digging on an expired ticket (EXDUGAFTER)*. The following tables show the percentage of these two root causes for the state groups. In Table 11, the denominator is all root causes from the *Excavating* and *Invalid Use of*

[15] Canada had a negligible number of reports with these two root causes.

Ticket groups, e.g., all which are excavator responsibilities, except for *No Locate Request* as there must be a ticket to begin with in order for ticket life to come into play. Essentially, the denominator is any way an excavator could go wrong, after 811 notification. For Table 12, locating practice root causes are added to the denominator, to account for the possibility that a facility marked incorrectly or missed on a previous locate might be corrected on an updated ticket. Since the denominator is now larger, everything drops a few percentage points from Table 11 to Table 12.

Table 11—Percent *EXMARKS* and *EXDUGAFTER*, by state group, over *Excavating Practices* and *Invalid Use of Request by Excavator* root cause groups

State Group	Marks faded, lost or not maintained *(EXMARKS)*	Excavator dug after valid ticket expired *(EXDUGAFTER)*
A	4.44	6.16
B	4.39	10.63
C	6.14	6.59
D	13.00	9.77
E	5.64	4.16

Table 12—Percent *EXMARKS* and *EXDUGAFTER*, by state group, over *Excavating Practices*, *Invalid Use of Request by Excavator*, and *Locating Practices* root cause groups

State Group	Marks faded, lost or not maintained *(EXMARKS)*	Excavator dug after valid ticket expired *(EXDUGAFTER)*
A	1.20	1.66
B	1.24	2.99
C	1.51	1.62
D	15.71	4.29
E	1.75	1.29

This statement comes from the Locator White Paper:

> Requirements that tickets are renewed or projects re-marked every 12-15 days could be overly burdensome on both locators and excavators, particularly if active digging has been completed on one section of land and excavators only need re-marks on a smaller portion.

If the desire is to move away from the Group A ticket life, and Group E does not apply since we do[16] want a ticket life to be a Best Practice, the numbers highlighted in green in Tables 11 and 12 represent the best results for Groups B, C and D. Based on this, a ticket life straddling Groups B and C may be appropriate: 15 working days (or ~21 calendar days or ~3 weeks). Alternatively, going by the principle that a Best Practice must be in use in at least some locations, rather than stating an "ideal" number, there could be a general statement such as: "most states with a ticket life rule are within the range of 15 to 20 working days, or 21 to 30 calendar days."

Elapsed Time from 811 Notice to Date of Damage

Most one call centers use a ticket number format with the date of notice embedded within the ticket number. Using what appear to be legitimate ticket numbers in the 2020 DIRT dataset, we calculated the number of days from ticket origin to damage date for damages with a root cause of *Failure to maintain marks (EXMARKS)* in states with no ticket life (Group E). Figure 18 depicts the results.[17] The plot terminates at 75 days, but there were actually many single-digit damage days extending out to 469 days (all ones beyond 145 days).

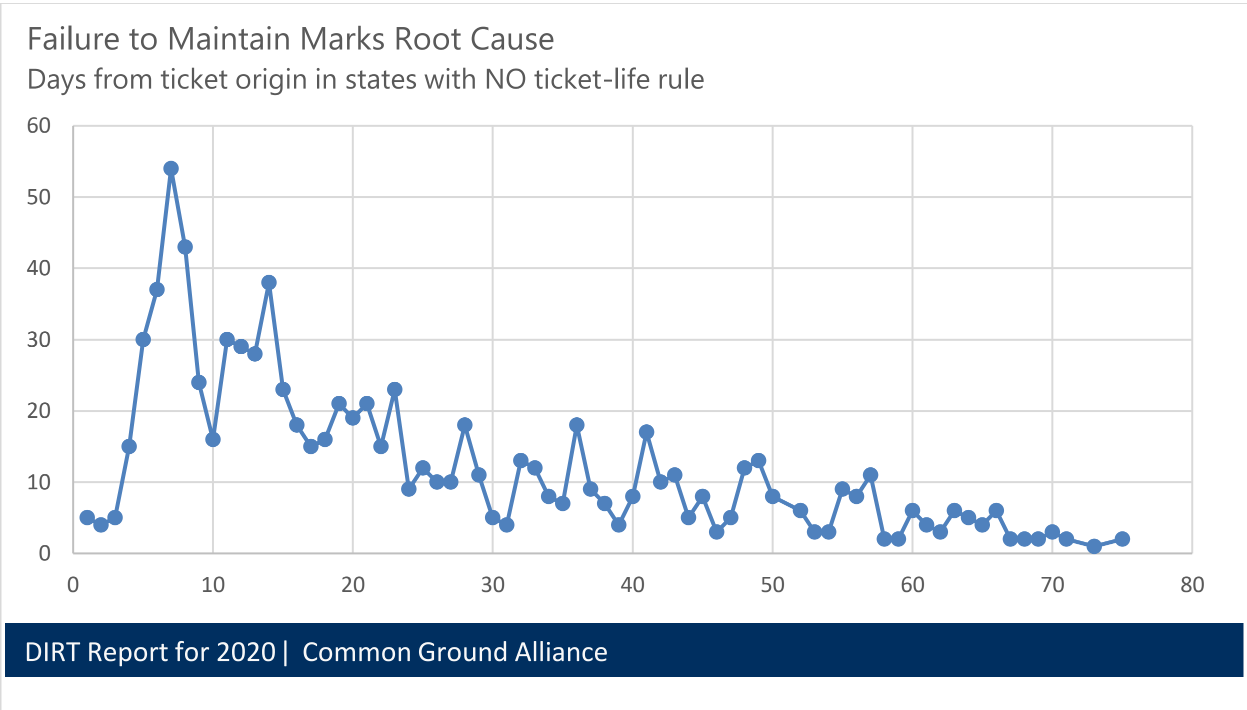


Figure 18

[16] See the USA North contribution to the pandemic effect analysis (Appendix D). The figure (D7) showing 2010 to 2020 ticket volume shows the effects when California and Nevada extended their ticket lives from 14 to 28 days.
[17] Wisconsin uses the week number but not the actual date, so the Wednesday of the week was assumed.

The peak occurs in the first week, indicating that a significant amount of *Failure to maintain marks* damages occur early in a project, due to a minority of excavators damaging/removing, digging up, covering with spoil, etc., rather than marks fading or being affected by weather/elements. After the initial wave, the peaks and valleys appear to occur about every seven days. The valleys probably correspond to weekends. For Wisconsin, Wednesdays were always assumed as the day of ticket origin, and some weekly peak-day damages could move forward or back a day or two. Still, the pattern that emerges is an initial wave followed by diminishing waves on a weekly cycle. A contributing factor may be that most digging projects are short duration, so there’s simply more opportunity for damage in the first week. This raises several questions:

- Would any ticket-life rule reduce the initial wave of damages?
- Should the majority of diligent excavators and all facility operators/locators be subject to stringent ticket lives due to the actions of a few bad actors?

The total damages occurring beyond 21 days (including beyond 75 days where Figure 18 ends) would add up to more than those in the first 21 days but are spread out over a longer time period. We assume a 21-day ticket life could avoid many damages that occur beyond 21 days. Rather than focusing on ticket life for damages occurring during the first few weeks, a better approach may be to focus on maintenance of marks. Best Practice 5-17 Marking Preservation covers this topic.

5-17: Marking Preservation

Practice Statement: The excavator protects and preserves the staking, marking or other designation of underground facilities until no longer required for proper and safe excavation. The excavator stops excavating and notifies the one call center for re-marks if any facility mark is removed or is no longer visible.

Practice Description: During long, complex projects, the marks for underground facilities may need to be in place far longer than the locating method is durable. Painting, staking, and other marking techniques last only as long as the weather and other variables allow. When a mark is no longer visible, but work continues around the facility, the excavator requests a re-mark to ensure the protection of the facility.

The following survey results were reported in CGA’s Excavator White Paper:

- Fewer than half of excavators reported always renewing tickets when marks are no longer present (See CGA Best Practice 5.17).
- Concepts such as pot-holing/test-pitting, needing to maintain marks or request re-marks, and other critical but lesser-emphasized excavation Best Practices do not have the same level of awareness and compliance as making the notification.

Best Practices 5-17 includes a practice description that focuses more on long-term projects and marks affected by weather. However, the data analyzed on *Damages due to failure to maintain marks* highlights the importance of maintaining marks from day one. There's nothing specific in the BP 5-17 practice statement or practice description about how to "protect and preserve" markings from destruction by non-weather causes. What are the "other variables?" The Best Practices Committee should consider revising 5-17 to provide more clarity and practical guidance.

Table 13 depicts the combinations of excavator type and work performed during the first 14 days. Almost half of the combinations point to *UNKNOWN* for one or both variables. This is an example where better-quality data could improve the quality of the analysis. Still, we see that water and sewer work rise to the top of "known" work types, while occupants make up a small percentage of excavator types, probably because most occupant projects are short duration while water and sewer projects typically take longer. This highlights the target audience for information on maintaining marks in the early stages of a project.

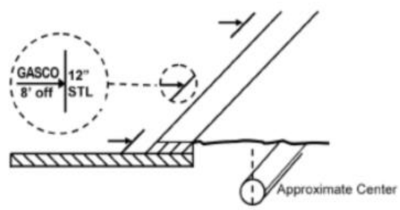
Table 13—First 14 days by excavator and work type

Excavator Type	Work Type	% Damages in first 14 days from Figure 18
Unknown	Unknown	27.1
Unknown	Water	12.3
County + Municipality	All types	12.3
Contractor	Unknown	8.4
Contractor	Water	7.8
Contractor	Sewer	4.7
Occupant	All types	1.4

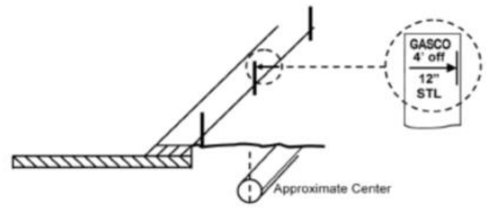
An alternate approach could be to encourage the use of offset marks. Instead of directly over the buried facility, offset marks are placed parallel and to the side. If it is obvious that marks directly over a facility would be disturbed by excavation activity, offset marks may be easier for the excavator to maintain. Excavators could be encouraged to request offset marks for appropriate situations when making their 811 notifications.

Best Practices Appendix B (Marking Guidelines) addresses offset marks.

Example: painted offset (off)



Example: staked offset (off)



3. Changes in direction and lateral connections are clearly indicated at the point where the change in direction or connection occurs, with an arrow indicating the path of the facility. A radius is indicated with marks describing the arc. When providing offset markings (paint or stakes), show the direction of the facility and distance to the facility from the markings.

The Practice Description for Best Practice 4-8 mentions offsets:

…Markings may include one or any combination of the following: paint, chalk, flags, stakes, brushes, ***or offsets****….*

“Paint, chalk, flags, stakes” are the physical materials used for marking, while “offset” has to do with where they are placed in relation to the buried facility. The Best Practices Committee could consider separating “offsets” from this sentence and adding one or more sentences specifically covering offset marking.

DIRT Report for 2020 Appendices

Appendix A: Terminology Used in This Report

Damage—Any impact or exposure that results in the need to repair an underground facility due to a weakening or the partial or complete destruction of the facility, including, but not limited to, the protective coating, lateral support, cathodic protection, or housing for the line, device, or facility. There does not need to be a release of product.

DIRT—Damage Information Reporting Tool.

Downtime—Time that an excavator must delay an excavation project due to failure of one or more stakeholders to comply with applicable damage prevention regulations or best practices. There may or may not be a damage associated with the downtime.

Event—The occurrence of facility damage, near miss, or downtime.

Facility Affected—The type of facility that is involved in a damage event: distribution, service/drop, transmission, or gathering.

Facility Damaged—The facility operation that is affected by a damage event: cable TV, electric, natural gas, sewer, water, etc.

Known Data—DIRT data, excluding unknown data. Unknown data depends on the DIRT field but usually is denoted as “unknown” or “unknown/other.”

Near Miss—An event where damage did not occur but clear potential for damage was identified.

Pothole—Hand digging or using a “soft excavation” practice such as vacuum excavation to dig a test hole to verify accuracy of markings prior to beginning excavation within the tolerance zone (AKA test hole, daylighting).

Root Cause—The primary reason that the event occurred. For purposes of DIRT, the point where a change in behavior would reasonably be expected to lead to a change in the outcome, i.e., avoidance of the event.

Substantial Reporting States—A set of states at the high end of a continuum of states where DIRT reporting reflects damages occurring in those states. These states are used as the basis for the estimate of total U.S. damages by identifying statistical correlations with independent variables such as construction spending, population, weather, one call transmissions, etc., and using those to estimate damages in the remaining states.

Test Hole— Exposure of a facility by safe excavation practices used to ascertain the precise horizontal and vertical position of underground lines or facilities (NOTE: verbatim from Best Practices Glossary).

Tolerance Zone—The space in which a line or facility is located and in which special care is to be taken.

Transmissions—The number of initial notices of intent to excavate sent by one call centers to their member facility operators, including those sent directly to locating vendors on behalf of members. Each incoming notice of intent to excavate generates outgoing transmissions to several members, such as electric, gas, cable TV, water, sewer, telecommunications, etc.

Unique Events—The number of events after identifying and consolidating multiple reports of the same event. Unless otherwise noted, this is the number (385,381) used in this report and on the online interactive dashboard.

Appendix B: Damage Report Path—Entry to DIRT Report

Whether interpreting written analysis, tables or figures in the DIRT Report, it is important to be mindful of what the numbers represent. To help explain how we transform reports into the analysis in the annual DIRT Report and online dashboard, the following describes the path damage reports follow:

1. DIRT users entered 475,770 underground damage reports and 2,453 near miss reports from the United States and Canada for 2020.

2. A program was run to match and weight reports of the same event. This compressed the totals to 385,381 unique underground damages and 2,329 unique near misses (U.S. and Canada). Near misses are set aside for separate analysis.[18] The online DIRT dashboard is based on the number of unique damages (385,381 with no filters applied), as are all figures and tables in this report.

3. CGA's DIRT Report consultant generates an estimate of annual damages in the U.S. Recognizing that DIRT is voluntary and not all damage events are entered in DIRT, the consultant uses statistical methods to extrapolate, from the matched/weighted damage reports entered in DIRT, an estimate of damages not entered in DIRT. This process produced a total of 468,000 estimated U.S. damages.

4. For 2020, the U.S. estimate of damages (468,000) is close to the number of underground damages initially entered into DIRT (475,770). Keep in mind however, the 475,770 includes reports from Canada and consists of roughly 19% multiple reports of the same event.

[18] See separate report at: https://commongroundalliance.com/Portals/0/Library/2020/DIRT%20Reports/Near%20Miss%20reports%202015_2018_Final%20-%2004.16.2020.pdf?ver=2020-08-14-130152-903

Appendix C: Estimate of Total U.S. Damages

Green Analytics, in consultation with the Data Reporting and Evaluation Committee, developed a model to estimate the total number of facility damages in the U.S. and to provide insight into the relationships between key variables. The modeling process used is summarized in this section.

Damages reported to DIRT are voluntary and for many states under-reported. As a result, the total reported damages in DIRT do not reflect the actual number of damages that occur in the U.S. By relying on states that are substantially reporting actual damages, statistical methods can be used to estimate damages for the states with less adequate reporting. In this way, an estimate can be made of the total number of damages. To start, a subset of states where damages are deemed to have been substantially reported was established. This subset was then used to develop a predictive model as outlined below.

Substantial Reporting States

This report uses the same set of substantial reporting states as in the 2017 through 2019 DIRT Reports, but with the addition of North Carolina. For more details on how the states were determined as substantially reporting, see the 2017 and 2018 DIRT Reports.

Table C1 lists the 10 substantial reporting states used for analysis along with reported damages over time.

Table C1—Reported damages from substantial reporting states, 2017 to 2020

State	2017	2018	2019	2020
Colorado	6,786	12,411	18,748	16,839
Connecticut	562	711	1,027	827
Florida	21,877	26,628	34,390	31,399
Georgia	29,655	29,844	43,538	30,163
Illinois	19,256	20,702	23,452	21,478
Kansas	5,476	5,435	5,965	5,265
New Mexico	1,479	1,825	2,069	2,824
North Carolina	N/A	N/A	N/A	26,778
Pennsylvania	8,878	9,706	14,239	11,890
Texas	45,384	36,543	70,011	58,617
Virginia	4,877	4,862	4,865	5,160
SUBSTANTIAL REPORTING STATES TOTAL [a]	144,230	148,667	218,304	211,240 (184,462)
TOTAL DIRT REPORTED DAMAGES	316,442	341,609	453,766	374,658
Reported Damages Attributed to Substantial Reporting Status	46%	44%	48%	56% (49%)

[a] Count and percentage in round brackets exclude North Carolina to enable more direct comparisons with past years.

Statistical Method

A Poisson regression model, with standard errors adjusted for the panel data structure, was used to develop the predictive model. The Poisson regression is a generalized linear model that is typically used to understand and model count data, such as the number of damage events in a state that is contained within the DIRT database. This model yields estimates of the percentage change in damages given a range of independent (or explanatory) variables.

The modeling exercise involved running a series of Poisson models to explore which independent variables had a statistically significant influence on the count of damages in a given state and month. In general, the modeling process involved adding all potential predictor variables to an initial model. Model coefficients deemed insignificantly different from 0 were then iteratively dropped from this initial specification. Thus, the final model used for predictive purposes included only significant coefficients.

Two different model specifications were initially run: 1) a model with linear quantitative variables and nominal variables, and 2) a model with linear and quadratic quantitative variables or a log-normal transmissions variable as well as nominal variables. The specification with quadratic and log-normal variables account for potential non-linear relationships. For this specification, the modeling process proceeded by first adding quadratic variables for certain quantitative predictors to the linear model independent of other quadratic variables. If the relationship was statistically significant, then the quadratic variable was considered a candidate for the final model.

The same procedures were used to run models for the two sets of substantial reporting states. However, in this appendix only the larger dataset of 11 states is presented because this data is more representative of all 50 states (although the trade-off is that the damage counts reported for the larger set of data may be more under-reported). For these reasons, the 11 states were used as the substantial reporting states in the main body of the report. However, damage estimates should still be treated as an underestimate because it is known that DIRT data used in the modeling process does not capture the actual total number of damages.

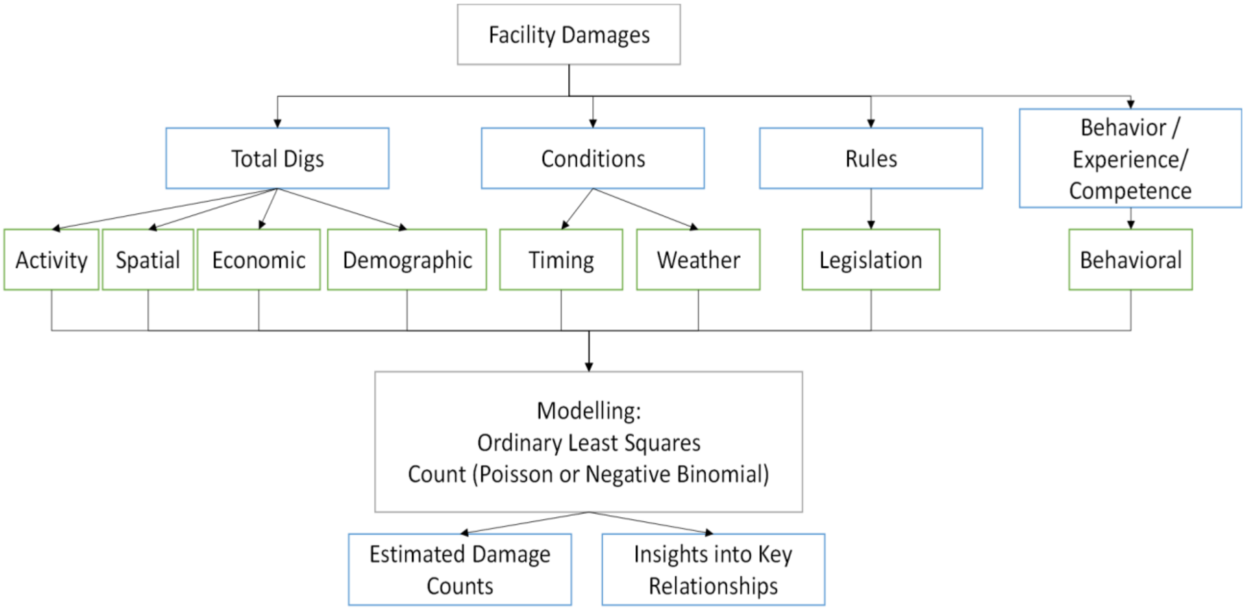


Figure C1—Conceptual framework of damage counts and possible outputs of modeling process

Data

The dependent variable in the model is the weighted damage count, rounded to the nearest integer. The dependent variable in the model is structured such that each observation represents the number of facility damages in a particular state ***s*** and month ***t***. The potential independent variables representing each data category in Figure C1 are summarized in Table C2. The analysts made efforts to match the resolution of each independent variable to that of the dependent variable. However, not all data was available on a monthly basis. For the final set of independent variables, the analysts attempted to focus on variables representing activity rather than value (e.g., number of building permits rather than the value of permits, or employment in an industry instead of its gross domestic product).

Table C2—Variables considered (Type categories correspond to those in conceptual model)

Type	Variable
Activity	▪ Total construction spending in state by month ▪ Construction employment in state by month (total and per capita) ▪ Outgoing transmissions from one call center(s) in state in the year[s] ▪ Total residential unit construction in state by month ▪ Quarterly real gross domestic product for construction by state
Weather[by]	▪ Mean precipitation in state by month ▪ Mean temperature in state by month
Time	▪ Rough indicators of season (Winter: Jan, Feb, Mar; Spring: Apr, May, Jun; Summer: Jul, Aug, Sep; Fall: Oct, Nov, Dec) ▪ Aggregate of rough indicators of season corresponding to spring and summer versus fall and winter (cannot enter model at same time as other season indicator variables)
Population	▪ Total population in state (2020) ▪ Population change in percent from 2019 to 2020 ▪ Population density in state (2020)[c]
Legislation	▪ Tolerance zone in inches ▪ Hand dig, vacuum, or soft excavation within tolerance zone (hand dig clause)
Spatial	▪ Area of state in kilometers squared [c]
Economic	▪ Unemployment rate in state by month ▪ Total employment in state by month (total and per capita) ▪ Quarterly gross domestic product for all industries by state

[a] One call transmissions were not reported for certain states. In these cases, a model was developed to impute the missing observations. Transmissions for certain other states were only partially reported (multiple one call centers in a state). To be conservative, the analysts did not impute these observations.

[b] Weather data were available from the NOAA National Climatic Data Center for all states except Hawaii. For Hawaii, the analysts estimated mean monthly temperature and precipitation using data from the state's weather stations.

[c] The area variable was causing unrealistic estimated damage counts for the state of Alaska in certain models for all years, so this variable was dropped from the analysis. Similar problems were encountered with the data when predicting damage counts for Washington, D.C., and these were caused by the population density and per capita employment variables.

Before running the models, variance inflation factors (VIFs) were calculated and used to check for high correlation between the linear and nominal independent variables, a situation known as multi-collinearity that affects the interpretation of coefficients and can impact predictions based on the model. The VIFs indicated that multi-collinearity is a problem when all independent variables are included (Table C3). Variables with the highest VIF scores were iteratively dropped. As noted above, the analysts focused on retaining variables representing activity and not value during these iterations.

Table C3—Checking for multicollinearity variance inflation factor

Variable	2020		2019		2018		2017	
	Initial	Reduced	Initial	Reduced	Initial	Reduced	Initial	Reduced
Total units	29		42	6	40		45	
Population	221		12,474		4,547		17,239	
Employment[s]			13,644		3,174	6	14,521	
Construction employment			1,320		305		641	
Population change	16		92	6	26	5	71	
Employment per capita	14	2	58	4				
Construction employment per capita	18	2	145	4	27	5	62	2
Hand dig clause	20		130		15		60	
GDP: All industries	214		4,040					
GDP: Construction	353		2,181					
Transmissions	30	2	275	4	16	6	44	1
Tolerance interval	8	2	39		15		31	
Unemployment rate	10		23	4	16	2	25	2
Population density							13	2
Total construction spending	14		12		13		12	6
Mean temperature	19	4	22	7	14	4	11	4
Winter (Jan, Feb, Mar.)	6	2	8	2	4	2	7	6
Fall (Oct, Nov, Dec.)		Omitted	Omitted	Omitted	Omitted	Omitted	4	3
Spring (Apr, May, Jun.)	6	2	6	3	3	2	2	2
Summer (Jul, Aug, Sep.)	5	3	8	5	4	3	Omitted	Omitted
Mean precipitation	2	2	2	2	3	2	2	2
Mean VIF	58	2	1,817	4	511	4	1,929	3

[a] Rounded to the nearest integer

[b] Omitted in favor of per capita measures

The analysts used a rule of thumb of a VIF score of 4 as a cut-off value for when to stop dropping variables (prior to 2020 the rule of thumb was a cutoff of 10; however, recent research suggests that lower values should be used). Although there were still some issues after removing the most collinear variables, multi-collinearity was much less of an issue. Note that different sets of data have different issues with collinearity, so the same set of variables was not used for each year.

Results

Table C4—Regression results for the final count models of facility damages

Variable	Poisson Count Coefficients[a]			
	2020	2019	2018	2017
Constant	-9.976181*** (1.418625)	-9.599709*** (1.463239)	5.117257*** (0.5495457)	4.58841*** (0.4610575)
Construction spending total				
Population change				
Population density				
Transmissions			0.0000000418*** (0.00000000981)	0.0000000524*** (0.00000000819)
Natural Log of Transmissions	1.024368*** (0.0835161)	1.007144*** (0.0857529)		
Spring and summer				-0.3651772** (0.1504601)
Winter	0.0805318 (0 .0721717)		0.002818 (0.0928489)	
Spring	0.2109702*** (0.0391188)		-0.2659848* (0.14766)	
Summer	-0.0327217 (0 .0507096)		-0.4020203** (0.197851)	
Fall	*Base season*		*Base season*	
Mean temperature	0.0111852*** (0 .0017926)	0.0132245*** (0.0020339)	0.0269653*** (0.0090757)	0.032051*** (0.0071174)
Total employment in construction per capita				
Hand dig clause				
N	132	120		
Log pseudolikelihood	-7897.91	-7383.01	-22,112.56	-16,195.66
Pseudo r2	0.90	0.93	0.62	0.76

***, **, * The coefficient is significantly different from 0 at the 99%, 95%, and 90% levels of significance, respectively.

[a] Coefficient with the corresponding robust standard errors in brackets.

[b] The natural logarithm of the transmissions variable was used in the 2019 and 2020 versions of the model.

Table C4 presents the best models for the 10 substantial reporting states for the 2017 to 2019 data and the 11 substantial reporting states for the 2020 data. Model fit, as indicated by the pseudo R^2 measure, was best for 2019, followed closely by 2020 and then more distantly 2017 and 2018.

- To be consistent with 2019, the model for 2020 used the natural logarithm of the transmissions variable (the model statistics were very similar to those of the quadratic model). Similar to the other years it indicates that damages rise with increases in outgoing transmissions and a state's mean monthly temperature. Further, damages appear higher in the spring relative to the fall.
- The model for 2019 also used the natural logarithm of the transmissions variable. However, similar to the other years it indicates that damages rise with increases in outgoing transmissions and a state's mean monthly temperature.

- The model for 2018 indicated that damages rise with increases in outgoing transmissions and a state's mean monthly temperature. Relative to the fall season, damage counts appear significantly lower for spring and summer though do not significantly differ in winter.
- For 2017, the models suggested that damages increase with increases in outgoing transmissions and the mean monthly temperature for the state—there are fewer damages in spring and summer relative to fall and winter.

These results are largely expected. For instance, it is sensible that damages increase with outgoing transmissions because transmissions directly reflect excavation activity; or that damages decrease during the spring and summer months because excavating conditions are likely better in this period relative to fall and winter. While this may seem counter to the calendar heat map, note that the calendar is highlighting that more damages happen in the summer, which is largely because there is more activity in the summer. The regression model, in contrast, is examining the relationship between variables holding all other variables constant as best as possible. In other words, holding activity constant, there are fewer damages during the spring and summer. If rising temperatures extend construction seasons, given this relationship, it is reasonable to anticipate increased damages in the future, all else being equal.

Using these regression results, all other state total damages can be estimated by applying the value of each variable from each state and then aggregating to estimate total U.S. damages (Table C5). This process assumes that reported damages in the defined substantial reporting states approximate total actual damages in those states, and that the estimated relationships in Table C5 hold for the states not included in these models. There is variation from year to year and a moderate upward trend from 2015 to 2019. The estimated count declines in 2020, which is in line with the drop observed in reported counts (Table C1). These declines are likely due to reduced activity caused by the COVID pandemic. In general, variation is expected, given that these are estimates based on incomplete data and the explanatory power of the models from 2017 and 2018 is relatively low. However, large jumps in damages—notably from 2017 to 2018 –may reflect factors such as different rates of economic growth (e.g., economic growth in 2018 was 2.9% relative to 2.2% in 2017).

Table C5 - Estimated damage counts, upper and lower bound estimates for the U.S. (11 states model), rounded to nearest 1,000

Year	Estimated Total U.S. Damages	Lower Bound of Estimated Total U.S. Damages	Upper Bound of Estimated Total U.S. Damages
2020	468,000	380,000	584,000
2019	532,000	430,000	666,000
2018	509,000	230,000	787,000
2017	439,000	270,000	715,000
2016	416,000	201,000	1,159,000
2015	378,000	217,000	738,000

Appendix D: Supplemental One Call Center Data & Analysis

Late Locates and Pandemic Effect

Late Locates – DIRT Data

The issue of locate requests not being completed on time continues to be a challenge within the damage prevention industry. The Next Practices Report to the Industry published in February 2021 identified it as a critical issue that erodes excavator confidence in the system.

There are a few areas within the DIRT data that provide insight into the issue of late locates. The DIRT root cause that corresponds most closely to late locates is *Facility not marked due to no response from operator/contract locator*. The DIRT Users Guidance states:

- **No response from operator/contract locator:** Facility owner/operator or their contract locator received a valid ticket, but did not mark, locate or communicate (i.e., positive response where required) with the excavator prior to the start of work. (BP 4-9)

In the 2020 dataset there were 5,330 (1.27% of known root causes) damage reports with this root cause, including 237 from excavators as the event source. Late locates can also lead to near-miss events, which are described in the DIRT Users Guide as:

- **Near Miss:** An event where a damage (as defined above) did **not** occur, but a clear potential for damage was identified. (BP*) Some examples include, but are not limited to the following:
  1. An excavator discovers a buried facility that was not marked or not marked accurately.
  2. An excavator is found digging without having notified the one call center.
  3. **An operator fails to respond to a locate request.**
  4. A one call center incorrectly entered data regarding the work site.

For 2020, 35 near miss reports with root cause *No response from operator/contract locator* were entered in DIRT, with 24 from excavators.[19]

Recent CGA reports identify practices used by excavators to address potential late locates. The Next Practices report states, "…excavators anticipating locating delays may flood the one call system with requests in order to ensure their ability to stay on schedule and be paid in full, which has the unfortunate side effect of overloading locators and contributing to locating delays." Additionally, the Locator White Paper stated, "In anticipation of late locates, excavators may place requests well before they actually intend to dig, creating an artificially accelerated timeline for locate completion and delaying the ability to locate projects that may actually be breaking ground sooner."

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[19] Near miss reports are not included in the DIRT report analysis, figures, or dashboard due to the low volume of reports. A separate report was released in April 2020 on near miss data for 2015 to 2018. https://commongroundalliance.com/Portals/0/Library/2020/DIRT%20Reports/Near%20Miss%20reports%202015_2018_Final%20-%2004.16.2020.pdf?ver=2020-08-14-130152-903.

These practices are essentially a workaround to avoid downtime. DIRT collects data on downtime (did it occur: Yes/No, duration and cost). The DIRT Users Guide defines downtime as:

> Downtime: Time that an excavator must delay an excavation project due to failure of one or more stakeholders to comply with applicable damage prevention regulations or best practices. There may or may not be a damage associated with the downtime.

Thirty-seven percent of 2020 damage reports submitted by excavators with root cause *No response from operator/contract locato*r indicated Yes for downtime. Although a smaller sample size, the same figure for near miss reports was 79%.

Based on the 2019 DIRT Report recommendations, the Best Practices Committee formed a task team to review practice 4-17 Forecasting/Planning for Predictable Workload Fluctuations.

Late Locates – One Call Center Data & Analysis

The issue of late locates requires data and analysis beyond the information gathered when a damage occurs. This year, several one call centers shared additional data, analysis and insights on the increasing challenge of late locates.

The responses from the participating one call centers are included throughout Appendix D. Due to the lack of consistency in the data collected and tracked by one call centers, it is impossible to compare information provided by each center.[20] Instead, the data provides information on how one call centers are using data to analyze and address late locates.

From the one call center data, it is clear that DIRT is only capturing part of this story.

Colorado

In 2020, Colorado implemented a legislative mandate for members to post a positive response through Colorado 811. Additionally, an automatic positive response re-notification is sent to each member who does not post a positive response by the locate by date. Each member who does not post on time will receive an automatic re-notification for the ticket duration or until they respond. Each re-notification is a transmission for which the member is charged.

Comparing 2019 to 2020 shows the impact of the mandate. Member codes with no response dropped from 22% in 2019 to 5% in 2020. Member codes with 100% on-time response increased from 16% in 2019 to 27% in 2020.

[20] For example, in some cases an "on-time" response could be the locator/facility operator indicated they need more time to complete the marking.

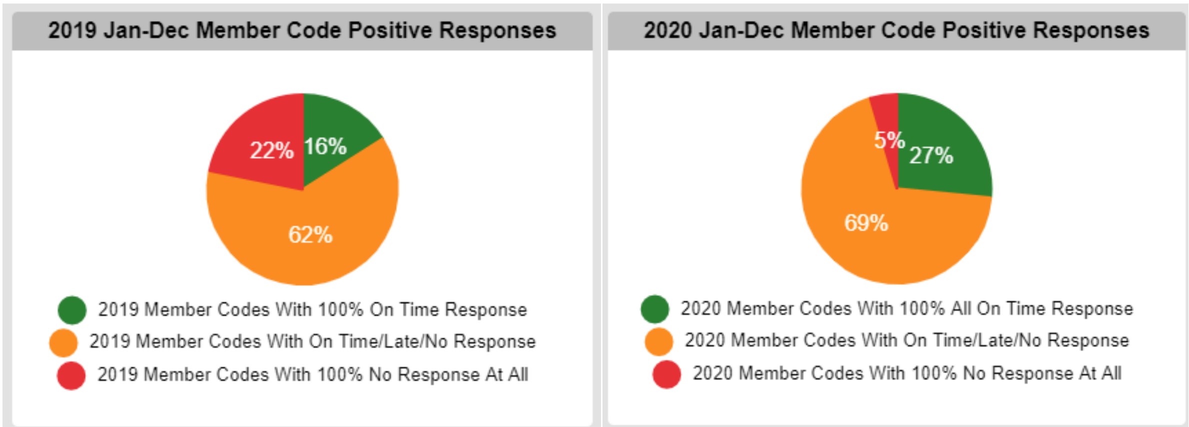

Figure D.I.1

Transmissions with no response dropped from 4% in 2019 to under 1% in 2020, shifting to transmissions that received on-time responses in 2020. Colorado 811 is continuing to analyze the impact and responses posted by the membership.

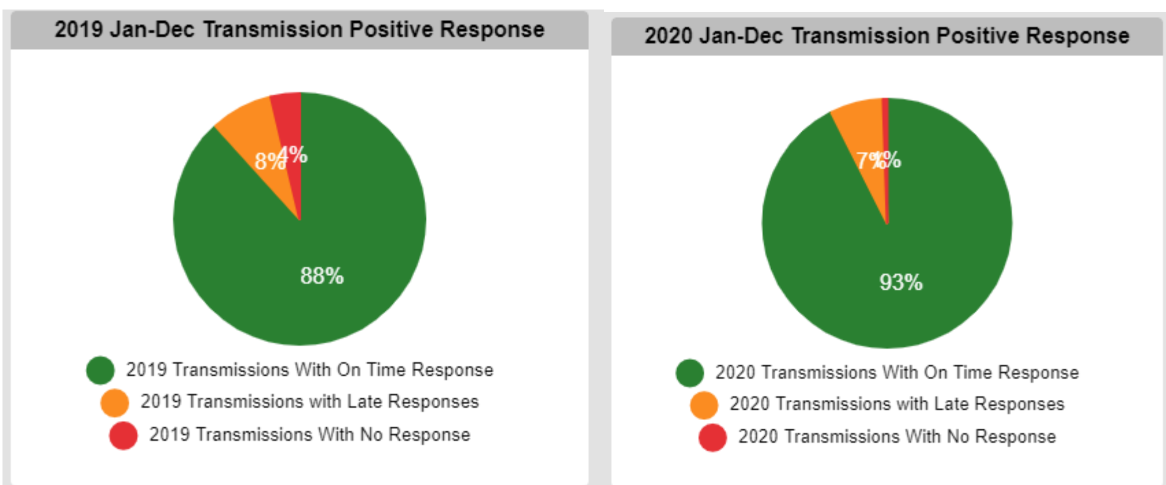

Figure D.I.2

Michigan

Positive Response is mandatory for facility owners to utilize. The MISS DIG 811 Positive Response system is an automated system that users can use to verify that a ticket has been marked or cleared of facilities in their excavation area. Table D1 shows the monthly transmissions and data for on-time, late, or no response.

Month	Total Trans	On Time	% On Time	Late	% Late	No Resp	% No Resp
January	335,526	300,761	89.64	20,269	6.04	14,496	4.32
February	291,217	260,056	89.3	18,381	6.31	12,780	4.39
March	475,187	432,237	90.96	20,650	4.35	22,300	4.69
April	445,724	405,368	90.95	19,995	4.49	20,361	4.57
May	740,482	679,271	91.73	33,117	4.47	28,094	3.79
June	854,119	779,048	91.21	46,841	5.48	28,230	3.31
July	795,738	724,557	91.05	42,892	5.39	28,289	3.56
August	758,567	690,790	91.07	41,151	5.42	26,626	3.51
September	776,903	703,405	90.54	45,423	5.85	28,075	3.61
October	735,104	660,084	89.79	47,991	6.53	27,029	3.68
November	514,918	464,396	90.19	30,475	5.92	20,047	3.89
December	418,023	382,217	91.43	21,605	5.17	14,201	3.4

Table D1

One factor that has contributed to the problem is the number of instances where the excavator puts in locate requests for far more jobs that they are able to begin within the ticket window. MISS DIG 811 has tried to promote a program that allows the ticket placer to push back their start date to a less congested date in order to allow the locators to catch up with their backlog. So far this has only seen a small uptick in use. MISS DIG 811 does not currently charge for any retransmits, nor does it bring complaints to the Michigan Public Service Commission.

North Carolina

Electronic Positive Response to the one call center is mandatory in North Carolina. Complaints were received by the Underground Damage Prevention Review Board with some fines issued for late locates as verified by a lack of positive response. The one call system is financed through assessments based on transmissions received by the members. Three-hour notices[21] are included in a member's transmission count. The figures below show the percentage of 999 Positive Response Codes (member has not responded by the required time) for 2019 and 2020.

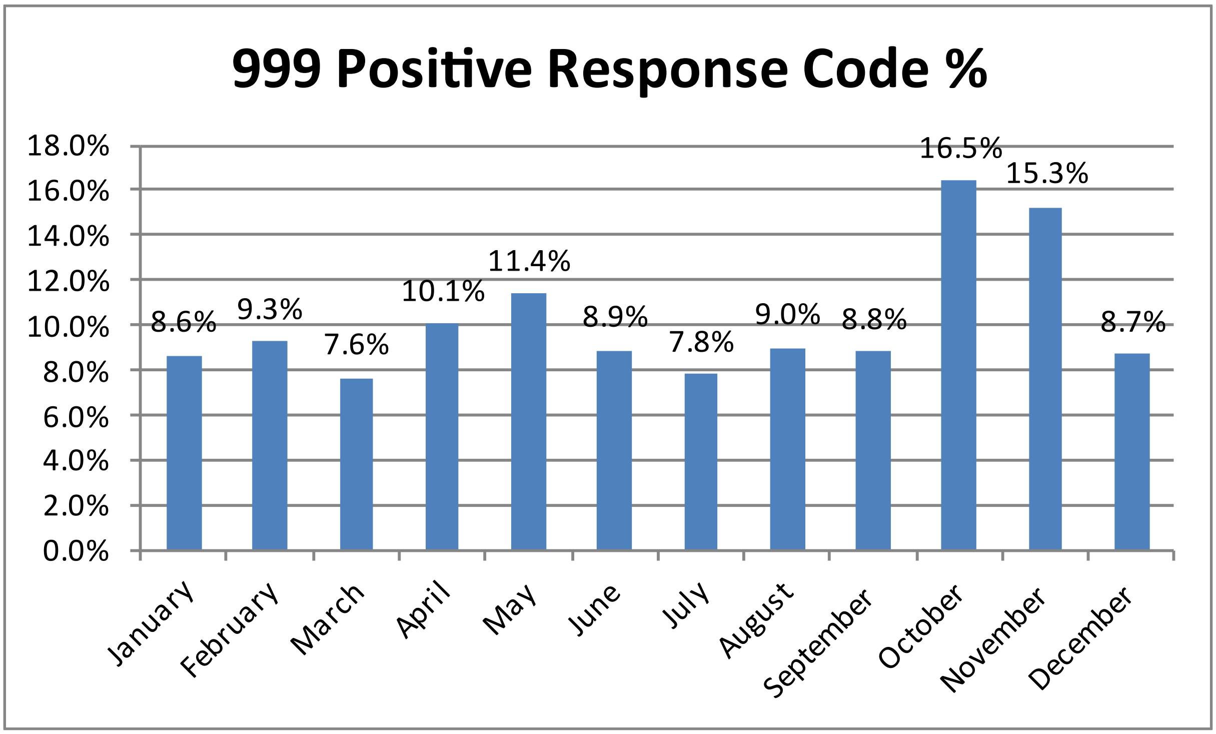

Figure D.I.3– 2019 Positive Response Code 999 from North Carolina 811

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[21] Per the N.C. Underground Safety and Damage Prevention Act §87-122(c)(6): If an operator fails to respond to the positive response system…if the excavator is aware of or observes indications of an unmarked facility at the proposed excavation or demolition area, the excavator shall not begin excavation or demolition until an additional notice is made to the Notification Center detailing the facility and an arrangement is made for the facility to be marked by the operator within three hours from the time the additional notice is received by the Notification Center.

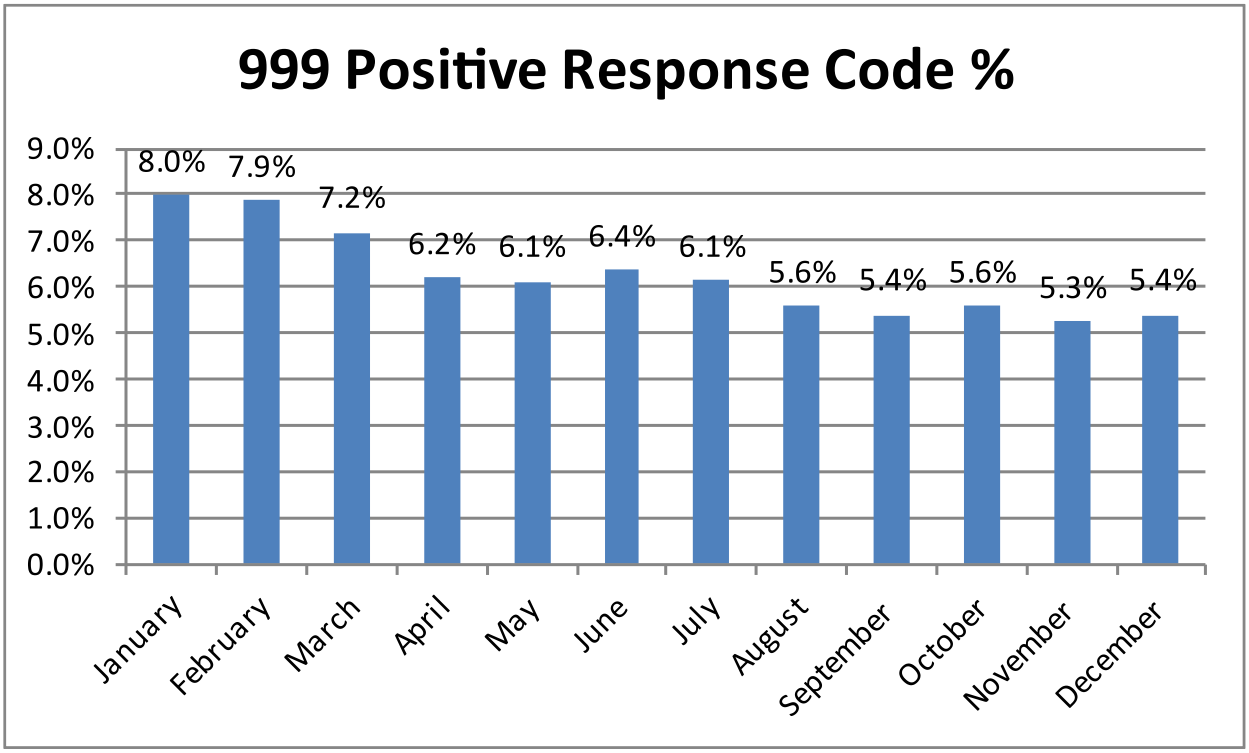


Figure D.I.4–2020 Positive Response Code 999

Pennsylvania

Positive Response is mandatory in Pennsylvania. Pennsylvania 811 launched its automated positive response system, Kathy Automated Response to Locates (KARL), in 1995. Pennsylvania law requires facility owners, excavators, designers, and project owners to report alleged violation reports through the one call system. These reports are investigated by the PA Public Utility Commission (PUC), which recommends fines or education to the Damage Prevention Committee. These activities motivate compliance. The percentage of responses through KARL increased since the PA PUC became responsible for enforcement.

South Carolina

South Carolina has mandatory Positive Response, with all elements accessed online. Stakeholders can add codes, comments and additional info to be communicated between the excavators and members. Despite continuing to see ticket volume increases each year, on-time response rates are improving incrementally.

% Response relative to requirements	2019	2020
Within requirement	78.1	80.7
Late	19.0	17.1
Never	2.9	2.3

Table D2

SC811 has been closely monitoring the no-show process initiated when an operator does not respond with a closed code in the time allowed. These notices have a 3-hour window to respond. The Board of Directors is discussing charging additional rates for repeat no-show notices. We are seeing where improvements in positive response compliance are reducing damages in some regions of the state. The other primary driver is enforcement.

No-show tickets by facility type[22]

Facility Type	# tickets 2019	% tickets 2019	# tickets 2020	% tickets 2020
Communications	26,955	47.78	31,510	53.43
Electric	12,244	21.67	13,281	22.52
Water/Sewer	7,493	13.26	6,267	10.63
Propane/Natural Gas	4,997	8.85	2,990	5.07
Water	2,377	4.21	2,525	4.28
Sewer	1,172	2.07	1,038	1.76
Municipalities	1,008	1.78	1,144	1.94
Street Lights, Traffic	101	0.18	74	0.126
Electric Fiber	46	0.08	83	0.141

[22] Some facility types are listed more than once because some municipal groups have multiple facilities in different configurations.

Storm/Wastewater	20	0.035	10	0.017
Fiber Sewer/Water	20	0.035	35	0.059
Liquid Pipeline	17	0.030	3	0.005
Electric, Gas, Petroleum Pipeline, Phone	4	0.007	14	0.024
Total	56,494	100	58974	100

Table D3

Virginia 811

- Virginia has mandatory Positive Response.
- Responses are allowed over the internet and through telephone/IVR. Those who use ticket management software respond electronically via batch file, and smaller utility operators often use an account-driven portal to post individual responses.
- Based on ticket transmissions (5.9 utilities notified per ticket), Virginia 811 had 1.5 % of ticket transmissions coded as “late” or “no-show” by the positive response system for the year.
- Late responses increased in the late summer and early fall. These were mostly due to the largest contract locator operating in Virginia. For example, in October it was responsible for approximately 70% of late notices.
- State regulators have the ability to impose civil penalties for locators who respond late to tickets and have done so for many years, when those issues are reported.
- The Damage Prevention Advisory Committee is looking into a pilot to potentially help alleviate the burden of heavy ticket load on the locating community at this time. A long-term plan will likely require legislative change, but the “proof of concept” idea being discussed is to allow excavators to request tickets at a time convenient for them but allow them to announce that they do not need the markings done by the legally mandated date and time, but rather at a future date and time. The hope is that this will help normalize ticket loads for the locating community.
- The Virginia Damage Prevention Advisory Committee has created a policy to address “over-notification,” excavators creating tickets where no work is done, or the described scope of work is much larger than the actual area worked during the life of a ticket. This has helped some, but there is still room for improvement.
- Virginia 811 contacts utility operators who have higher no-show rates (10% or higher) to work with them on responding to tickets in a timely manner. Most of these member utilities are smaller operators and do not have the same impact on excavator work as the larger companies.
- The Positive Response system has a “code 60” which allows locators and excavators to agree to an alternative marking schedule. This can give locators some flexibility in meeting the legal response date and time when the excavator agrees and does not need the markings by the legal date and time.

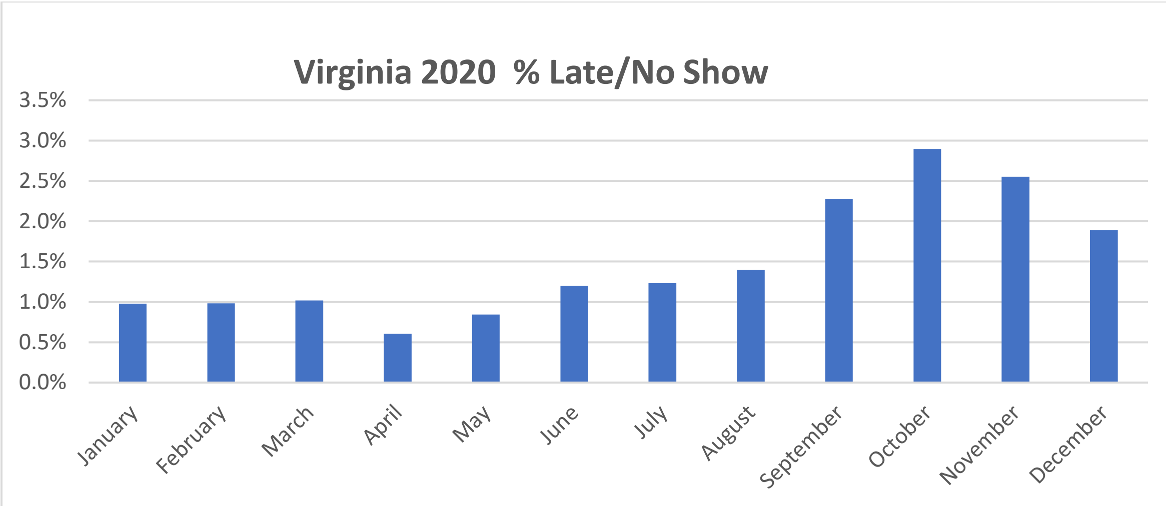


Figure D.I.5

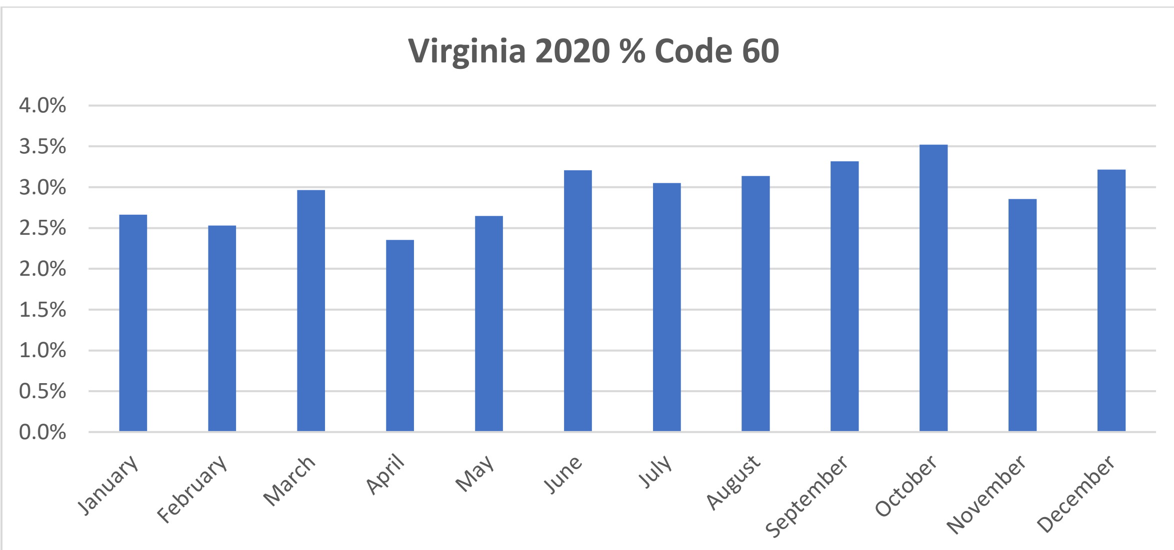


Figure D.I.6

Pandemic Affect – One Call Center Data

For the 2020 DIRT Report, we asked several one call centers to share information on how the COVID-19 pandemic affected construction activity and ticket volumes in their states. Their responses are included below. In some cases, we provide data from the DIRT Dashboard to add support and context to the information. Readers are encouraged to visit the Interactive Dashboard and experiment with their own filtering combinations.

Arizona 811

In 2020, ticket volume increased slightly (4.8%) over 2019. The first three months started with a higher upward trend from 2019 with a 10.2% average monthly increase. During the time of the heavier lockdown (April/May), volume decreased from 2019 by an average of 6% per month even though construction remained and was considered essential. Once the lockdown was lifted, ticket volume continued to increase from 2019 by an average of 6% per month.

Looking for changes in various types of work and homeowner tickets, the noticeable trends identified are shown below and are continuing into 2021.

Swimming Pool Tickets				
Year	**Jan-July Unique Locations**	**% Increase**	**Full Year Unique Locations**	**% Increase**
2019	7,224		11,295	
2020	8,211	+13.7%	14,987	+32.7%

Table D4

Unique pool locations means if the homeowner requested a ticket and a pool company later requested the same location, only one ticket was counted assuming only one pool was being installed.

Homeowner Tickets				
Year	**Jan-July**	**% Increase**	**Full Year**	**% Increase**
2019	20,717		34,025	
2020	24,382	+17.7%	40,761	+19.8%

Table D5

New Home - Service Installations*				
Year	Jan-July	% Increase	Full Year	% Increase
2019	20,987		40,441	
2020	29,047	+38.4%	60,208	+48.9%

Table D6

New home service installations are considered more of a trend of migration from other states as a result of their continued lockdowns and taxation climate.

Northern California and Nevada (USA North)

Incoming ticket volume was down slightly in 2020 compared to 2019 in both Northern California (-1.29%) and Nevada (-0.30%). Ticket volume in 2019 was 41.4% higher than 2018. This is largely attributed to testing and repairing/replacing power poles/towers following severe wildfires. This type of work is expected to continue for at least several more years. Since that was such a dramatic increase it was not surprising to see 2020 down slightly, especially with California having a tight COVID lockdown compared to many other states. Despite overall ticket volume being down slightly in 2020 compared to 2019, homeowner ticket volume was up 14% in California and 15.5% in Nevada. Homeowner ticket volume was likely dampened by air quality issues due to smoke from the wildfires.

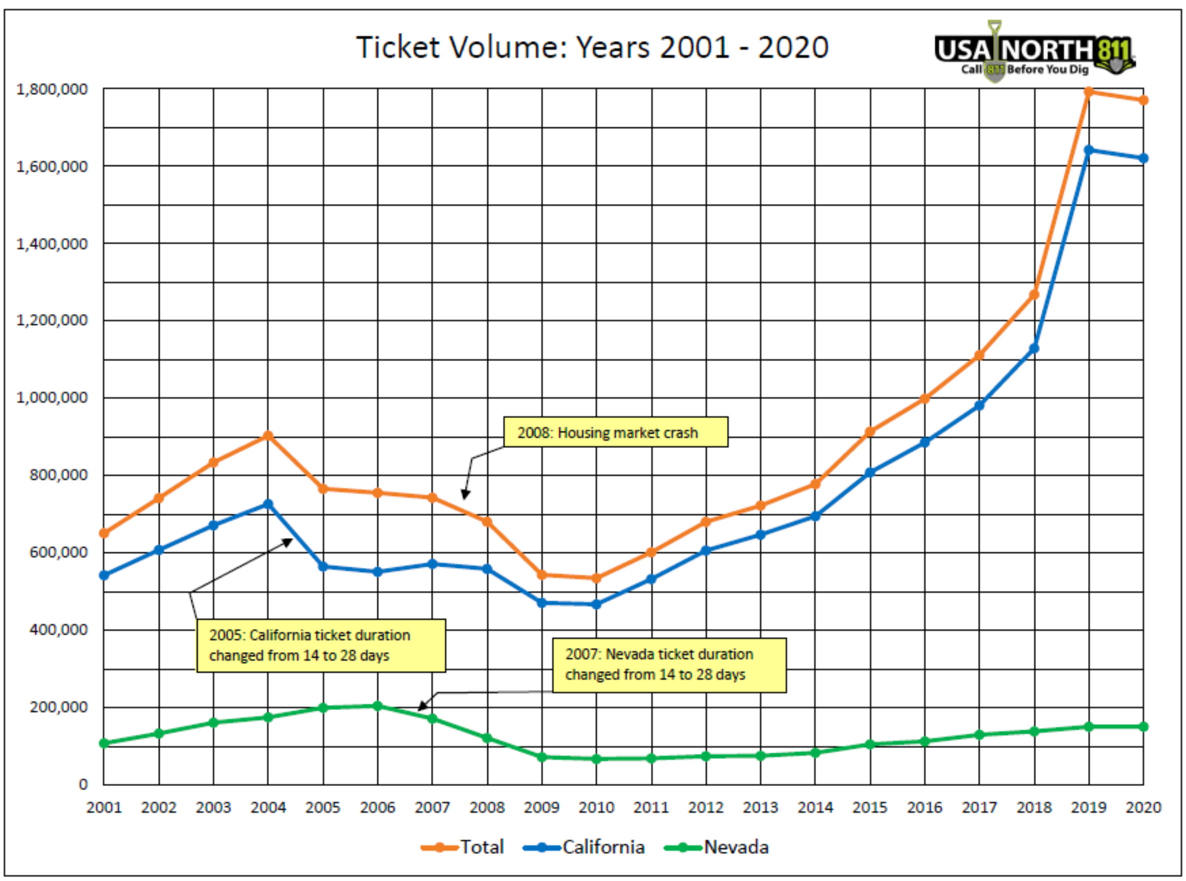


Figure D7

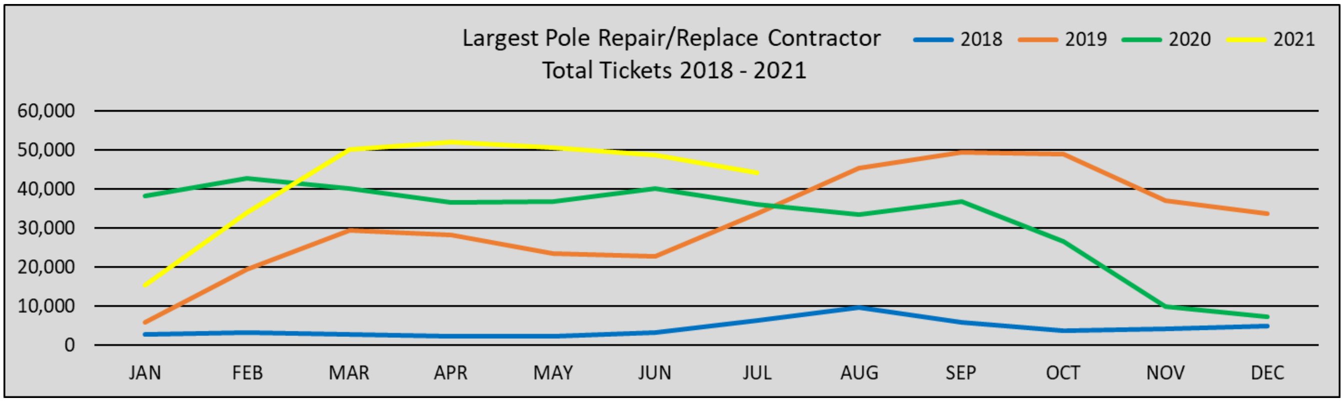
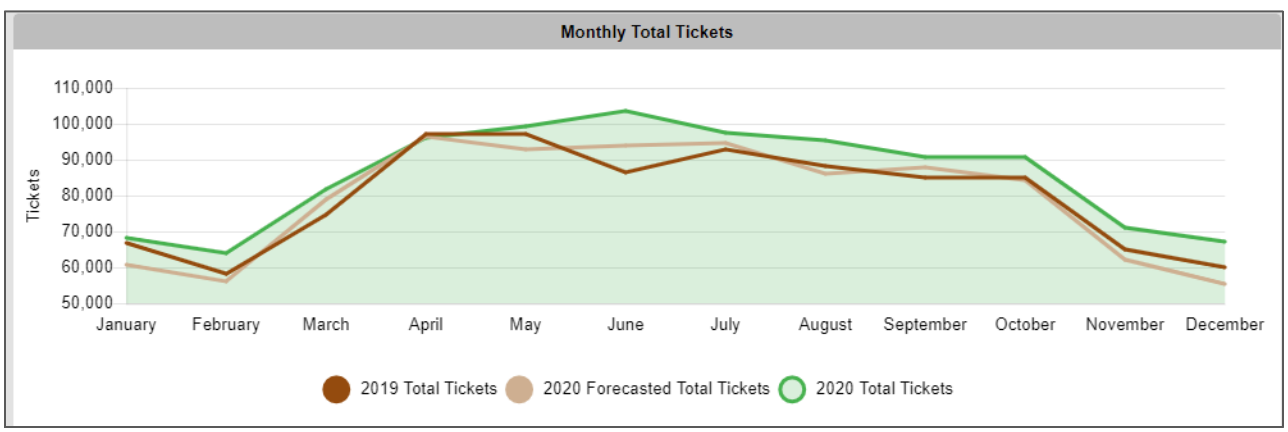


Figure D8

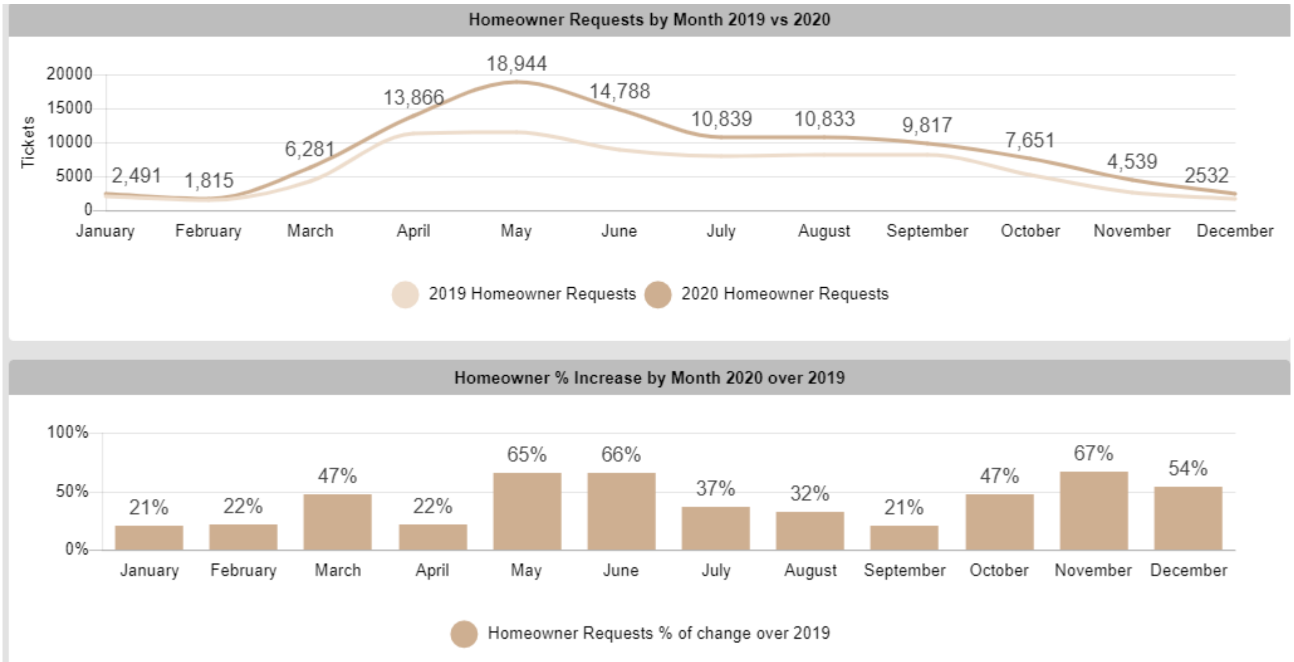
Colorado 811

Colorado's 2020 ticket volume increased over 2019 by 7%. A stay-at-home order was in effect from March 25 to April 26. During April there was a slight decrease of -1% in ticket volume. However, once the stay-at-home order lifted, ticket volume increased, with the most significant monthly ticket increase of 20% in June 2020. Overall, homeowner requests increased by 42%, and single address requests[23] increased by 17%.

In general, the work types provided did not significantly shift from 2019 to 2020. Colorado 811 allows multiple work types to be added to each ticket. Therefore, there is not a one-to-one relationship of work type to the ticket. The percentages of tickets for the most general categories of types of work remained consistent from 2019 to 2020.



[23] Single address tickets may have been requested by professional excavators, but are indicative of home improvement work such as decks, pools, landscaping, etc.



Figures D9 – D11

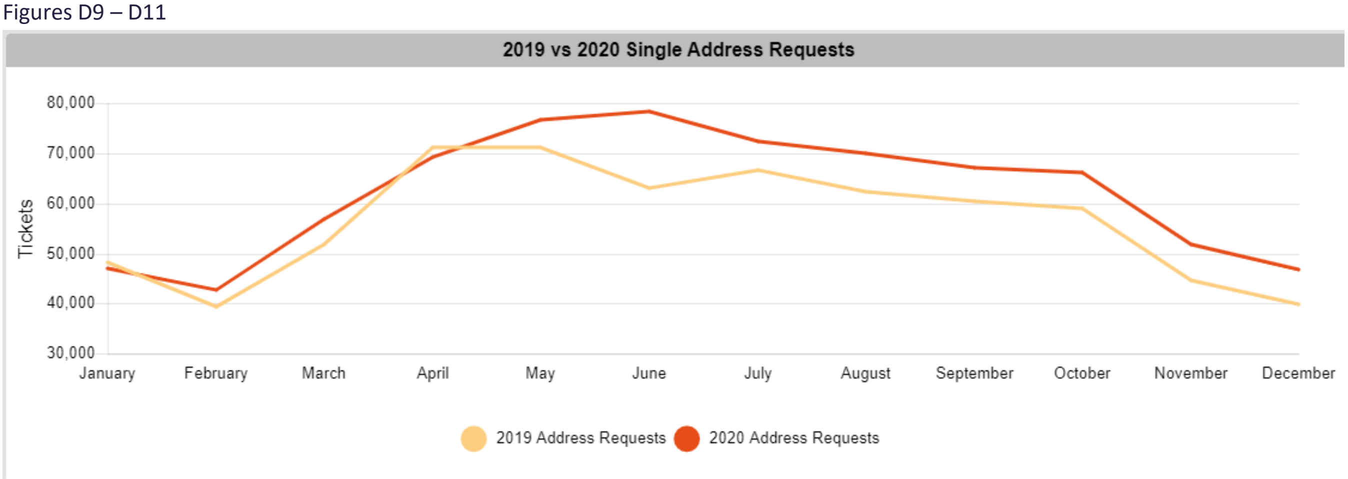
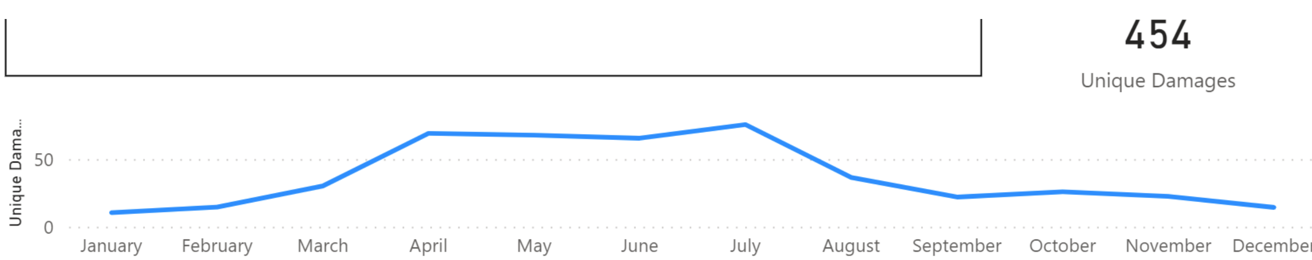
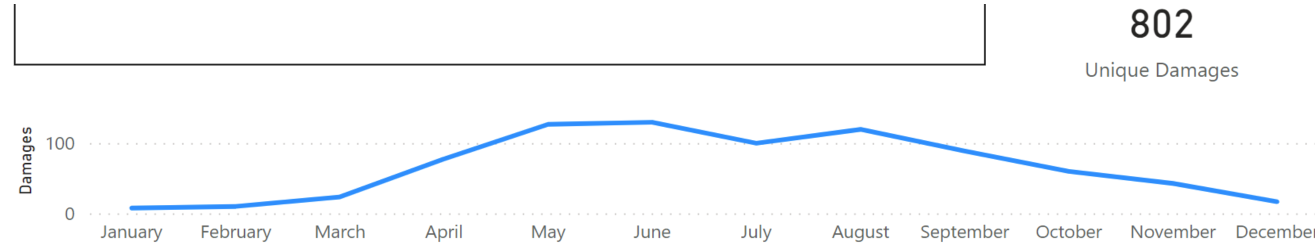


Figure D12

The following snippets from the DIRT Dashboard illustrate how timelines for occupant damages generally mimic the timelines for incoming single address requests, with a bit of a time lag. These damages were up significantly when calculating the percentage (77%) but in raw numbers (348) they were very small compared to the increase in tickets.



2019 Colorado, Occupant Excavator



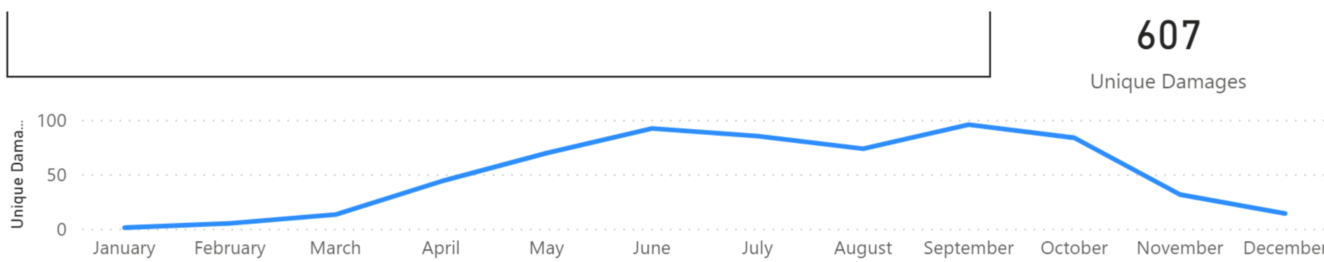
2020 Colorado, Occupant Excavator

Figures D13 – D14

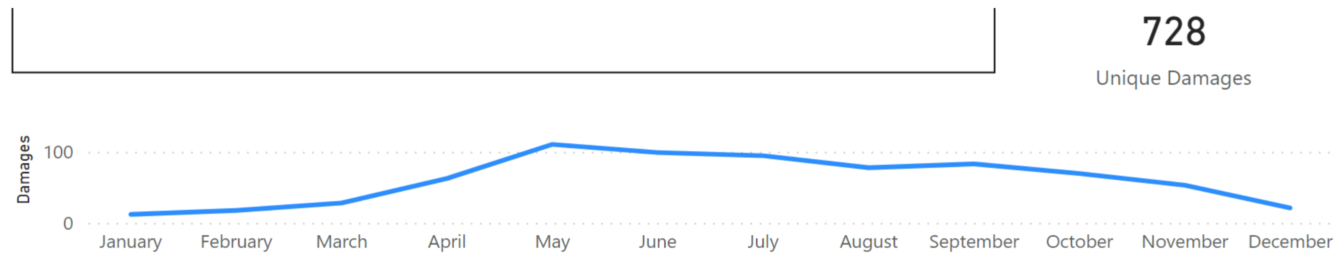
Michigan

The COVID-19 pandemic impacted ticket volumes and projects in 2020. However, it did not seem to have a prolonged effect. April saw about half the normal ticket volume and May had a 17% decrease. The remainder of the year had similar monthly volumes compared to 2019 with most months actually having higher ticket counts. Overall, 2020 only saw a 2.1% decrease in total ticket volume compared to the record-setting year of 2019. Utility tickets decreased 6.3% while homeowner tickets saw a 19.4% increase showing a shift towards more home improvement projects. There was a modest 6.7% increase in first-time callers from the previous year which is in line with the previous yearly rates. All in all, while 2020 was a difficult year to navigate with the pandemic, business proceeded as usual after the initial slowdowns and the industry was able to navigate through the changing remote environment. Despite the March-May shutdown, normal road and outdoor construction did not cease.

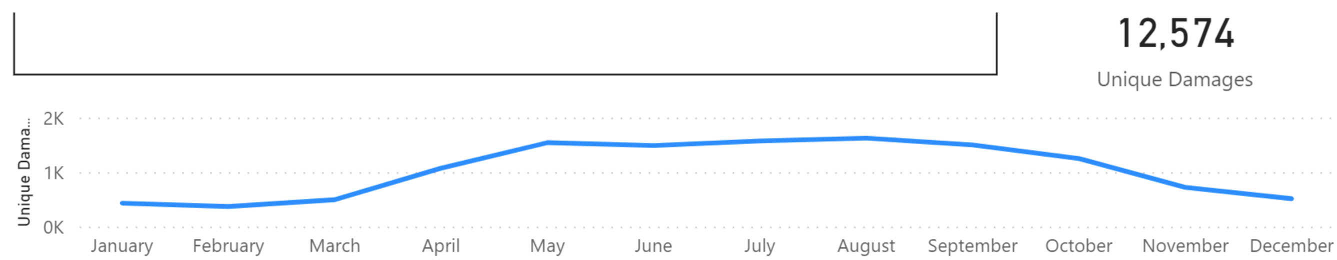
The following snippets are from the DIRT Dashboard for 2019 and 2020. Consistent with the trends in ticket volume, total damages were down while occupant damages were up a bit, but much less than might be expected given the increase in homeowner ticket volume.



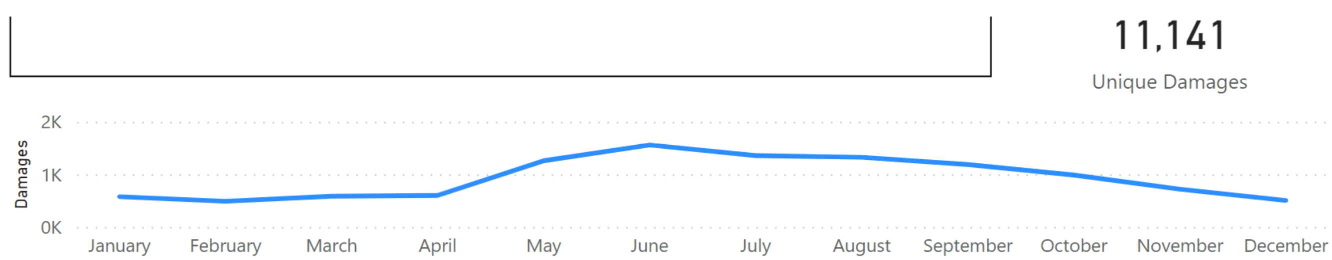
2019 Michigan, Occupant Excavator



2020 Michigan, Occupant Excavator



2019 Michigan, All Damages (no filters)

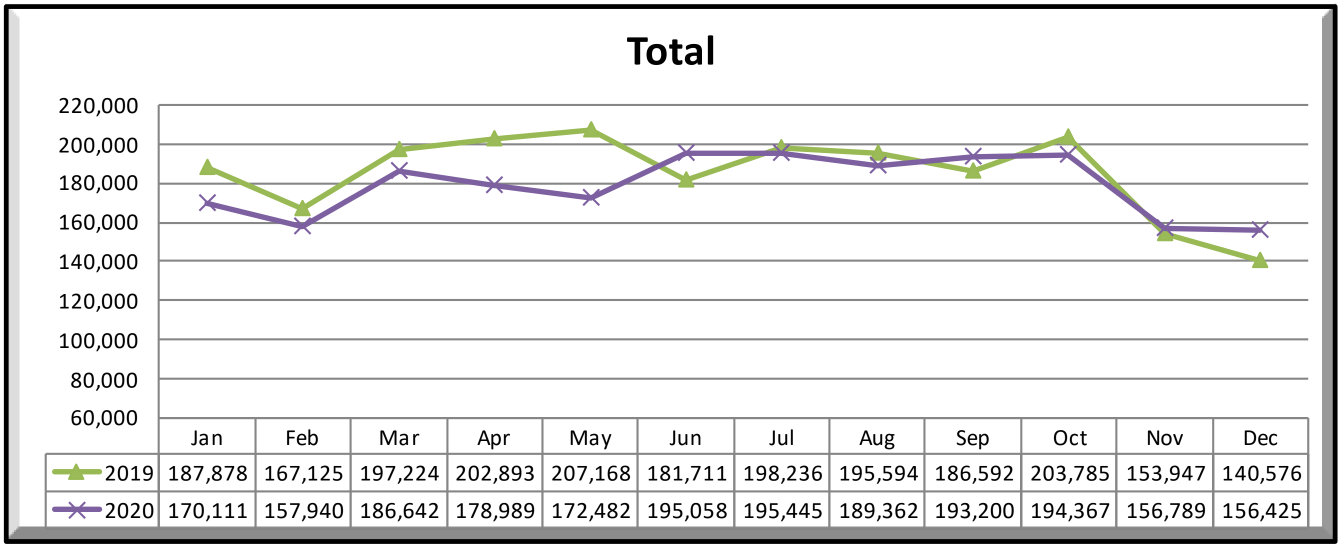


2020 Michigan, All Damages (no filters)

Figures D15 – D18

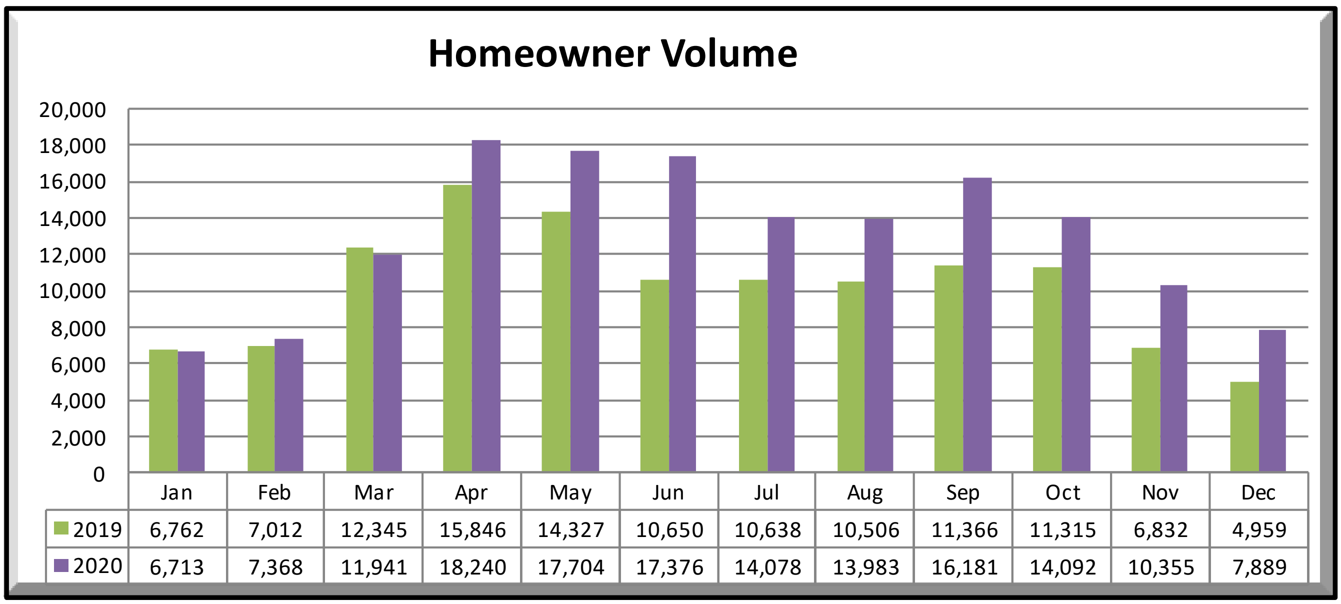
North Carolina 811

North Carolina 811 experienced an essentially flat year for volume in 2020 vs. 2019. It did experience a dramatic increase in homeowner volume (see chart) as more people used the time at home to do outdoor projects. While there was not an unusually high amount of Department of Transportation work, there was a continuation and expansion of fiber installation. This makes up the majority of excavation work in North Carolina and is anticipated to continue for the next five years. The biggest challenge faced is a locator labor issue.



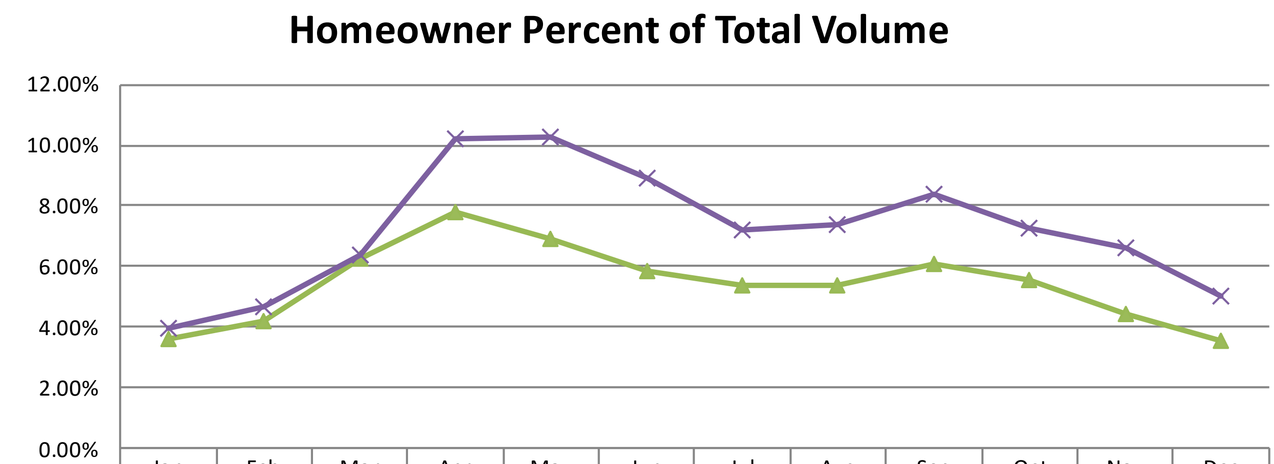
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	187,878	167,125	197,224	202,893	207,168	181,711	198,236	195,594	186,592	203,785	153,947	140,576
2020	170,111	157,940	186,642	178,989	172,482	195,058	195,445	189,362	193,200	194,367	156,789	156,425

Figure D19–North Carolina: Total incoming locate requests



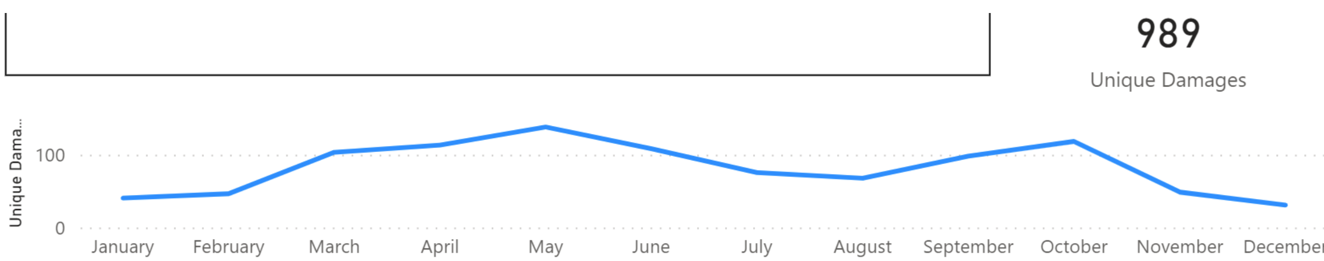
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	6,762	7,012	12,345	15,846	14,327	10,650	10,638	10,506	11,366	11,315	6,832	4,959
2020	6,713	7,368	11,941	18,240	17,704	17,376	14,078	13,983	16,181	14,092	10,355	7,889

Figure D20–North Carolina: Homeowner incoming locate requests

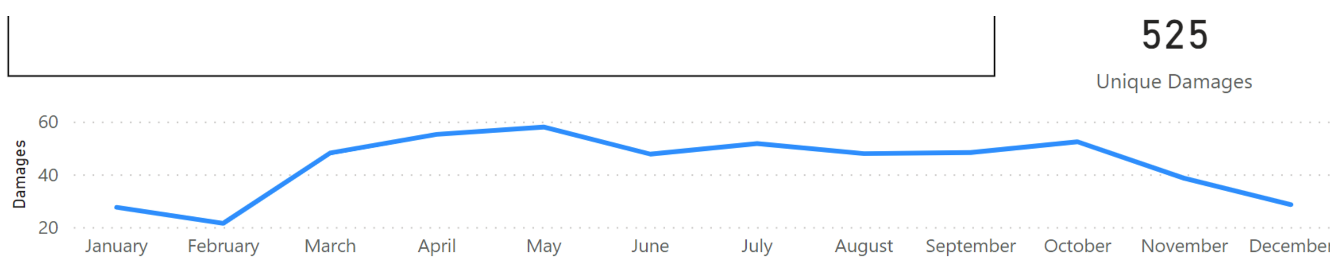


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	3.60%	4.20%	6.26%	7.81%	6.92%	5.86%	5.37%	5.37%	6.09%	5.55%	4.44%	3.53%
2020	3.95%	4.67%	6.40%	10.19%	10.26%	8.91%	7.20%	7.38%	8.38%	7.25%	6.60%	5.04%

Figure D21–North Carolina: Homeowner percent of total volume



2019 North Carolina, Occupant Excavator



2020 North Carolina, Occupant Excavator

Figures D22 – D23

Pennsylvania 811

Ticket volume in 2020 dipped along with increased awareness of the COVID-19 pandemic. Governor Wolf issued stay-at-home orders that included the construction sector on March 19. The result was the volume in the month of April was over 30% lower than 2019 numbers. The construction lockdown ended on May 1, and Pennsylvania recovered briefly through June. Volume went down and remained flat the remainder of the year. Overall, 2020 volume declined 4.38% from 2019.

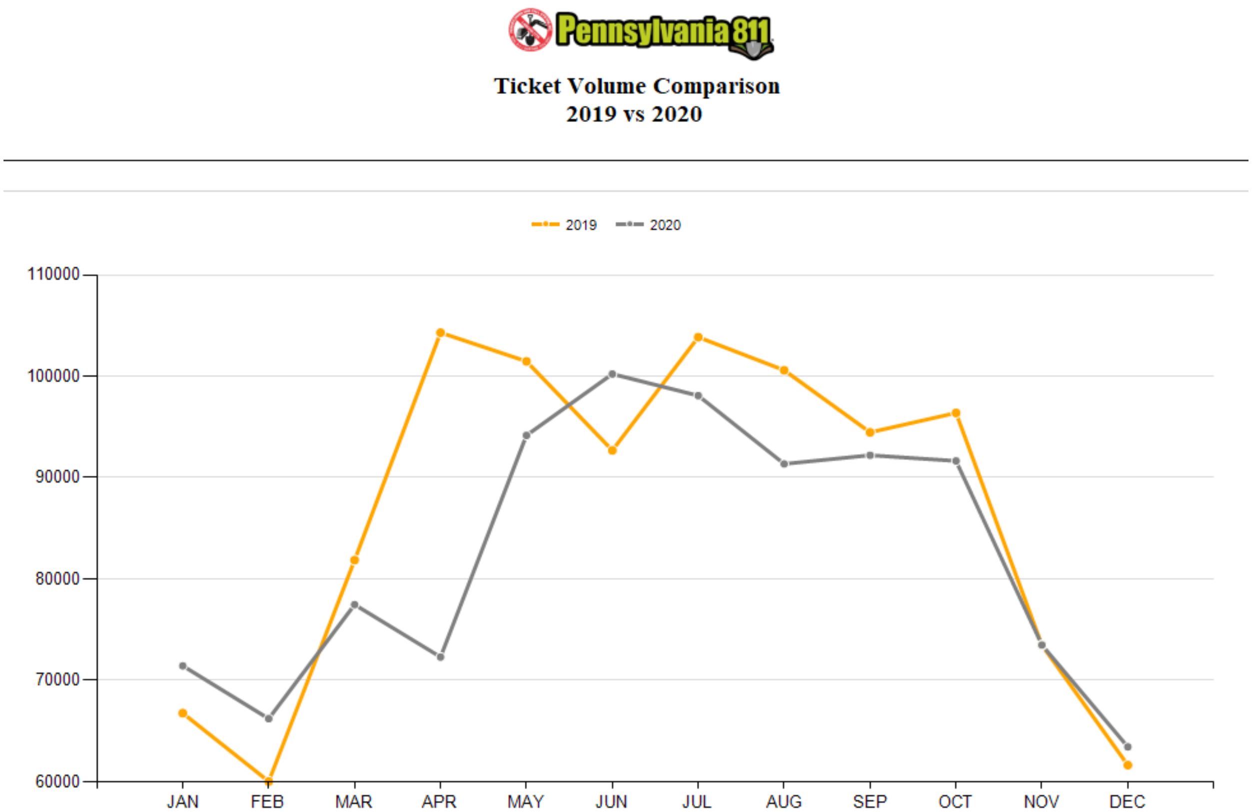


Figure D24—Pennsylvania Total Ticket Volume

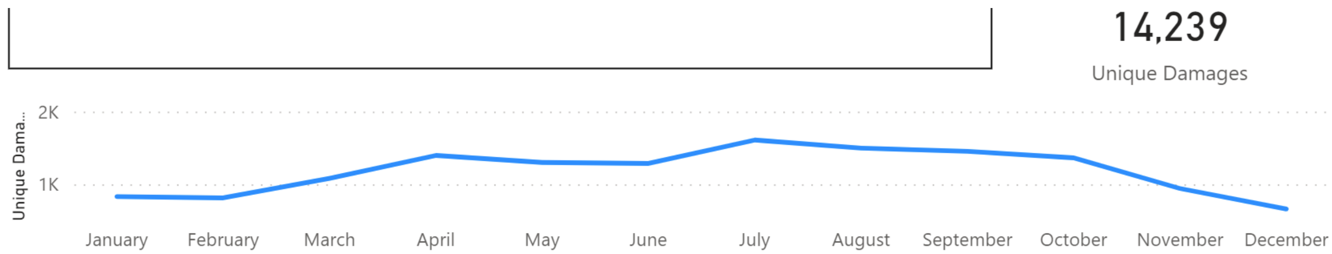
Despite volume decline, there were encouraging changes in 2020 over 2019. For example:

- Damages dropped by 16.5%
- Emergency tickets were down by 5.17%
- Updates (new request for a previous locate) decreased by 11.8%
- Positive Response improved by 1.79% (96.8% of all tickets)
- Project coordination entries increased by 46.09% with 79.16% more Complex Project tickets
- Design tickets went up by 1.66%
- Homeowner ticket volume increased by 14.15%
- Homeowner and professional excavators increased usage of the online Web Single Address application.

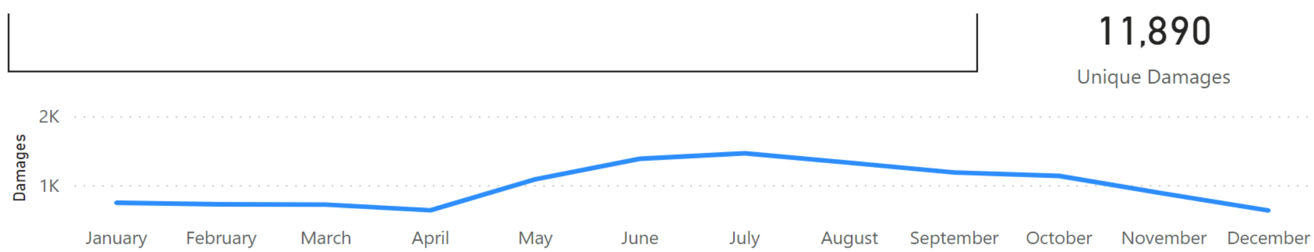
A few lessons learned from the pandemic are:

- To halt rumors that the center was closed, Pennsylvania 811 learned to communicate earlier and more frequently that it maintained all 24/7 operations throughout the pandemic.
- The use of technology for large project pre-construction meetings became a necessity.
- Callers expressed frustration over locating delays caused by members' staffing shortages.

The following snippets are from the online DIRT Dashboard showing total damages for 2019 and 2020. The effect of the construction lockdown can be seen through May 2020.



Pennsylvania 2020 Total Damages



Figures D25 – D26

South Carolina 811

From 2017 through 2019, SC811 averaged a 6.6% annual increase for inbound notification volume. In 2020, the center had a 2.11% increase in inbound volume. While January and February volumes fluctuate due to potential winter weather impacts, March through May are typically not impacted and have traditionally been some of the highest on record. Volume increased during the months homeowners are typically working on home improvement projects. However, it did not slow or level out after August as it traditionally does, continuing well into November 2020. Professional contractor work also picked up in home-related categories like fences, pools, and landscaping. SC811 typically sees significant jumps in first-time callers each year. For 2020, the center saw higher ratios of hearing about SC811 on television and social media, likely due to being at home more.

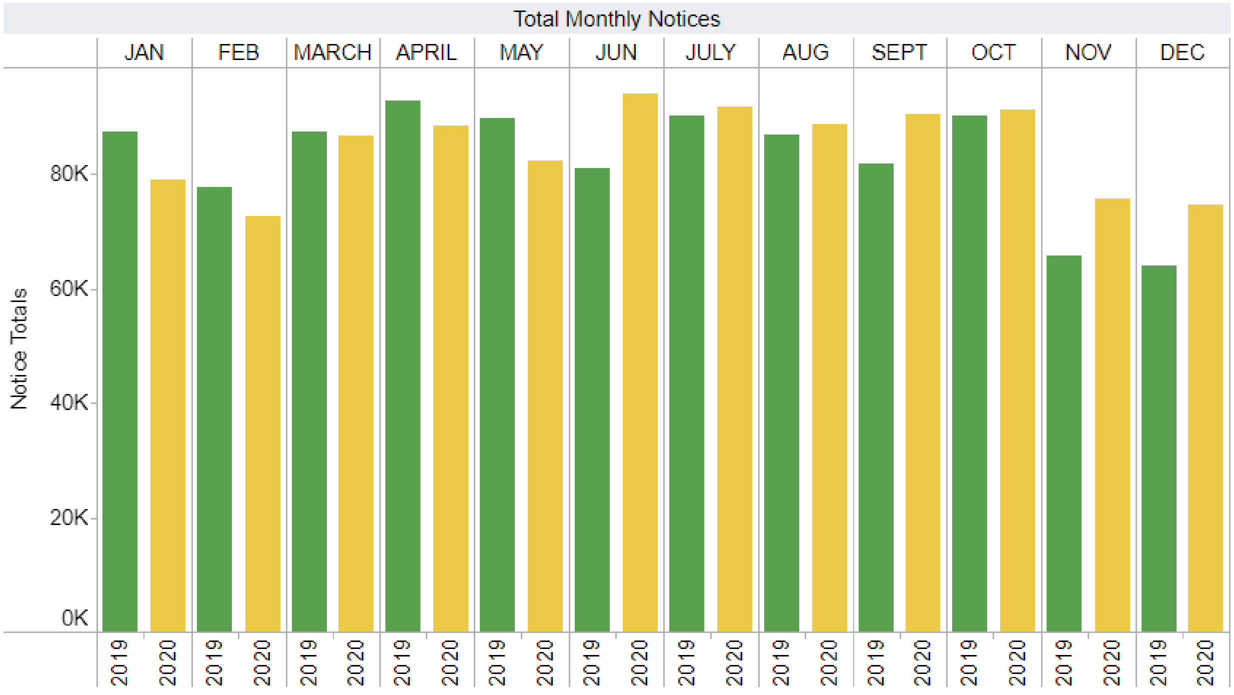


Figure D27

SC811 continued to have large fiber builds and road improvement projects. Home building has continued to evolve through as South Carolina has grown in new and temporary residents at an exponential rate since COVID began.

Table D7 shows homeowner ticket volumes for 2019 and 2020.

Month	2019	2020
January	467	528
February	513	588
March	999	1,194
April	1,100	2,327
May	815	2,462
June	53	1,869
July	581	1,278
August	503	1,180
September	550	1,103
October	571	1,061
November	438	821
December	351	576
Total	7,423	14,987

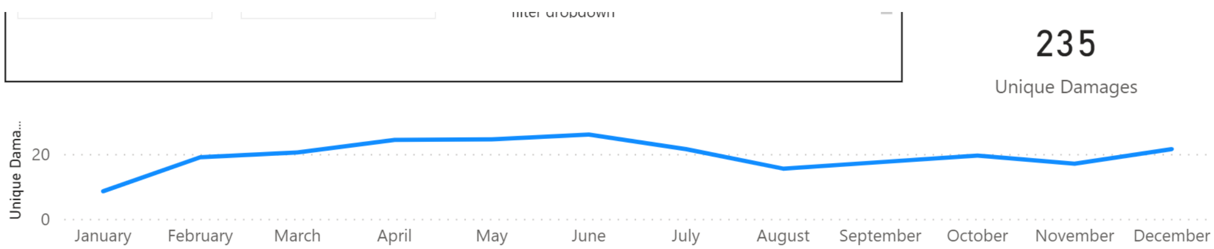
Table D7

Table D8 shows ticket volumes for common home improvement projects, including notices made by professional contractors.

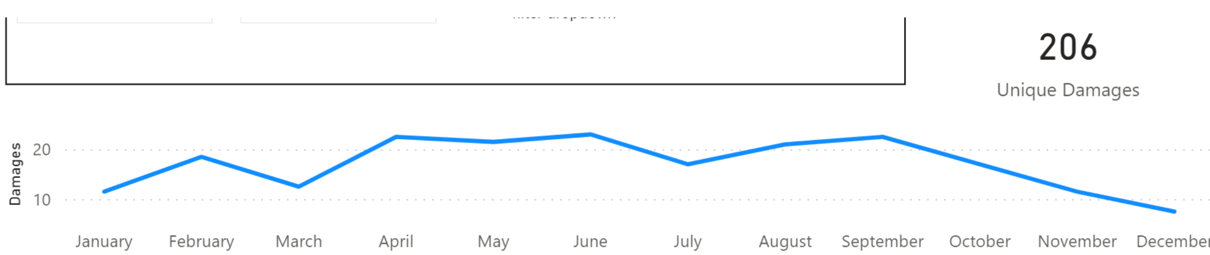
Work Type	2019	2020
Fence install	18,950	22,099
Landscaping install/repair	17,814	18,159
Drain install/repair	9,110	11,219
Tree/stump removal	7,235	8,889
Irrigation install/repair	7,392	7,234
Driveway install/repair	3,558	4,196
Conduit install/repair	5,080	2,900
Pool install/repair	2,140	2,821
Trenching/misc digging	2,251	1,997
Deck install/repair	1,054	1,504
Mailbox install/repair	1,419	1,425
Satellite install/repair	2,421	1,414
Gardening/farming	755	1,282
Pest control install/repair	1,437	1,054
Pet burial	35	32

Table D8

The snippets below are from the DIRT Dashboard, filtered on occupant damages. These damages were down in 2020 despite the increase in ticket volume. The monthly damage trends do seem to track with the ticket volume trends described by SC811.



South Carolina 2019 Occupant Damages



South Carolina 2020 Occupant Damages

Figures D28 – D29

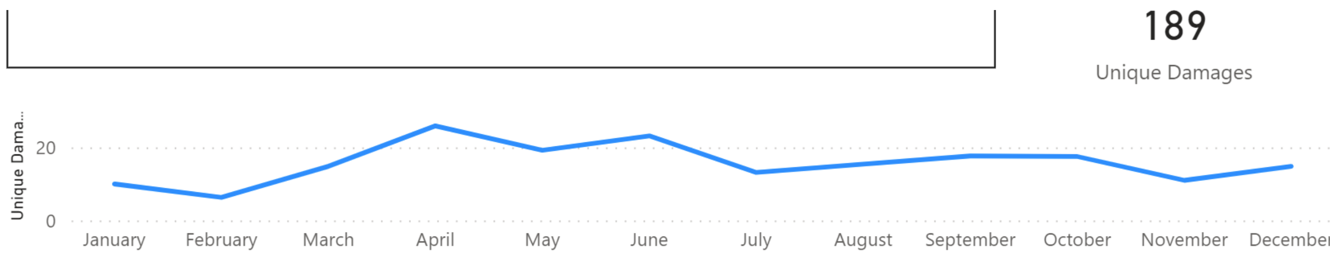
Virginia 811

- Ticket volume for 2020 increased 8% over 2019. And that was after 2019 saw a nearly 5% increase from the previous year.
- Ticket volume never really dipped during 2020. Volume was flat in April and May, but the drop-off was negligible.
- The steadiness and growth in volume is certainly due to the governor including utility and construction work in the list of "essential workers/businesses" during the pandemic.
- Utility work in most of the "work type" categories increased from 2019, and the same is true for those associated with homeowner home-improvement projects.
- There was an increase of almost 30% in homeowner tickets.
- Virginia 811 has several internet ticket tools, by which incoming volume increased from just over 65% in 2019 to just under 68% in 2020.

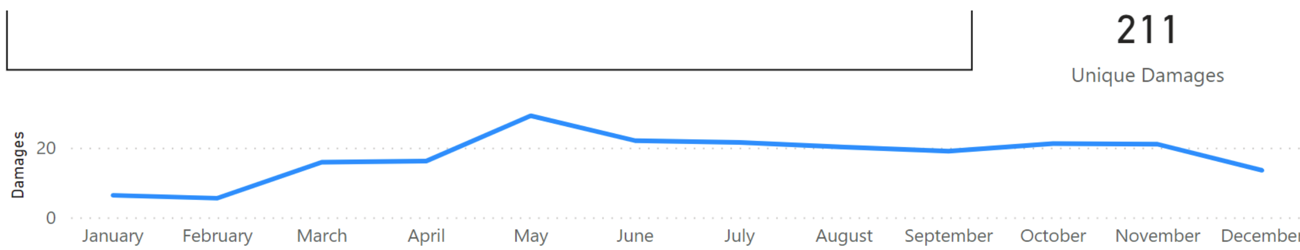
Top 20	2019	2020	% Change
FENCE - INSTALL, REPAIR OR REPLACE	14,839	20,709	40%
LANDSCAPING	6,938	8,821	27%
PLANT TREES OR SHRUBS	6,487	7,507	16%
STUMP GRINDING OR REMOVAL	5,349	6,513	22%
DRAINAGE WORK	3,827	5,109	33%
DECK - INSTALL, REPAIR OR REPLACE	3,107	4,972	60%
OTHER - SEE EXCAVATION AREA FIELD FOR DETAILS	3,030	3,411	13%
DRIVEWAY - INSTALL OR REPAIR	2,883	3,528	22%
GARDEN - PLANT OR ROTO-TILL	2,716	4,181	54%
WATER SERVICE - REPAIR, REPLACE OR ABANDON	2,402	2,219	-8%
DRAIN PIPE - INSTALL, REPAIR OR REPLACE	2,112	2,880	36%
ELECTRIC SECONDARY - INSTALL	1,753	2,476	41%
POST - INSTALL	1,738	2,285	31%
PATIO - INSTALL OR REPAIR	1,468	2,866	95%
MAILBOX - INSTALL OR REPLACE	1,462	1,553	6%
FOOTERS, SLAB OR FOUNDATION - INSTALL	1,344	1,524	13%
TRENCHING	1,311	1,692	29%
FRENCH DRAIN - INSTALL	1,268	1,755	38%
GRADING - ROUGH OR FINAL	1,264	1,645	30%
ADDITION - BUILDING OR HOUSE	1,246	1,653	33%

Table D9

The following snippets are from the DIRT Dashboard. Occupant damages were up slightly but not commensurate with the increase in homeowner ticket volume.



2019 Virginia, Occupant Excavator



2020 Virginia, Occupant Excavator

Figures D30 – D31

Appendix E: Damage Prevention Metrics

It is not known when or where damages/ticket originated as the standard damage prevention metric, but by late 1990s it was in use by some facility operators as a way to measure progress and compare to peer companies. The data is easy to gather and understand – count damages, count the tickets received from the one call center(s), and do the math.

As it caught on, more organizations and regulatory agencies started looking at it as a means to measure progress in reducing damages and identify what good-performing companies/states are doing so the less well performing could learn from them.

In 2010, PHMSA started collecting damages and ticket numbers in annual reports required to be filed by regulated natural gas distribution companies. Also in 2010, the CGA Stakeholders asked the Data Committee to address damages per ticket information in annual DIRT Reports. CGA's OCSI Committee has a data collection tool where one call centers enter data on incoming locate requests and outgoing transmissions to member operators (or directly locating services). The 2010 DIRT report presented data for 31 entities that provided the requisite ticket data (See Figure E1). Note that the entities/states were anonymized due to confidentiality concerns. As used here, "One Call Center Tickets" was the total incoming locate requests. It must also be kept in mind that DIRT reporting varies widely state by state. The low-number entities in Figure E1 may have less robust DIRT reporting. In addition, each incoming locate request is transmitted to multiple facility operators which may be at risk of damage. In some cases, there may be more than one damage in the numerator divided by one ticket in the denominator, meaning the ratio is artificially high. DIRT did not start adjusting for multiple reports of the same event until 2015.

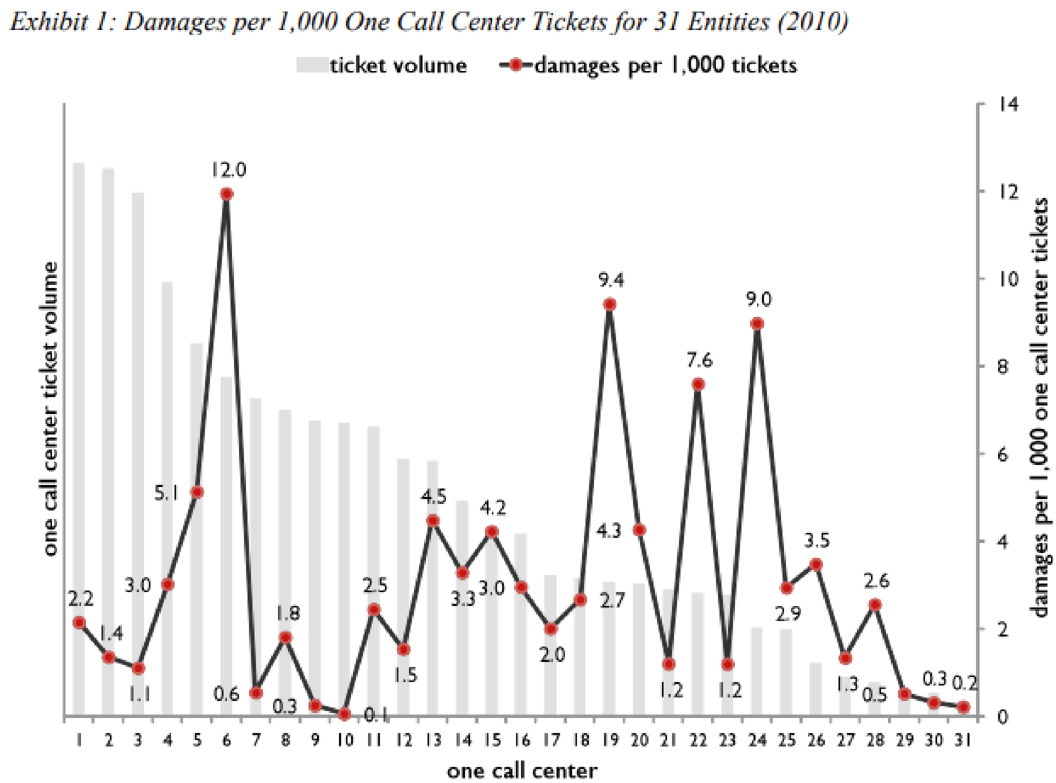


Figure E1—Damages per 1,000 One Call Center Tickets from 2010 DIRT Report

In 2011 and 2012, the DIRT Reports included similar exhibits, each year picking up a few more reporting entities, but still anonomyzed. In 2013, the DIRT Reports transitioned to using outgoing transmissions in the denominator (still anonomyzed), based on the following rationale:

> … the denominator for this metric is incoming notifications to the one call center, and each incoming notification can result in multiple outgoing transmissions sent to member facility operators, such as gas, electric, telephone, sewer, water, cable TV, etc. Since there is potential for multiple facilities to be damaged on the same locate request, each individual facility operator represents an opportunity for a damage to occur. Therefore, a more meaningful way to calculate a damage rate is to use outgoing transmissions to the facility operators. This would provide a value similar to the value an individual operator using this metric would experience, since an outgoing transmission from the one call center is an incoming locate request for each facility operator.

This shift makes the denominator a larger number, which makes the ratio lower. However, not all facility damages are reported equally to DIRT in all locations, so the results from this method can be artificially low.

Starting with the 2015 DIRT Report, CGA began providing an online dashboard in conjunction with the annual DIRT Reports. The dashboards included damages per transmission and identified the states and provinces. By this time stakeholders recognized the value of identifying states because that is the level where differences in laws/regulations, one call center policies make a difference. The dashboards have always included caveats similar to this:

State & Province Metrics

This page presents DIRT damage data for States and Provinces according to several metrics from other data sources. Note that participation in DIRT is voluntary and varies by state, which means that the DIRT data may not provide a complete picture of damages and damage prevention efforts. When viewing the data at a state or province level, higher damages may indicate a relatively higher level of voluntary reporting rather than higher damages. Thus, care must be taken when comparing state damage rates against each other or against a national metric. Similarly, year-to-year increases in unique damage reports in a State or Province may be at least partially attributable to growth in voluntary reporting.

The damages per ticket metric is most meaningful when the numerator and denominator are drawn from the same population. An individual facility operator, state/province, or even an entire country can use the metric to measure its own performance over time, so long as the data sources and collection methods remain consistent. Comparisons drawn from different populations can be misleading because they are no longer “apples-to-apples.”

These bullets are from the 2013 DIRT Report, and variations of the same message have been provided in other years and on the dashboards:

- It is important to keep in mind that locate request criteria vary from state to state. Requirements for submitting locate requests, such as length or size of the excavation (e.g., a city block, 1 mile, or from county line to county line, etc.), life of the ticket (e.g., 14 business days, 30 calendar days, indefinite), and notification exemptions, will affect how many locate requests may be submitted in a particular state.
- For these reasons, users of the metric need to keep in mind how the number is derived when attempting comparisons, whether they be state vs. state, operator vs. operator, or state vs. operator. However, the metric remains valuable as a means for states and operators to measure their own “Damages per 1,000 locate requests” data in a year-over-year basis to ensure that improvement is being made.

The transmission number used in conjunction with the estimate of annual U.S. damages to obtain the U.S. damage per ticket ratio is also an estimate (see Table 5 in the main part of this report). Similar to the estimate of the number of damages, the consultant takes available ticket data and uses statistical methods to extrapolate and estimate the missing data.

Table E1 is based on the U.S. one call centers that provided 2020 ticket data. It illustrates the wide range of actual outgoing/incoming ratios. The weighted average (7.03) is the one used for the overall U.S. damages/tickets ratio.

Table E1—Statistics for Outgoing Transmissions / Incoming Notices

Statistic	Outgoing Transmissions Incoming Notices
Minimum	3.08
Maximum	16.64
Weighted Average	7.03
Average	6.56
Median	5.84

PHMSA makes data for regulated natural gas distribution companies publicly available: https://primis.phmsa.dot.gov/comm/DamagePrevention.htm?nocache=384
Figure E2 shows damages per thousand tickets for the entire U.S. The website also allows for filtering on individual states.

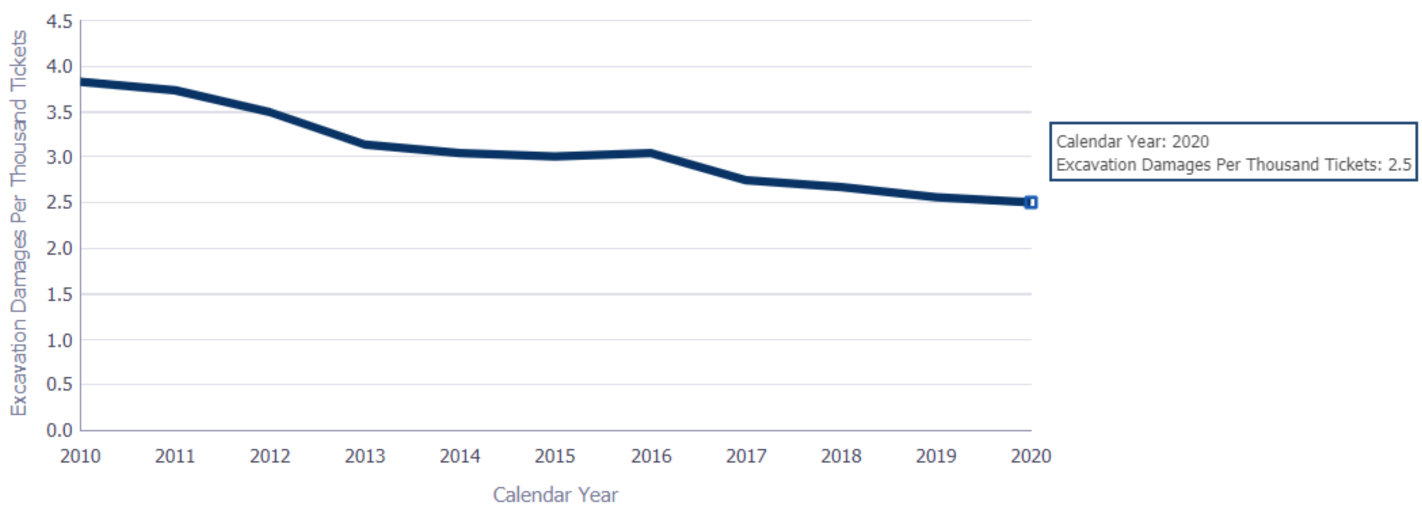


Figure E2—PHMSA, Damages per 1000 tickets for natural gas distribution

The numerator can be considered reliable because reporting is required by regulation. The denominator is tickets received by individual companies. This is easy enough to count consistently, and the numerator/denominator populations align. However, there is no equivalent for other industries. Some stakeholders look to DIRT for industry-to-industry benchmarking comparisons but do not find it there. To align the damage/ticket population we would need to collect transmissions data broken down to industry (X# to electric, Y# to telecommunications, Z# to water, etc.). The same principle would apply if we tried to apply the metric to different types of excavators (landscapers, road builders, homeowners, etc.). The one call centers would need to track and report the number of incoming locate requests from each type of excavator. As it is, not all one call centers complete the OCSI tool. DIRT could ask for annual ticket data from facility operators, but it is unlikely we would get full participation.

The 2020 estimate of U.S. damages (468,000) lies within a lower and upper bound confidence intervals of 380,000 and 584,000. The 1.71 is based on the 468,000 estimated damages divided by the estimated number of transmissions. It is most likely lower than the reality. If incoming notifications were used rather than outgoing transmissions, the damages/ticket ratio would have been approximately 12,[24] obviously higher than reality.

PHMSA's 2.5 damages per 1,000 tickets from Figure E2 sits reasonably within this range. However, readers should NOT interpret the 2.5 versus 1.71 to mean PHMSA-regulated natural gas companies are poorer performers than the U.S. as a whole. This illustrates why DIRT emphasizes the direction of the trend rather than the actual number. It may indicate that the DIRT reported numbers comes closer to reality using outgoing transmissions rather than incoming notifications (2.5 is a realistic number for natural gas distribution, and DIRT's 1.71 is closer to 2.5 than is 12). By using a consistent method[25] and aligning the numerator/denominator populations as closely as possible, the value of the metric in the DIRT reports is in year-to-year trending for the U.S. Care must always be taken when using it for comparison to states, industries, companies, etc.

The numbers shown on the metrics page of the DIRT Dashboard are actual DIRT-reported damages[26] divided by ticket transmissions. No *Per 1,000 Transmissions* number is shown for states/provinces that do not provide the necessary data.

State / Province	Unique Damages (2020)	Per 100,000 people (2020)	By population per mq mile (2020)	By 2020 Construction Spending (per $Million) (U.S only)	Per 1,000 Transmissions (2020)
NC	26778	255.32	127.78	1.59	2.19
ND	395	51.83	36.65	0.13	0.44
NE	5259	271.89	210.36	1.14	
NH	250	18.39	1.70	0.22	0.63
NJ	1750	19.70	1.54	0.14	
NL	8	1.53	2.41		4.10
NM	2824	134.68	163.73	0.82	2.54

24 (468,000 x 1,000) / (273,900,000 / 7.03).
25 As discussed in the main report section on the U.S. Estimate of Damages, by changing how it reports transmissions Michigan introduced some inconsistency from 2019 to 2020.
26 Accounting for multiple reports of the same event.

As noted above, there is wide variation among the states regarding how many damages (numerator) are reported to DIRT. That has been the case since the earliest days of DIRT and will be for the foreseeable future. However, we set that aside for now and concentrate on the denominator.

The damages/transmissions metric is actually trying to capture damages divided by opportunities for damage. It essentially uses transmissions as a proxy for excavations near[27] buried facilities. However, this is not always exactly the case. Theoretically, if all stakeholders contributed, we could count damages with and without a one call ticket, incoming notifications and outgoing transmissions to/from one-call centers, and notifications/transmissions without damage. We have no direct means to count excavations with no one-call ticket and no damage, near (or not) to buried utilities.

Focusing on the pieces that we can count, we find that there are several factors that influence how many locate requests are made to one call centers and how many they in turn transmit to their participating members. Here is a partial list:

- States have varying requirements for how long a ticket is valid (life of ticket) and the size or scope of a ticket. The tighter the requirement, the larger the number of tickets, and the lower the damages/ticket ratio.
- States have varying exemptions to 811 notification rules for types of excavators (homeowners), types of work (agriculture), equipment (hand tools), and depth of excavation. Some types of facility operators are exempt from one call center participation. These can affect the numbers of incoming notices and outgoing transmissions.
- There are competing incentives in managing ticket volumes. In addition to being a message forwarding service, one call centers are also screening services. The goal is to transmit the tickets that members truly need because their buried facilities are in the vicinity of the excavation work, while screening out the ones they do not need. Many one call centers are funded at least in part by charging a per-ticket fee to their members, who in turn have a financial incentive to keep unneeded notices received to a minimum. Conversely, the more tickets the members receive, the lower (better) they do in damages/ticket. That said, some non-zero percentage of tickets received by a facility operator can be screened out from requiring site marking, because they have no facilities in the work area.
- There has been much discussion recently in the industry about locators keeping up with volume. Tickets are not being marked on time, so excavators place more tickets than they can realistically start at the same time so as to have options to keep their crews busy if some work sites are not marked on time. This occurs in varying degrees in different states, introducing further distortions in the denominator of damages/ticket.

The Data Reporting & Evaluation Committee has a task team examining ways to account for these issues. The team has been following two tracks:

(1) “Normalizing the denominator,” and
(2) Looking for proxies for “opportunities for damage” that do not involve one call tickets.

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[27] For now, we also set aside “how near is near?”

Normalizing the Denominator

In 2019, CGA's DIRT report consultant, Green Analytics, was engaged to explore options for developing a new normalization process that minimizes the limitations of the existing damages per 1,000 notifications metric. The main research question that was explored was: Are there better proxies for excavation activity than one call ticket data, whether incoming notifications or outgoing transmissions? Green Analytics' approach included a literature review and web-based research to develop a list of potential alternative denominators and exploration of their strengths and limitations, as well as a look at what other jurisdictions have employed to test whether universal indicators exist. They do not exist, here is one notable passage from Green Analytics' report:

> *Among the literature and reports reviewed, there seems to be an underlying theme for utility plans and underground assets to be mapped and stored in a centralized repository. Such a repository would inform excavators on the location of assets before they start their work. Additionally, available systems could be updated and verified by those in the field, when as-built drawings are no longer accurate. The main benefit of this type of system is that it provides a one-stop-shop for information on underground assets avoiding the need to contact multiple utilities and stakeholders for such information. … In the United Kingdom, this approach is being utilized by Line Search BeforeUDig to reduce damages to assets. In the United States, a centralized repository could benefit the damage prevention world and their stakeholders by following a similar process to Line Search BeforeUDig, however, the geographic coverage and volunteered information from stakeholders and asset owners is paramount to the success of such a system.*

This is very similar to one of the opportunities for systemic improvement with the greatest return on investment (ROI) for industry identified in CGA's Next Practices report:

> **Pursue a GIS-based mapping system/database**. A comprehensive national GIS map of buried infrastructure would make the locating process drastically more efficient and accurate and identify abandoned facilities.

Meanwhile, the Metrics Team was exploring what data was available from one call centers that would enable teasing out the differences in state rules and policies with the greatest effect on ticket volume. The consensus of the team was that ticket life and geographic scope were the major influences. In late 2019 to early 2020 the team issued an RFP for a consultant to develop a mathematical model to "normalize" denominator of damages/ticket to account for different life and scope of tickets. The team selected a firm called Impakt Advisors, Inc., (IA) whose proposed approach was to use North Carolina as a baseline state and run simulations of excavation projects to estimate how many tickets would be required in the other states if that same work were performed under North Carolina's rules. North Carolina was chosen as the baseline state because it had the most restrictive ticket life and scope among the participating states.

Impakt Advisors produced normalization factors (NF) that seemed rather high to the Metrics Team. The team decided to separate out work that would be covered by one ticket in any state (short duration small projects, single-address tickets) and apply the normalization factors to the remainder. Table E2 shows the results.

Table E2—Original and Adjusted Normalization Factors (NF)

State / One Call Center	Impakt Advisors Original NF	%Single AddressTickets	Adjusted NF
Arizona 811	2.76	70.3	1.05
California (Southern – Dig Alert)[28]	10.86	59.7	1.30
Colorado 811	5.0	80.1	1.12
Illinois (Julie)[29]	1.89	81.2	1.03
Michigan (MISS DIG 811)	7.63	74	1.20
North Caroline 811	1.00	85	1.00
Nevada (USA North)	10.36	70.3	1.28
New York 811[30]	15.33	36	1.43
Pennsylvania 811	3.60	70.3	1.08
Texas 811	2.27	73	1.04
Utah (Blue Stakes)	1.17	70.3	1.01
Virginia 811	4.51	71.4	1.11
Washington Call Before You Dig	2.04	70.3	1.03

There are several points to keep in mind regarding Table E2:

- 70.3% single address was assumed for centers that did not provide actual numbers, based on the average of those that did so. More exact data could lead to different adjusted NFs for those currently listed as 70.3% single address. It could lead to a different average for any remaining states that do not supply the data.
- California, Illinois, and New York all have two one call centers, but only one from each state participated in this project.
- Higher concentrations of urban areas appear to lead to higher NF, probably due to lower percentages of single address tickets.
- New York and California have the highest NF's but if the entire states were included their NFs would likely decrease.
- Illinois (JULIE) had low a NF, but if Digger-Chicago were included its NF would likely rise.

[28] Covers Imperial, Inyo, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara and Ventura Counties

[29] Excludes Chicago metro area

[30] Covers five boroughs of New York City and two counties on Long Island

- With a NF = 1.01, Utah is most similar to North Carolina in terms of ticket life and size rules, indicating we are on the right track.
- North Carolina is the baseline for this project because it had the tightest rules regarding ticket life and scope among the participating states. Thus, its NF is 1.00 and all other states are higher. If additional states participated with tighter rules than North Carolina, they would likely have NF's lower than 1.00.
- This process accounts for life and size of ticket, which were considered the leading drivers of ticket volume. The process could potentially be made more exact by factoring in other variables (ex. exemptions, buffer zone size, whether electronic white lining is offered). However, this would require more granular data collection, and there may be a point of diminishing returns where additional refinements have little effect on the results.

Q. What does this mean – how would it be applied?

A. As an illustration, take Michigan's Adjusted NF of 1.20. Its incoming ticket volume would be multiplied by 1.20 to get the "normalized" number of incoming notifications. To convert to transmissions, the normalized number would be multiplied by Michigan's ratio of outgoing transmissions to incoming tickets. That would lead to a larger number in the denominator, and thus a lower (better) damages/transmissions ratio.

The work thus far should be considered a demonstration project or "proof of concept." The Data Committee does not want this to be where it ends. It would like to get more one call centers to participate, and to obtain feedback on what data is available to apply to this effort.

Proxies for "Opportunities for Damage"

To avoid some of the weaknesses and agita associated with damages per one call tickets (whether incoming or transmission), the Data Committee is looking for alternative metrics to measure progress and identify trends. In addition to damages per 1,000 transmissions, the DIRT Dashboard in recent years has included damages per:

- 100,000 population
- Population per square mile
- Construction Spending (per million dollars)

There are other sources of data that could be used, but there are pros and cons associated with each. Options at the state and/or national level include the following (areas of trending growth may be more indicative of construction activity than GDP or population numbers alone):

- GDP Growth
- Population growth
- Housing starts
- Seasonally-adjusted construction employment

Such data may only be available at the state/province level, and so would only be useful for comparisons on that basis. An entity not organized by state/province boundaries may not be able to find the matching data for its geographic footprint.

Denominators that might be appropriate for individual facility operators might include:

- Miles of buried facilities
- Number of service lines
- Number of customers served
- Square miles of service territory

Comparisons at this level could be influenced a number of factors, including but not limited to:

- Differences in density of buried facilities and population in urban versus rural areas
- Transmission pipelines operate linearly (miles) while square miles make more sense for distribution companies
- Transmission companies do not serve *customers* in a comparable manner to distribution companies
- Telecommunications and electric operators would need to filter out overhead facilities

Summary

Damages per ticket seems to have become a “one size fits all” metric for the damage prevention industry. On the surface it is easy to understand, the data is *out there*, and the calculation is simple. However, on closer examination we find one size does not fit all. Stakeholders need to be cautious when using the metric to make sure they are comparing apples to apples. Alternative metrics that come closer to capturing the true opportunities for damage require additional data gathering/collection time and effort.

The preceding discussion has been from the perspective of facility operators. Gold Shovel Standard developed a metric geared to excavator performance that incorporates field-work-hours and number of facility operators notified on a ticket. This requires a bit more data collection effort than counting tickets but comes closer to leveling the field from an excavator perspective regarding for opportunities for damage – thus aligning the numerator/denominator population within a specific segment of the industry.

The best solution may be a set of metrics, with some better suited than others to certain situations, such as state/province, company, industry, etc. To carry this a step further, metrics that could be applied in countries besides the U.S. and Canada could be beneficial in expanding the universe of comparable entities to gauge damage prevention effectiveness.

Perhaps a blended metric, similar to the Mayo Clinic’s health Well-Being Index, or an economic or weather Misery Index, or baseball’s Wins-Above-Replacement, could be developed.

The Data Committee would also like to explore the idea of baseline ticket template which could be used to categorize and measure the differences by state. Software could then be developed to "interpret" the baseline ticket to each states' specific requirements, which would allow national or regional facility owners and their excavators to use it while still meeting individual state requirements.

Common Ground Alliance[SM]

2020 DIRT Analysis & Recommendations

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