Released, September 2018

# DIRT

Damage Information Reporting Tool

# 2017
# Analysis & Recommendations

## Volume 14

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

**Dear Damage Prevention Stakeholders**,

As you will see, the 2017 DIRT Report has a new look and feel. CGA's Data Reporting & Evaluation Committee has worked closely with a new consultant, Green Analytics, to use new data analysis methods and bring a fresh perspective and to this very important damage prevention tool.

For the fourth year in a row, the number of events submitted into DIRT increased, with more than 411,000 records submitted for 2017. This is an increase of approximately 5 percent over 2016. After consolidating multiple reports on the same event and filtering out near-misses, total damage reports for 2017 were 316,422.

One of the committee's goals with the new report is to provide additional details on the data and the analytical methods employed, particularly for the annual estimate of total U.S. damages. A detailed appendix is included with specific information on the new methodology and approach for 2017. The new approach estimates an increase in total U.S. damages from 2015-2017 with a levelling-off of damages per one call transmissions and damages per dollars of construction spending during the same time frame. So, although we are seeing an annual increase in damages in recent years, the overall rate of damages has remained stable when taking construction activity into consideration.

We have made significant improvements to the DIRT online interactive dashboard, which now includes enhanced data visualizations and powerful sorting and filtering capabilities. The new dashboard features allow users to analyze damages in a variety of ways, including by facility types in individual states, and the ability to quickly create customized charts for these types of data.

One of the primary objectives in CGA's 2018 strategic plan is to "develop information and analysis designed to enhance our members' ability to implement effective damage prevention processes and programs." With this in mind, I encourage our stakeholders to use the report and online dashboard to identify opportunities for improvement. This may include the identification of audiences for targeted outreach, development of new or revised Best Practices, identification of new technology solutions or strengthening legislation in your state.

There is no question the data included in the DIRT Report plays an important role in helping us reduce damages to underground infrastructure. Please take this opportunity to review your damage and near-miss data collection practices for improvement opportunities. If you're not collecting key DIRT fields such as root cause, type of excavator, equipment and work performed, I would ask that you consider educating your personnel and/or change your internal processes start collecting this data. Improved data quality will enhance our annual DIRT analysis and will improve stakeholders' ability to assess their own success and identify opportunities.

I want to thank everyone who works diligently to make the DIRT Report a key tool in helping stakeholders determine how to best protect underground utilities, the people who dig near them and their communities.

Be safe,

**Sarah K. Magruder Lyle**
President & CEO
Common Ground Alliance

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**Also visit the 2017 DIRT Dashboard at**
commongroundalliance.com/dirt-dashboard

# 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.

**DIRT**—Damage Information Reporting Tool.

**Event**—The occurrence of downtime, damage, and near miss.

**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," "unknown/other," or "data not collected."[1]

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

**Root Cause**—The predominant 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.

**Transmissions**—The number of 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 remaining after identifying and consolidating multiple reports of the same event.

[1] As part of the revisions to the DIRT form effective January 1, 2018, Data Not Collected is removed from all fields where it was an option.

# INTRODUCTION

The Damage Information Reporting Tool (DIRT) is an initiative of the Common Ground Alliance (CGA) through the Data Reporting & Evaluation Committee. It is a system for gathering data regarding damage and near-miss events from excavation activities related to buried facilities. An event is defined in the CGA DIRT User's Guide as "the occurrence of downtime, damages, and near misses." DIRT allows industry stakeholders in the U.S. and Canada to submit data anonymously to a comprehensive database. The database is used to identify the characteristics, themes, and contributing factors leading to damages and near misses. Such findings are summarized in an annual DIRT report. This report provides a summary and analysis of the damage events submitted in 2017.

The number of events reported via DIRT for the U.S. and Canada in 2017 totalled 411,867. After consolidating multiple reports of the same events[2] and filtering out near misses, the number of reported damages was 316,442, comprised of 10,644 in Canada and 305,799 in the U.S. (Table 1).

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

| | 2015 | 2016 | 2017 |
|---|---|---|---|
| **Reported Events (total entered in DIRT)** | 363,176 | 390,366 | 411,867 |
| **Reported Near Misses (unique events)** | 9,485 | 6,093 | 1,588 |
| **Reported Damages (unique events)** | 278,861 | 317,869 | 316,442 |

[2] See the 2015 Annual DIRT report for a description of the method used to match and weight multiple reports of the same event. Also see the May 2016 and July 2016 Monthly Updates (http://commongroundalliance.com/media-reports/cga-monthly-updates).

2017 DIRT Highlights

**Most reported damages (52%) are the result of Insufficient Excavation Practices. A**pproximately a quarter of the damages (24%) resulted from Notification Not Made to the One Call Center, and approximately 17% are due to locating issues.

The leading type of excavator involved in damages is Contractor at about 61%. Occupants and Farmers make up about 5%. For reports where a root cause is provided, 78% involving Occupants with hand tools are due to No Notification to the One Call Center. For Contractors with backhoes, it's about 21% due to No Notification to the One Call Center, with Excavating Practices making up about 43%.

A refined approach to estimating the total annual damages in the U.S. results in an estimate of 439,000. This approach was applied retroactively to 2015 and 2016, resulting in revised estimates of 378,000 and 416,000, respectively.

## What Is New for 2017?

- A new approach to data characterized as "unknown" increases transparency and informs readers of the significance of unknown data and the implications for drawing conclusions about larger data trends. Specifically, unknown data is included in datasets where it constitutes a significant portion of the total. This approach also clearly demonstrates areas in the data collection process where efforts to reduce unknown data are most needed.
- To allow for year-over-year comparisons with a high degree of confidence in trends in the data, a subset of data from stakeholders that have consistently submitted over time was extracted from the larger dataset and used to demonstrate trends from 2015 to 2017. Focusing on this subset ensures that changes from one year to the next reflect actual changes in damages rather than potentially being due to an increase, decrease, or different combination of entities reporting through DIRT.
- A section titled "Understanding the Data" educates readers on where uncertainties lie in the DIRT dataset and how such uncertainties have been addressed in the DIRT report.
- A consistent approach was used in the organization of the sections presenting the DIRT data, including an overview of the dataset under consideration (i.e., root cause, reporting stakeholder, excavator type, facility damaged), followed by cross-tabulations demonstrating how the data fields intersect and relate to each other (e.g., root cause by reporting stakeholder, facilities damaged by root cause). This is followed by presentations of the data over time (2015 to 2017).
- A calendar heat map shows the timing of damages with analysis contrasting combinations of root cause, type of excavator, and equipment by weekdays and weekends.

- A section on Call Before You Dig (CBYD) Awareness relates damages by occupants with CBYD and 811 services awareness and use. Trend lines are included for the 2017 and 2018 awareness surveys demonstrating U.S. regions where use and awareness of such services are lagging.
- A conclusion section summarizes key trends and articulates recommendations for improvements to DIRT for future consideration.
- A detailed technical appendix (Appendix A) describes a refined approach used to establish substantially reporting states and the statistical analysis undertaken to build the predictive model to estimate total damages for the U.S. for 2015 to 2017. Results of the statistical analysis are presented along with comparisons of damages for substantially reporting states with the larger DIRT dataset. In general, the comparisons demonstrate that the substantially reporting states dataset is a strong representation of the larger DIRT database.

## 2017 ONLINE DIRT DASHBOARD

A redesigned interactive dashboard available allows users to interact with the complete DIRT dataset, run queries, and extract trends of interest to users. Key features of the interactive DIRT analysis tool include the following:

- State summaries and interactive visualizations
- Easy comparisons between states
- Temporal damage trends over the year
- Interactive maps
- Root causes and associated excavation information (type of excavator, work, and equipment)

### Online Dashboard URL:

commongroundalliance.com/dirt-dashboard

# UNDERSTANDING THE DATA

The DIRT database has grown and improved since data collection began in 2004. The DIRT data is a rich source of industry intelligence on damage and near-miss events from excavation activities related to buried facilities. Despite this, uncertainties remain that limit the ability to draw firm conclusions on the trends in damage events over time and across jurisdictions. There are four reasons for this:

1. Reporting to DIRT is voluntary in many jurisdictions.[3]
2. In some cases, details pertaining to damage events are unknown or not collected, which translates into unknown data in the DIRT database.
3. Reported data is not a complete census of damage to all buried facility operators.
4. There is limited knowledge of the population of companies or entities performing excavation work that might cause damages.

These considerations result in the following issues that must be kept in mind while interpreting the data:

1. Some jurisdictions contain more comprehensive data than others. Thus, the damages reported via DIRT are not necessarily a reflection of the actual total damages that take place in a given jurisdiction in a particular year.
2. Changes over time may be due to variations in the number and combination of entities reporting damages, or from actual increases or decreases in the number of damages.

To allow stakeholders to draw firm conclusions about the trends in damage events, two subsets of data were extracted from the DIRT database: damages for substantially reporting states and damages for consistently reporting stakeholders. The reporting states dataset contains reported damages from states at the high end of the spectrum for reporting events via DIRT. This dataset is used to predict total damages for the U.S. in a given year, the results of which are presented in the *Estimating Total Damages* section of this report. The consistently reporting stakeholders dataset is described in detail next.

## Consistently Reporting Stakeholders

The consistently reporting stakeholders dataset focuses on entities that have consistently reported events via DIRT over time. Because use of DIRT is voluntary, it is difficult to interpret trends in damages over time because changes may be caused by an increase or decrease in actual damages, or by more or fewer stakeholders employing the database in any given year. Feedback from DIRT users and stakeholders has indicated that year-over-year comparisons at the level of aggregation presented in Table 1 should therefore be undertaken with caution.

[3] Although some state's laws and/or rules require reporting all or some specific facility type events to DIRT, compliance may not be 100%.

To allow for year-over-year comparisons with a higher degree of confidence that changes reflect differences in actual damages rather than shifts in reporting, it is useful to examine annual damages reported for the subset of stakeholders that have employed DIRT on a consistent basis. Consistently reporting stakeholders are comprised of those companies that reported into DIRT during 2015, 2016, and 2017. Table 2 presents total reported damages over time along with those from the consistently reporting stakeholders.

Table 2—Reported damages and total damages for consistently reporting stakeholders in Canada and the U.S., over time

| | 2015 | 2016 | 2017 |
|---|---|---|---|
| **Reported Damages** | 278,861 | 317,869 | 316,442 |
| **Reported Damages for Consistently Reporting Stakeholders** | 275,885 | 307,336 | 295,141 |
| **Reported Damages Attributed to Consistently Reporting Stakeholders** | 99% | 97% | 93% |

As shown in Table 2, consistently reporting stakeholders account for the clear majority, albeit a decreasing amount, of reported damages. Subsequent sections employ the consistently reporting stakeholders dataset to demonstrate temporal trends in the DIRT data. Given the high percentage of total reported damages captured by the consistently reporting stakeholders, readers can be confident that the trends over time are a solid representation of changes in actual damages.

## A Note About Unknown Data

Consideration was also given to the proportion of any given dataset that was characterized by unknown data entries. In cases where the unknown data was deemed to have an insignificant impact on the overall trend in the data (i.e., the unknown data does not skew overall data trends), it is excluded from the data presented in the report. However, in cases where the unknown data does have a significant impact on the overall trend in the data, it was left in the dataset and is presented in this report along with known data. This is a different approach than used in past years, when all unknown data was excluded from the DIRT report. Including the unknown data where it plays a significant role in the data trend serves two important purposes:

1. It improves transparency about what is known and what is unknown and can highlight the areas where improved reporting will enhance overall understanding of the damages.
2. Suppressing unknown data where it accounts for a significant proportion of reported damages can lead to misinterpretation of overall trends in damages. Allowing unknown data to remain allows the reader to be more cautious when interpreting such variables.

To establish whether to include or exclude unknown data, each dataset was graphed so as to distinguish between the known and unknown data. An example of this is shown in Figure 1, which demonstrates the breakdown of root causes. The figure differentiates between all data (known plus unknown, in blue) and only data with known root causes (green). When the unknown data is filtered out the contribution

of the known causes to the total shifts only slightly. With the unknown data excluded, Failure to Use Hand Tools, Failure to Maintain Clearance, and Facility Marking or Locating Not Sufficient increase by a mere 1–2%. No Notification Made to the One Call Center and Other Excavation Practices Not Sufficient increase as well by just 3–4%.

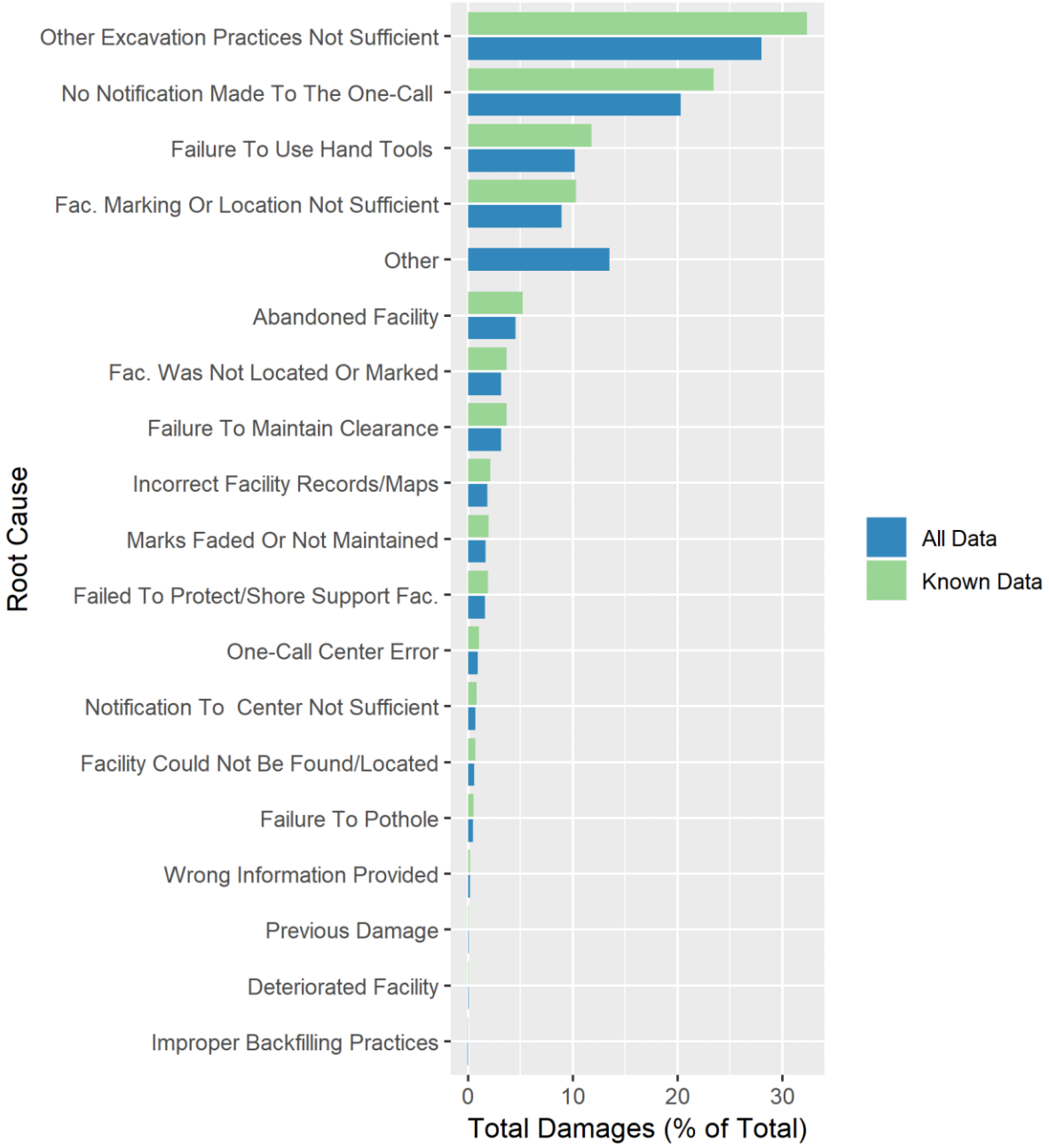


Figure 1- Root cause of reported damages in Canada and the U.S., 2017

Root cause is an example where the unknown data has a relatively insignificant impact on the overall trend in the data. This was also the case for facilities damaged, where most reported damages involved telecommunications with or without the unknown data included. Thus, for root cause and facilities damaged, this report presents only the known data. For the excavator type dataset, unknown data was relatively significant (48%), and so for this dataset it is included in the trends presented in this report.

## Data Quality Index

The data quality index (DQI) is a measure of the completeness of DIRT reports. Starting with a theoretical score of 100 (i.e., information is provided for all fields within DIRT), points are subtracted when *unknown, other, or data not collected* are used. This allows stakeholders to identify opportunities to improve reporting in the future. Figure 2 demonstrates the trend in the DQI for 2016 and 2017 across reporting stakeholders. The lowest DQI scores are associated with Excavators (DQI of 49) and One Call Center (DQI of 43). All other DQI scores exceed 50. Note that the average DQI for 2017 is down from 2016 by 5 points (from 68 to 63).

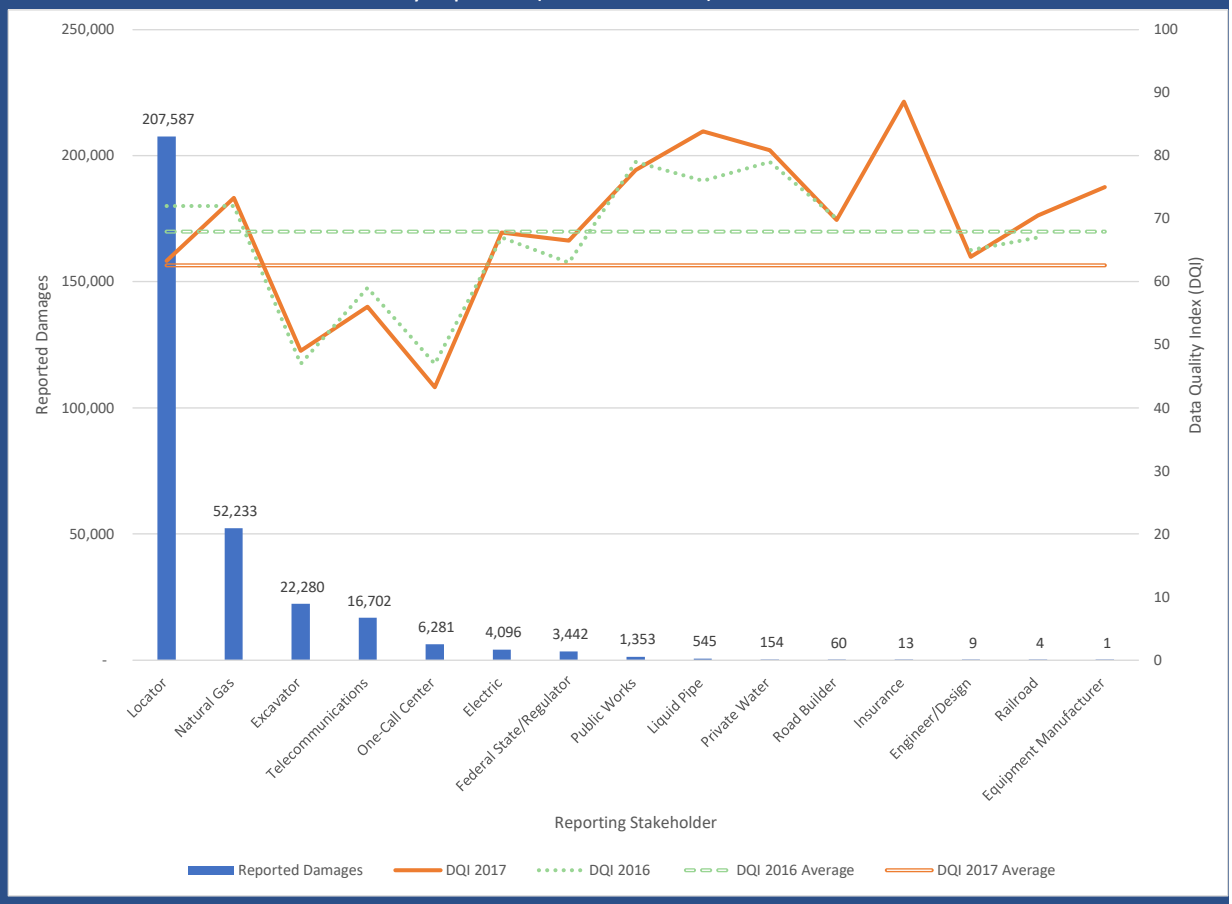


Figure 2-Data Quality Index by Reporting Stakeholder

# ESTIMATING TOTAL DAMAGES

Each year, the damage reports entered into DIRT are used to estimate the total number of damages for the U.S. As noted previously, damages are reported to DIRT on a voluntary basis and thus do not necessarily reflect the total number of damages that take place in a given year. A new approach (described in detail in Appendix A) was employed to generate an improved estimate of total damages occurring in the U.S. in 2017. As a result, the 2017 estimate was not directly comparable with the estimates in previous DIRT reports. The new approach was therefore retroactively applied to the 2015 and 2016 datasets.

Substantially reporting states are those that lead in employing DIRT to report their annual damages. A similar subset of the DIRT database has been used in past years' reporting. This year, the definitions and criteria for identifying eligible states were refined to improve confidence in the chosen states. Table 3 lists the 10 qualifying states along with their reported damages over time.

Table 3—Reported damages from substantially reporting states, 2015 to 2017

| State | 2015 | 2016 | 2017 |
|---|---|---|---|
| Colorado | 12,863 | 12,660 | 6,786 |
| Connecticut | 597 | 561 | 562 |
| Florida | 8,570 | 10,661 | 21,877 |
| Georgia | 20,554 | 37,562 | 29,655 |
| Illinois | 18,529 | 21,293 | 19,256 |
| Kansas | 6,403 | 4,650 | 5,476 |
| New Mexico | 2,227 | 1,431 | 1,479 |
| Pennsylvania | 7,211 | 7,983 | 8,878 |
| Texas | 45,624 | 53,899 | 45,384 |
| Virginia | 1,715 | 4,273 | 4,877 |
| SUBSTANTIALLY REPORTING STATES TOTAL | 124,294 | 154,974 | 144,230 |
| TOTAL DIRT REPORTED DAMAGES | 278,861 | 317,869 | 316,442 |
| Reported Damages Attributed to Substantially Reporting States | 45% | 49% | 46% |

Table 4 presents the estimates from the previous approach (2015 and 2016) and the new approach (2015, 2016, and 2017). With the new approach, the estimated damages for 2017 are 439,000, which lies within an estimated range of approximately 320,000 to 715,000.

Table 4—Key performance indicators for total estimated damages in the U.S., over time

| | 2015 | 2016 | 2017 |
|---|---|---|---|
| **Total Estimated Damages (U.S.) Previous Approach** | 317,000 | 379,000 | Not Applicable |
| **Total Estimated Damages Updated Approach** | 378,000 | 416,000 | 439,000 |
| **Total Estimated Transmissions** | 199.9 M | 221.9 M | 234.9 M |
| **Total Estimated Damages per 1,000 Transmissions Updated Approach** | 1.89 | 1.88 | 1.87 |
| **Damages per million dollars of construction spending** | 0.354 | 0.351 | 0.359 |

The new approach leads to mid-point estimates for 2015 and 2016 that are higher than those published in the DIRT reports for those years. Please note however that while the revised retroactive mid-point estimates are higher than the original estimates, they do fall with the range of those estimates.[4]

A similar approach was used to estimate the total number of one call transmissions. Using data from the one call centers that did submit the information to the CGA's One Call Systems International database (or provided it separately), estimates for the missing one call centers were calculated and added. The net result of these revised estimates is that the ratio of Damages per 1,000 Transmissions is declining slightly each year.

The increased estimates of U.S. damages for 2015 and 2016 are the result of two key factors:

1. A more sophisticated modeling approach that is better suited to the type of data contained in the DIRT database.
2. A refined approach to defining substantially reporting states.

The primary objective of estimating total damages for the U.S. is to demonstrate trends over time. For this reason, it was important to apply the new approach to previous years. While the new approach provides an improved estimate, it is important to note that the updated approach is probably still

[4] See Exhibit 1 of the 2016 DIRT Report.

underestimating total damages for the U.S. They do, nonetheless, provide a sense of how damages are trending over time. The consecutive years of data also allow for comparisons with other time trend data such as construction spending (Figure 3).

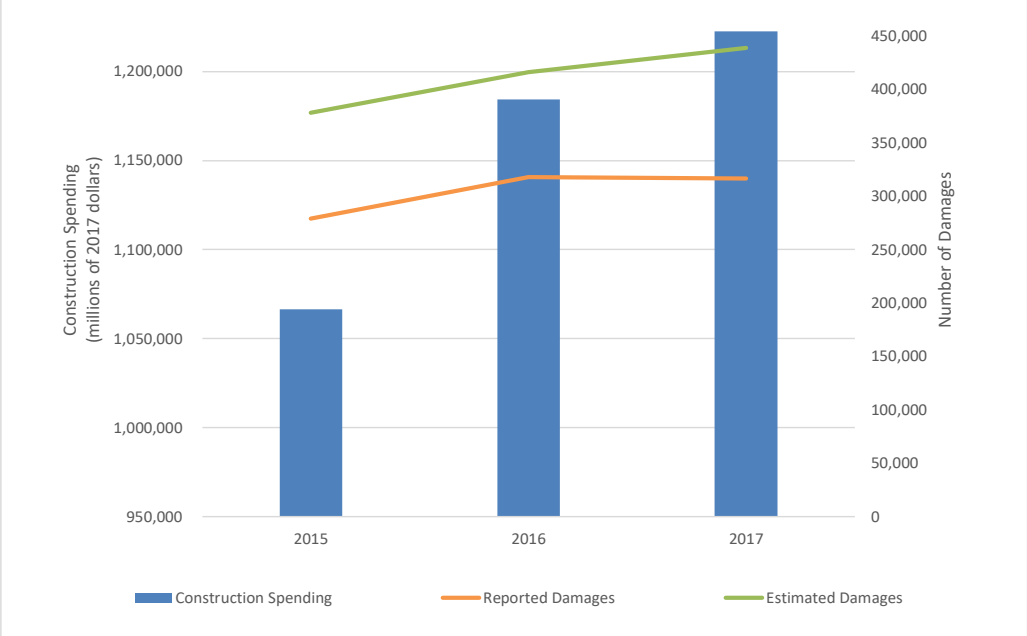


Figure 3—Comparison of reported and estimated damages with construction spending

# DATE AND LOCATION OF DAMAGES

The clear majority of reported damages in 2017 occurred during the work week (Monday to Friday). Across all states, 279,760 reported damages occurred during the work week and 26,038 occurred on weekends. The same trend was observed for Canada, with 9,789 reported damages occurring during the work week and 854 on weekends. Figure 4 illustrates the distribution of reported damages by month and day for 2017. The majority of damages occur in the months of June, July, August, and September. In 2017, 50% of the reported damages occurred during these four months. The highest number of damages were reported for the month of August with 11%. For types of excavators excluding from Occupants, more than 90% of damages occur on weekdays. For Occupants, it's approximately 73% weekdays and 27% weekends. Hand Tools are the type of equipment for 13% of damages occurring on weekdays but 24% on weekends. For Backhoes, it's 32% of damages on weekdays and 26% on weekends.

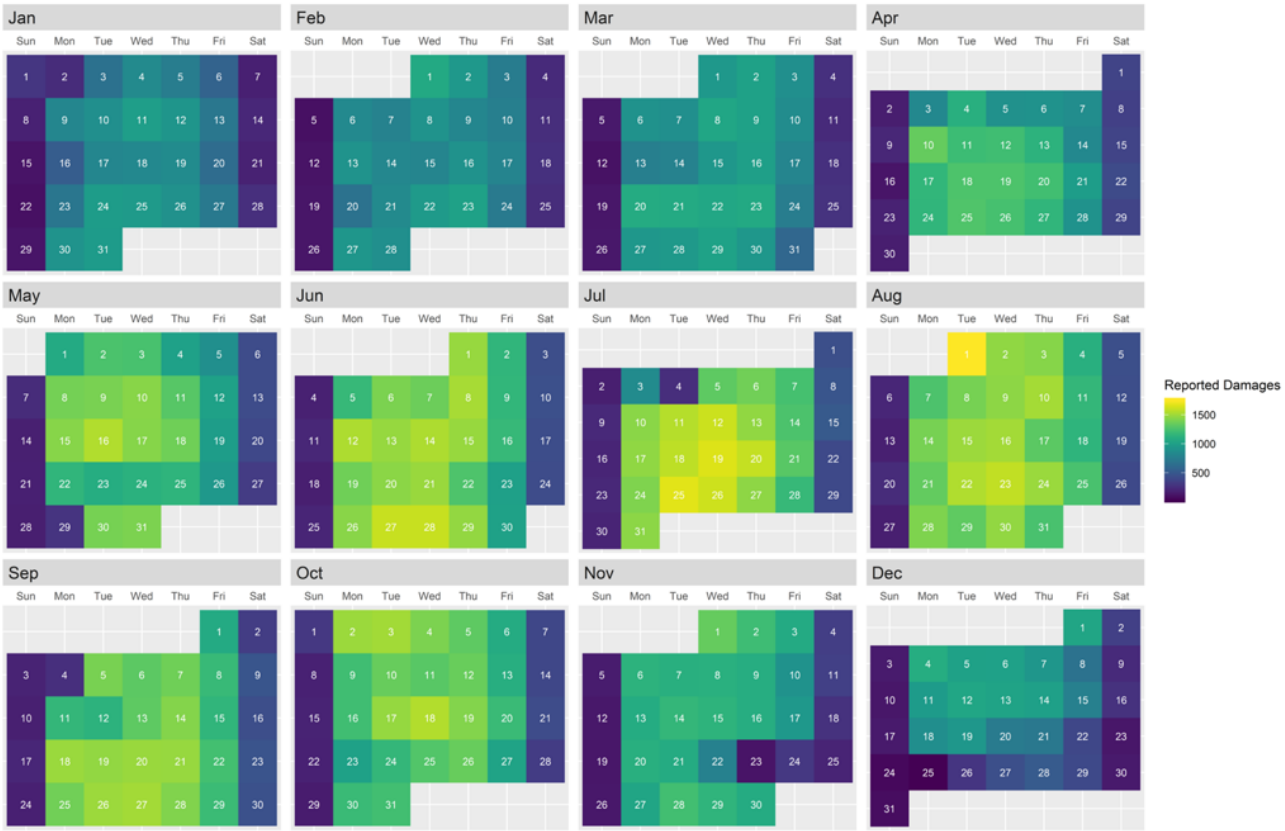


Figure 4—Heat calendar of total damages in Canada and the U.S. by month and date, 2017

Figure 5 displays ranges of damages by location as reported via DIRT. Because participation in DIRT is voluntary and varies by state, the damage ranges indicated may not provide a complete picture of damages and damage prevention efforts. Specifically, higher damages may indicate a higher level of voluntary reporting rather than a higher level of actual damages. As a result, Figure 5 should be interpreted as an indication of which states and provinces are providing damage reports and not an assessment of which are experiencing the most damages.

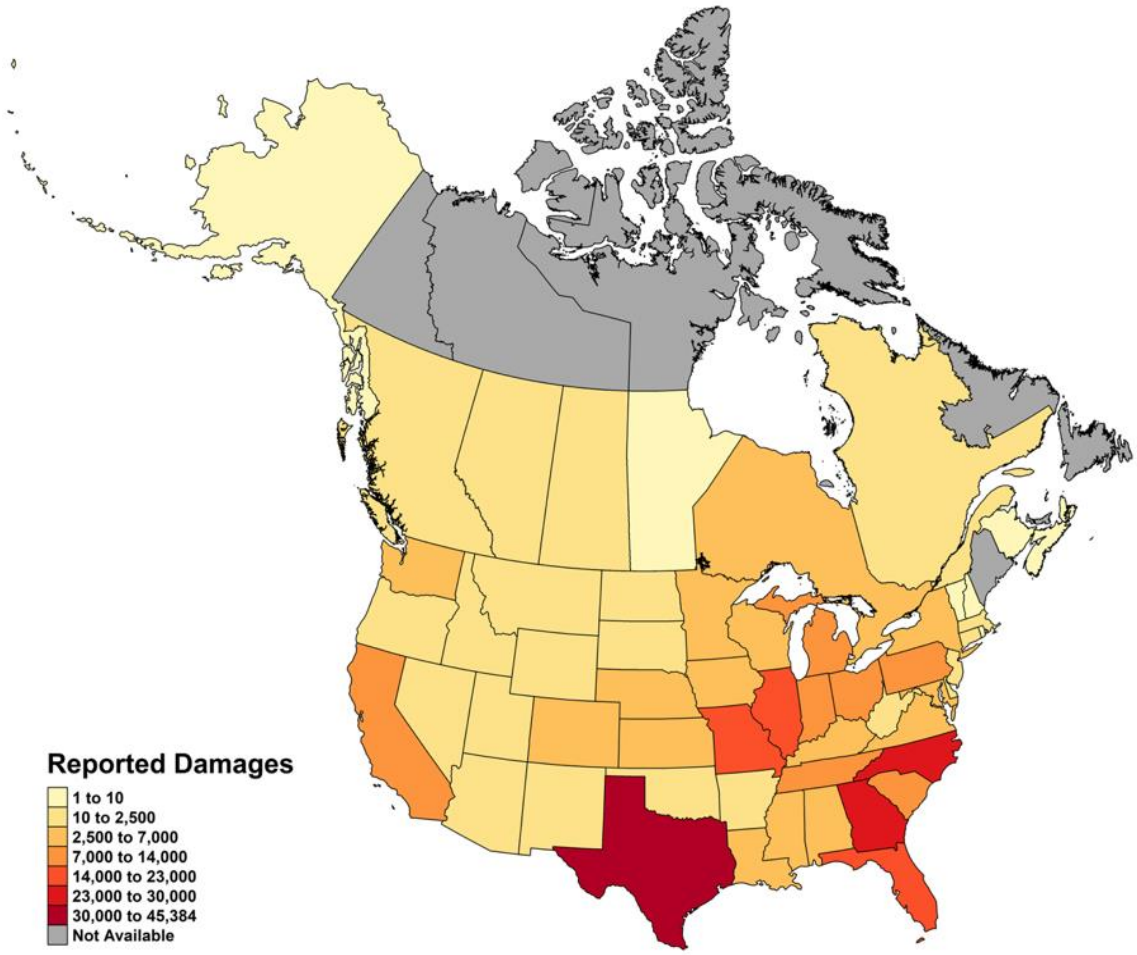


Figure 5—Map of reported damages, 2017

# REPORTING STAKEHOLDERS

The reporting stakeholders are the entities collecting the information into DIRT. Note: As part of the revision to the DIRT form effective January 1, 2018, "Reporting Stakeholder" is changed to "Original Source of Event Information." Figure 6 summarizes damages for 2017 by reporting stakeholders for Canada and U.S. combined. The stakeholder reporting the highest number of damages is Locator (207,587 or 66% of events) followed by Natural Gas (52,233 or 16% of events). See Appendix B for a detailed breakdown of damages by all reporting stakeholders.

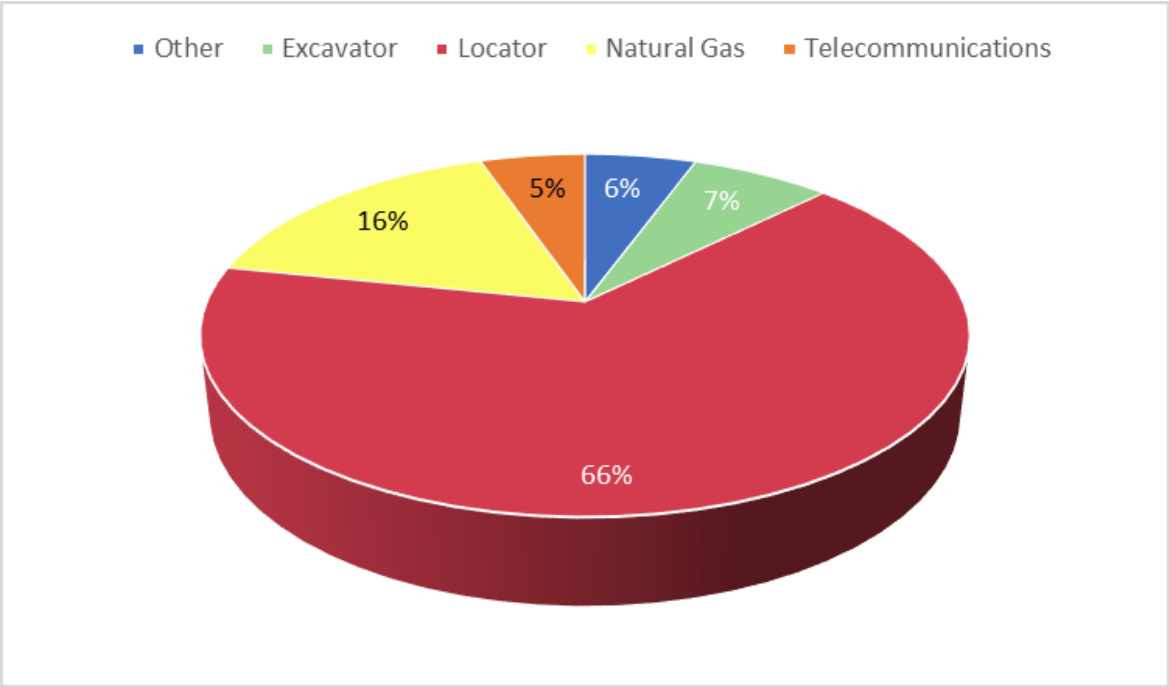


Figure 6—Damages by reporting stakeholders in Canada and the U.S., 2017

## Reporting Stakeholder Over Time

To allow for a comparison of reporting stakeholder over time, Figure 7 presents data for consistently reporting stakeholders. As can be seen in this figure, Locator has been by far the most significant reporting stakeholder over the last three years, with year-over-year increases in the number of reported damages. Note: As part of the revision to the DIRT form effective January 1, 2018, One Call and Insurance will be removed as selections.

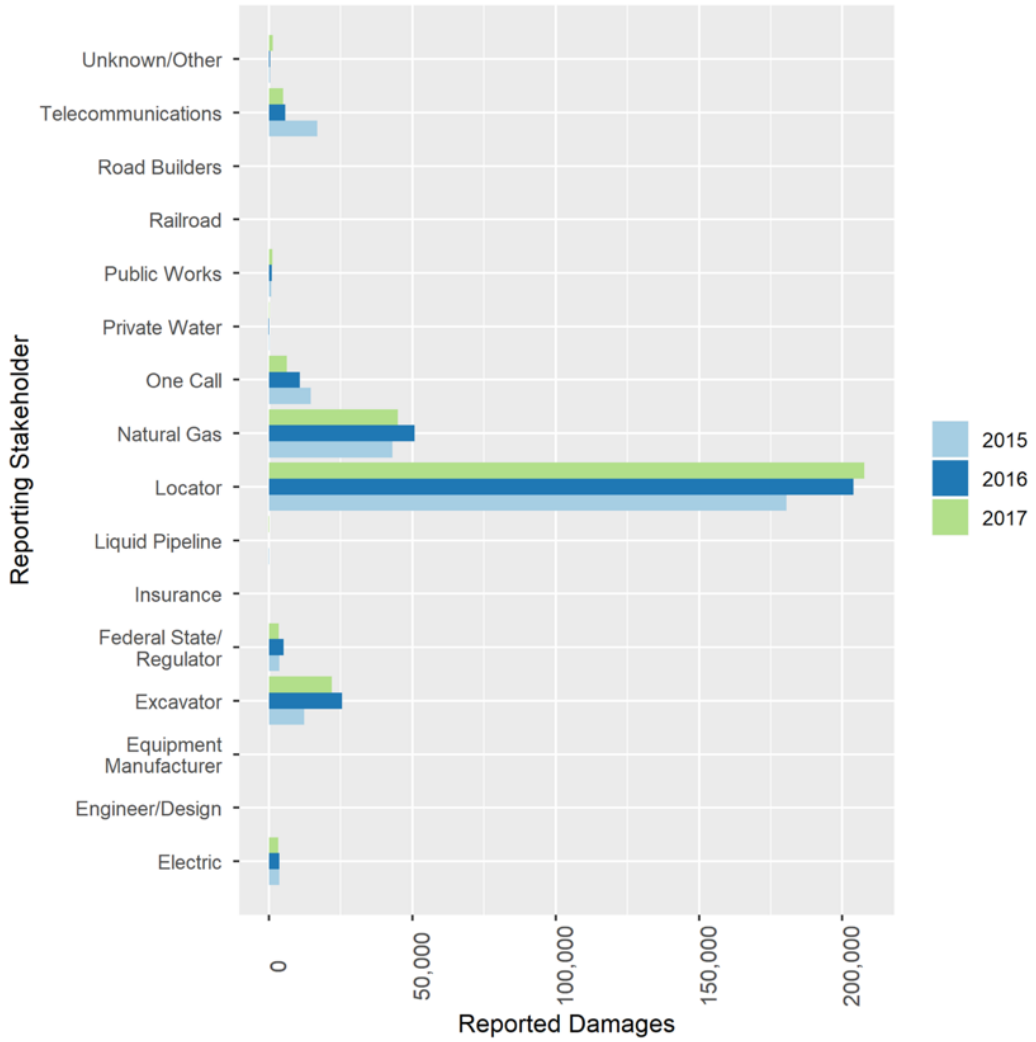


Figure 7—Reported damages by reporting stakeholder for consistently reporting stakeholders in Canada and the U.S., over time

# ROOT CAUSE

This section of the report presents data trends for root cause. Because the unknown data related to root cause is relatively small (see *Understanding the Data*, A Note About Unknown Data), the data and trends in this section are centered around the known data.

Figure 8 demonstrates the breakdown of root cause for damage events. The most commonly listed root cause in 2017 was Other Insufficient Excavation Practices[5] (32%). This was followed by No Notification *Made to the One Call Center* (24%).

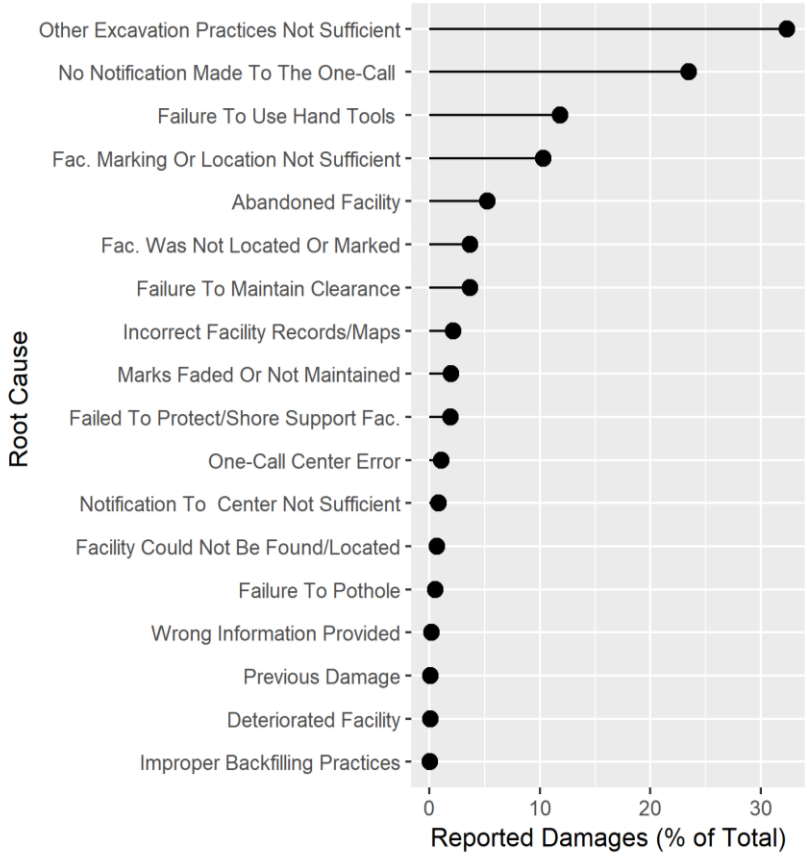


Figure 8—Reported damages by root cause, known data, in Canada and the U.S., 2017

[5] This root cause is intended to be a last resort after considering the other more specific excavation-practice choices, such as Failure to Maintain Clearance, Failure to Pothole, or Marks Faded or Not Maintained.

## Root Cause by Group

To provide a higher-level overview of the root causes, the Data Committee groups root causes into major groups as per Table 5, demonstrating that the leading root cause group is Excavation Practices Not Sufficient. This group accounts for 142,980 damages. See Appendix C for grouping definitions.

Table 5—Reported damages by root cause group, known data, in Canada and the U.S., 2017

| Root Cause Group | Total Damages |
|---|---|
| Excavation Practices Not Sufficient | 142,980 |
| Notification Not Made | 64,189 |
| Notification Practices Not Sufficient | 5,645 |
| Locating Practices Not Sufficient | 46,056 |
| Miscellaneous | 14,758 |
| Total Damages[6] | 273,628 |

The significant contribution of Excavation Practices Not Sufficient to total damages is also demonstrated in Figure 9. Over half of the plot is attributed to this root cause group.

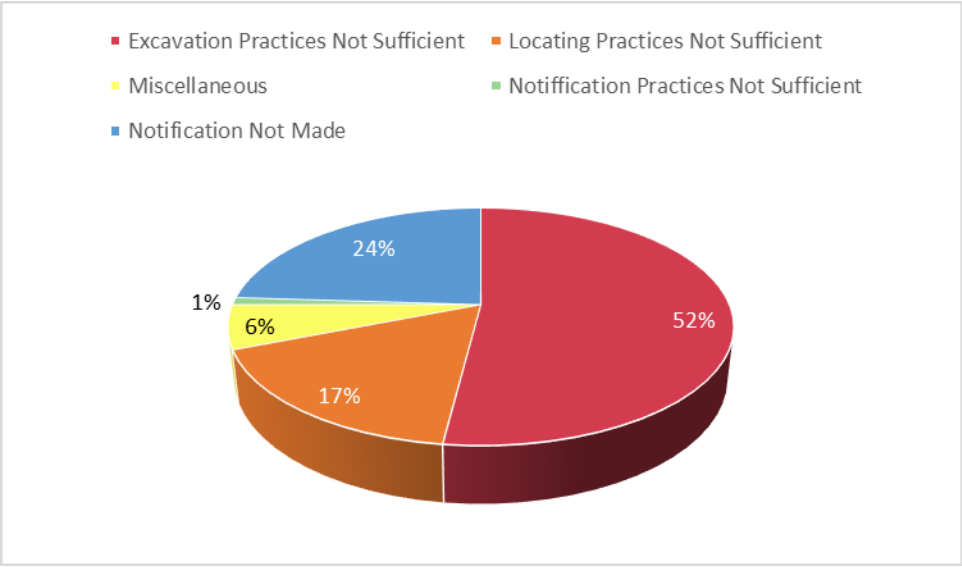


Figure 9—Reported damages by root cause group, known data, in Canada and the U.S., 2017

[6] Total reported damages (after consolidating multiple records of the same event) were 316,442, of which 42,814 had an unknown for root cause, leaving 273,628 with known root causes.

## Root Cause by Reporting Stakeholder

Figure 10 shows some significant differences in the root cause group percentages by reporting stakeholder (with total damages (*n* = xx) by reporting stakeholder labeled at the top of the figure). When interpreting the graph, this number should be considered. Where *n* is low, the distribution of root causes by that reporting stakeholder provides little insight because the number of reported damages is insignificant. For instance, the number of damages provided by Engineer/Design, Equipment Manufacturers, Insurance, Railroad, and Road Builders are likely too small to draw any solid conclusions. Figure 10 demonstrates that Natural Gas and Telecommunications have very similar distributions. For Excavators, Locating Practices Not Sufficient is by far the most reported root cause group, whereas for Locators it's much lower. One call centers also report a relatively high percentage of Locating Practices Not Sufficient. This may be caused by several one call centers that take "damage tickets" from excavators and submit them as DIRT reports.

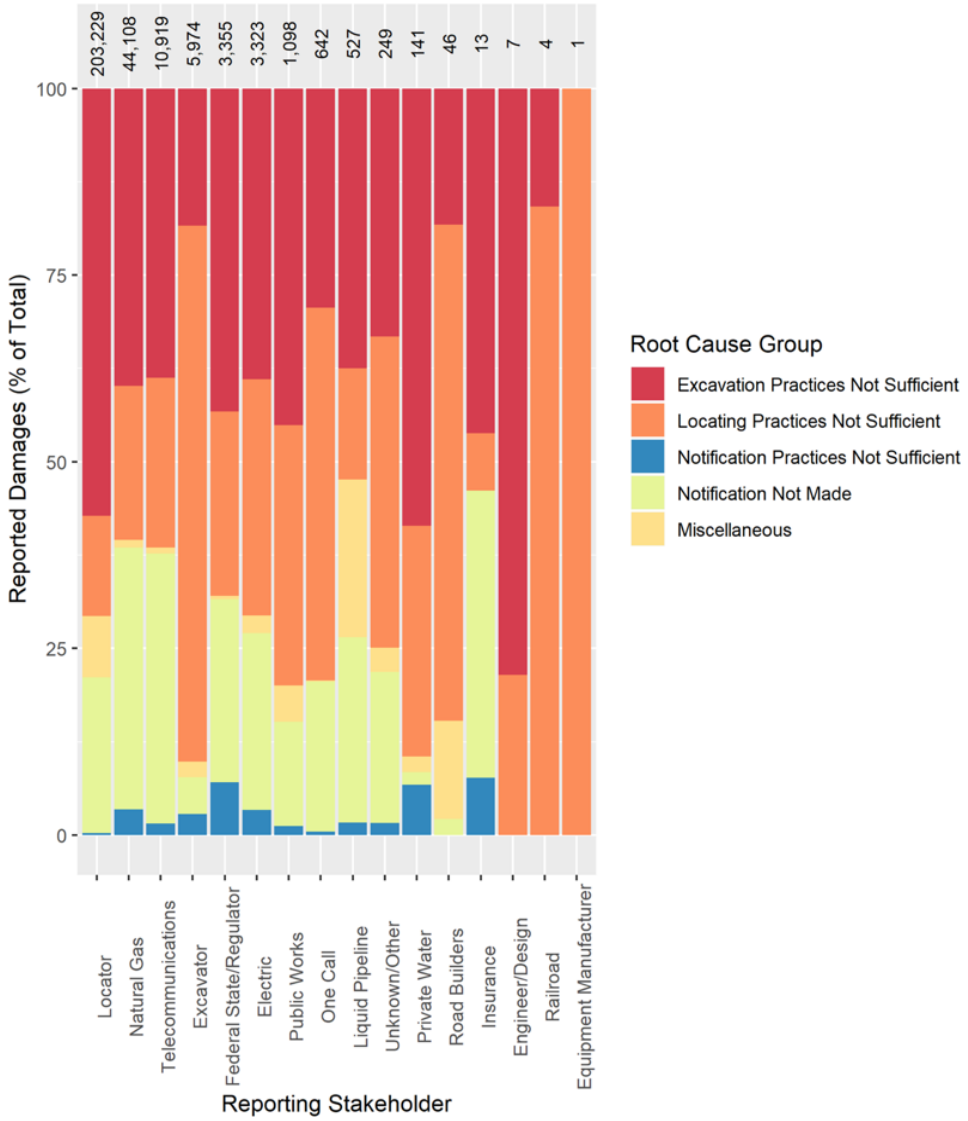


Figure 10—Root cause groups to total damages by reporting stakeholder, known data, in Canada and the U.S., 2017

## Root Cause Over Time

To allow for a comparison over time, Figure 11 presents root cause groups for consistently reporting stakeholders. Here, both known and unknown data are presented. The most frequently cited root cause groups in the last three years are Notification Not Made and Excavation Practices Not Sufficient. Although Excavation Practices Not Sufficient declined as a root cause between 2016 and 2017, Notification Not Made increased. It is encouraging that Unknown/Other continues to trend downward.

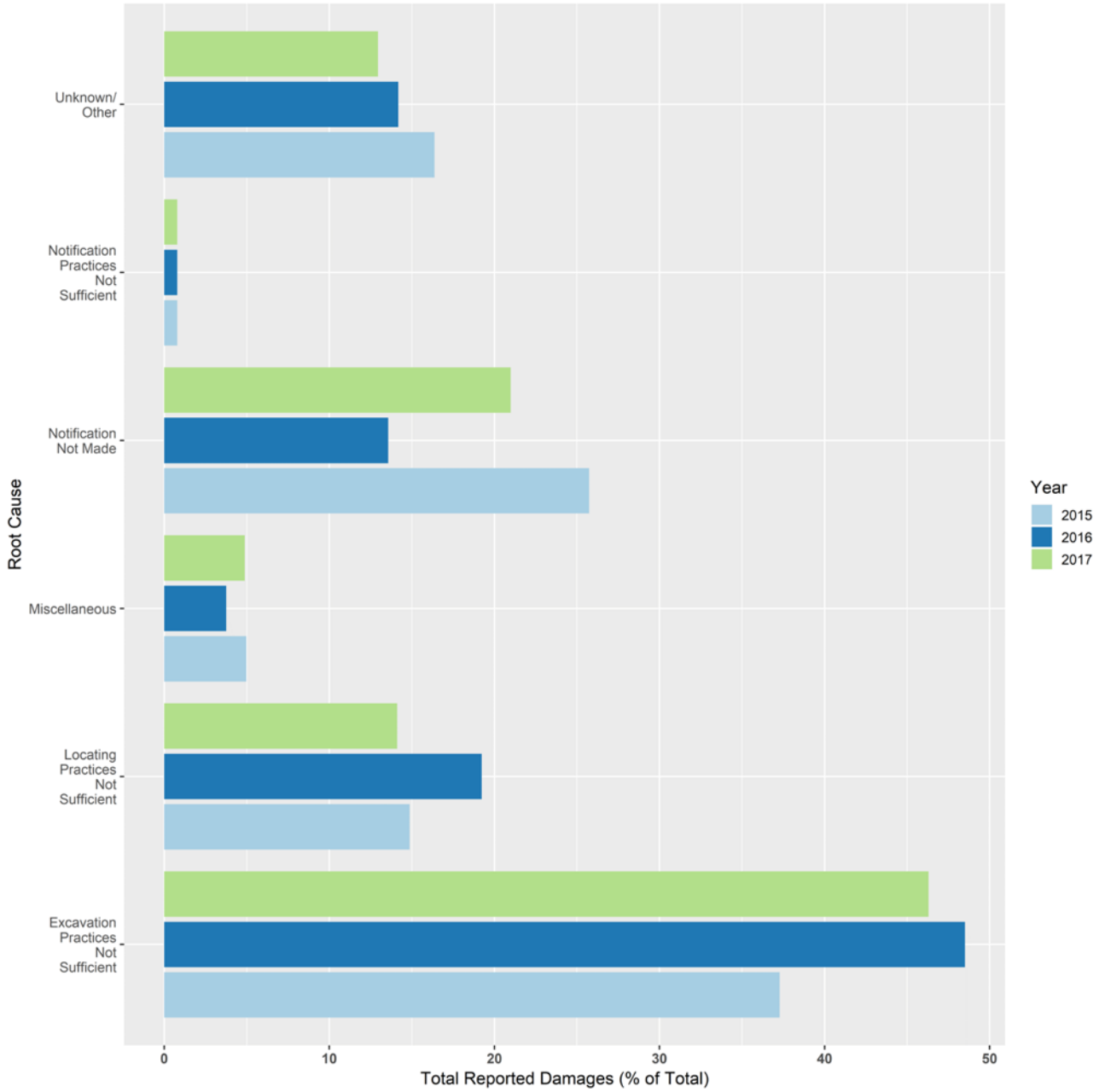


Figure 11—Root cause by group for consistently reporting stakeholders, in Canada and the U.S., over time

The Notification Practices Not Sufficient group covers events where an 811 notice was made (or attempted) but something went wrong, such as a wrong description of the work site that led to no marks at the actual work site, or an excavator did not provide sufficient advance notice in accordance with the local rules or began work before the marks were completed. These typically account for around 1% of the total damages. As part of the revision to the DIRT form effective January 1, 2018, the root causes are revamped to more easily capture such scenarios.

Because the total must always add to 100%, a decrease in one group will be offset by an increase in another. It appears that the distribution of root cause groups for 2017 is similar to that of 2015 and prior years, and 2016 may have been an anomaly, especially regarding Notification Not Made.

Past DIRT reports can be accessed at

http://commongroundalliance.com/media-reports/dirt-reports

# EXCAVATOR TYPE

This section describes the type of excavator, type of work performed, and type of equipment involved in damages. Figure 12 presents damage information by excavator type clearly demonstrating the significant involvement of Contractors (32%). The high number of unknowns is also obvious at 54%. This is an indication of the strength of the data for excavator type, which, when compared to root cause data, appears to be relatively more uncertain.

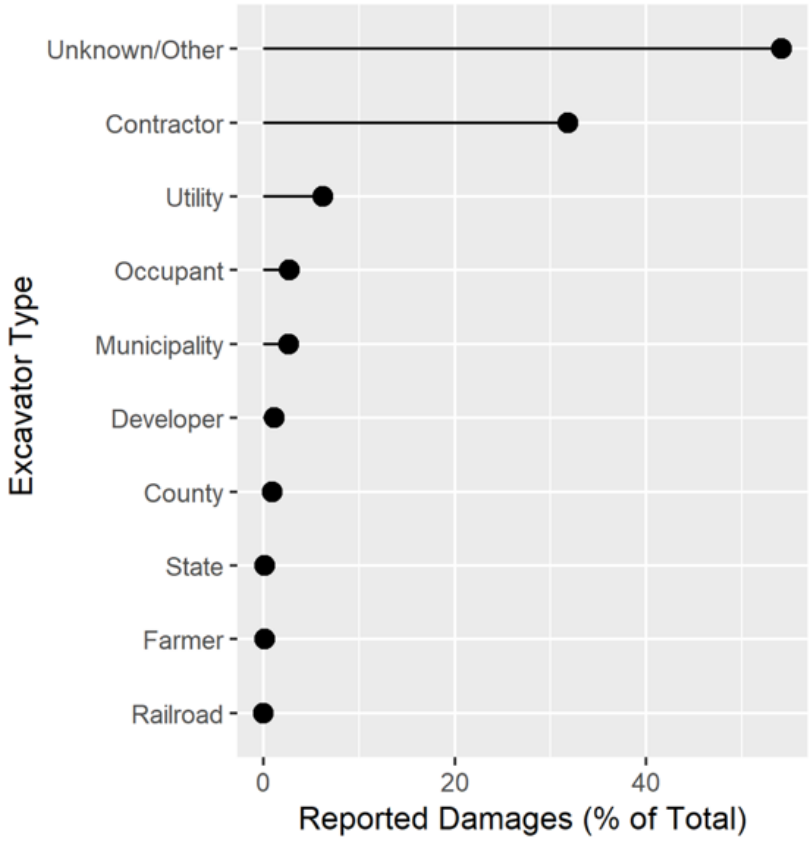


Figure12—Total damages by excavator type, all reported data, in Canada and the U.S., 2017

Because of the significant contribution of unknown data to the excavator dataset, in the sections below, unknown excavator type data is included in the presentation of the data unless otherwise noted.

## Excavator Type by Type of Work Performed and Equipment Used

For this section of the report, data for excavator type, work performed, and excavation type (i.e., equipment used) was cross-tabulated with and without unknown data. Appendix D shows the top 20 combinations of excavator type, work performed, and equipment used ranked by number of reported damages. The appendix highlights the large proportion of unknown data in the excavator dataset (120,152 damages in the DIRT database are associated with an unknown excavation type). Table 6 demonstrates the top 10 combinations of excavators, work performed, and equipment used, excluding combinations with one or more unknown data points. The leading combinations with known data are Contractors doing Sewer or Water work using Backhoes/Trackhoes.

Table 6—Top 10 combinations of excavator, work performed, and equipment used, known data, in Canada and the U.S., 2017

| Excavator | Work Performed | Equipment Used | Reported Damages |
|---|---|---|---|
| Contractor | Water | Backhoe/Trackhoe | 4,812 |
| Contractor | Sewer | Backhoe/Trackhoe | 4,624 |
| Contractor | Cable TV | Trencher | 2,555 |
| Contractor | Water | Trencher | 2,376 |
| Contractor | Electric | Backhoe/Trackhoe | 2,262 |
| Contractor | Sewer | Trencher | 2,219 |
| Contractor | Natural Gas | Trencher | 2,104 |
| Contractor | Natural Gas | Backhoe/Trackhoe | 2,056 |
| Contractor | Fencing | Auger | 1,709 |
| Contractor | Bldg. Construction | Backhoe/Trackhoe | 1,627 |

Figure 13 demonstrates the relationship between excavator and work performed groups graphically. See Appendix C for grouping definitions. The significant number of damages attributable to Contractors across a range of work performed is evident as is the significant number of damages associated with unknown excavators.

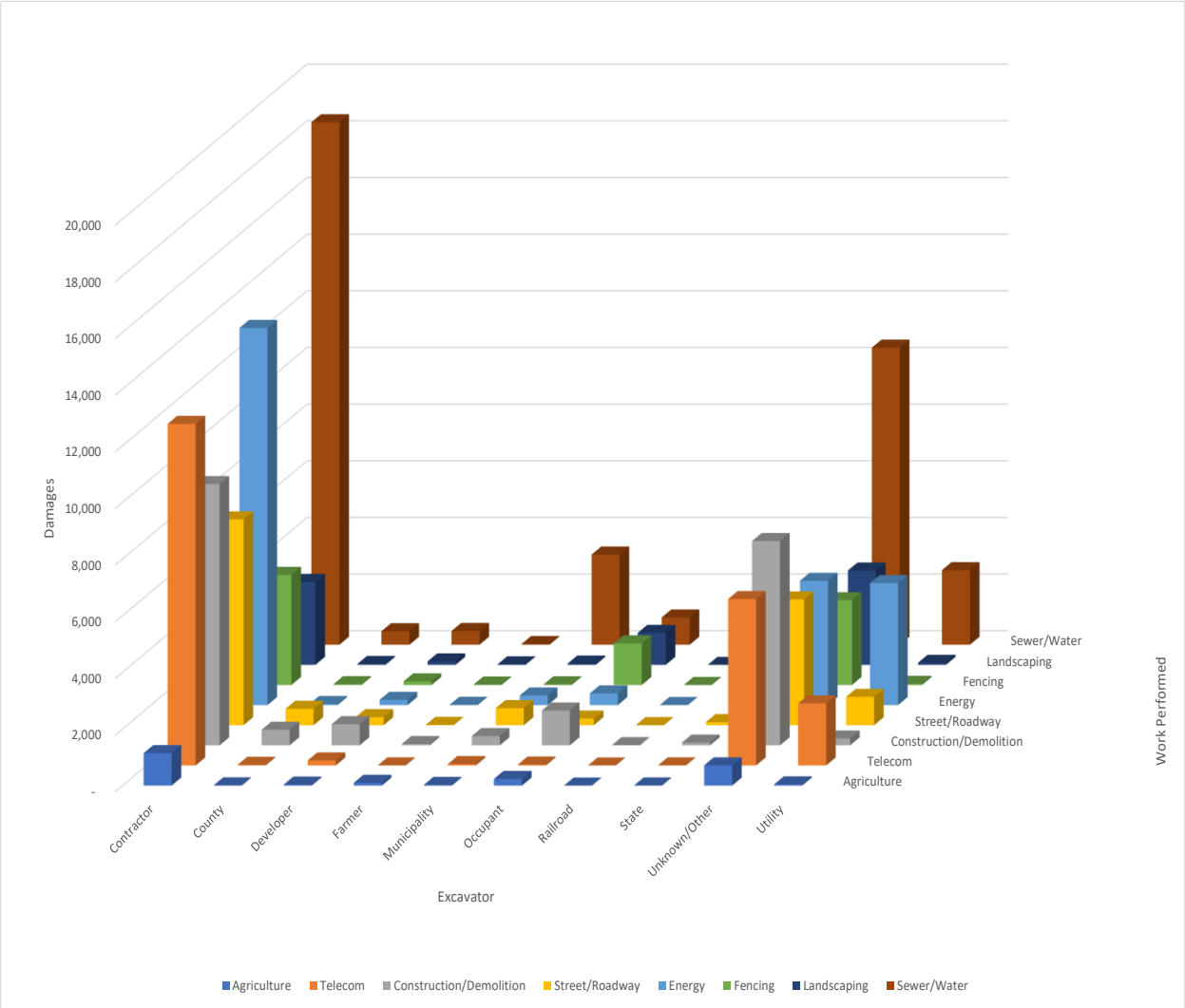


Figure 13—Reported damages by excavator and work performed in Canada and the U.S., 2017

The relationship between type of equipment used by excavators can also be examined graphically (Figure 14). A similar trend can be seen here, with a significant number of damages attributable to Contractors across a range of equipment types.

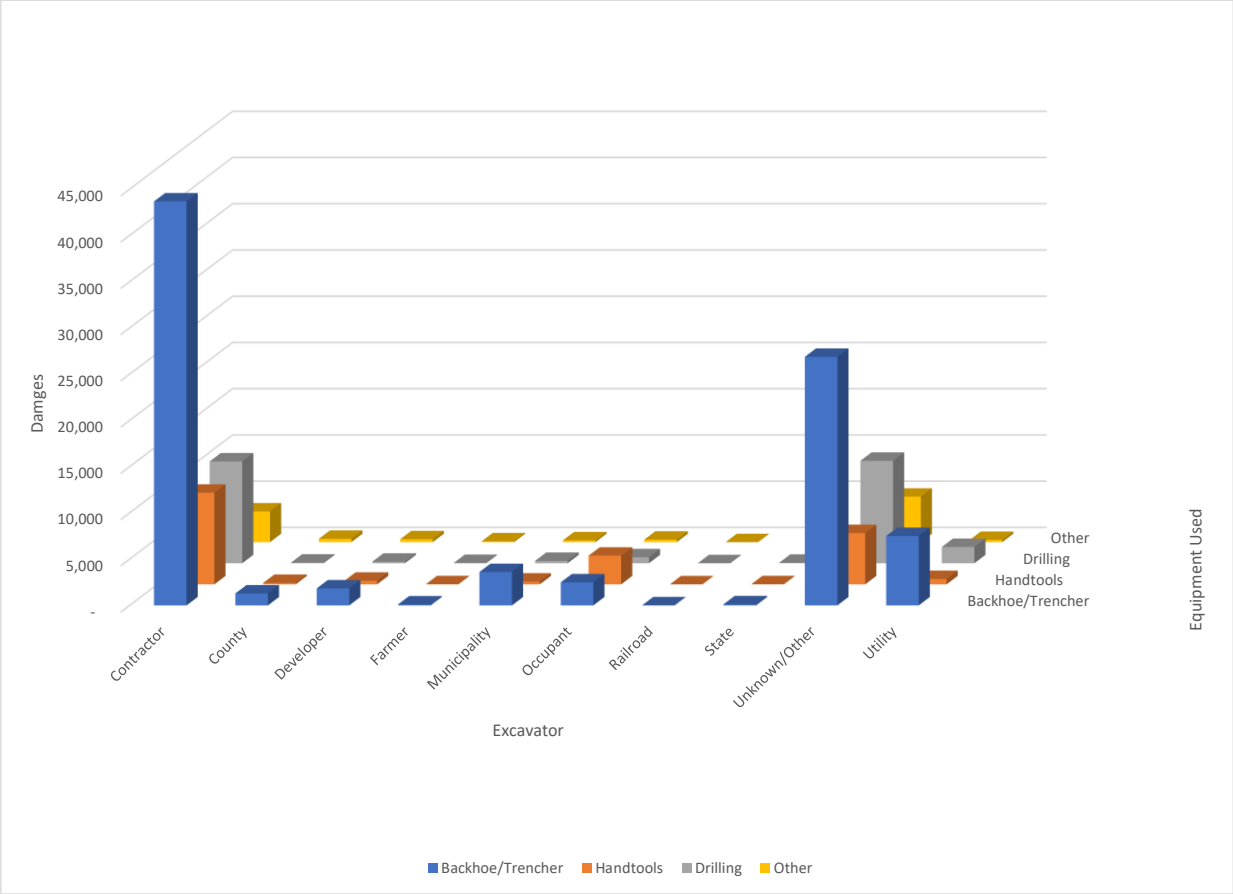


Figure 14—Reported damages by excavator and equipment used in Canada and the U.S., 2017

## Excavator Type by Root Cause

Figure 15 shows the root cause groups by type of excavator involved. As can be seen in the figure, Excavation Practices Not Sufficient (shown as the red bars) is the leading cause of damages for most excavator types in 2017.

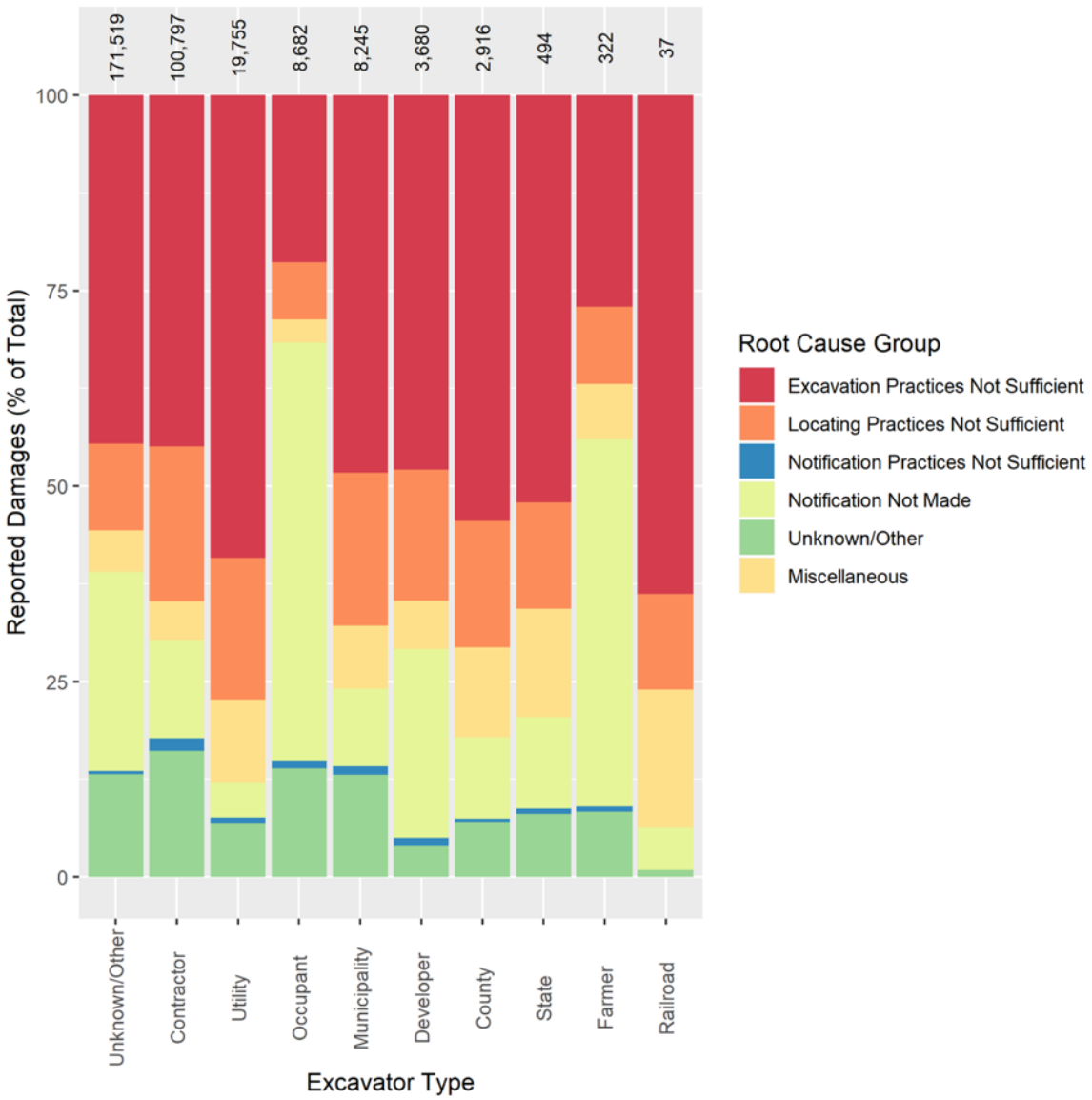


Figure 15—Damages by excavator type and root cause group, all reported data, in Canada and the U.S., 2017

## Excavator Type Over Time

Figure 16 shows the trend in damages by excavator type over time, focusing on consistently reporting stakeholders. Between 2015 and 2017, Contractor and Unknown/Other have remained the main excavator types with the contribution of the unknown data increasing from 2016 to 2017 and Contractor declining over the same period.

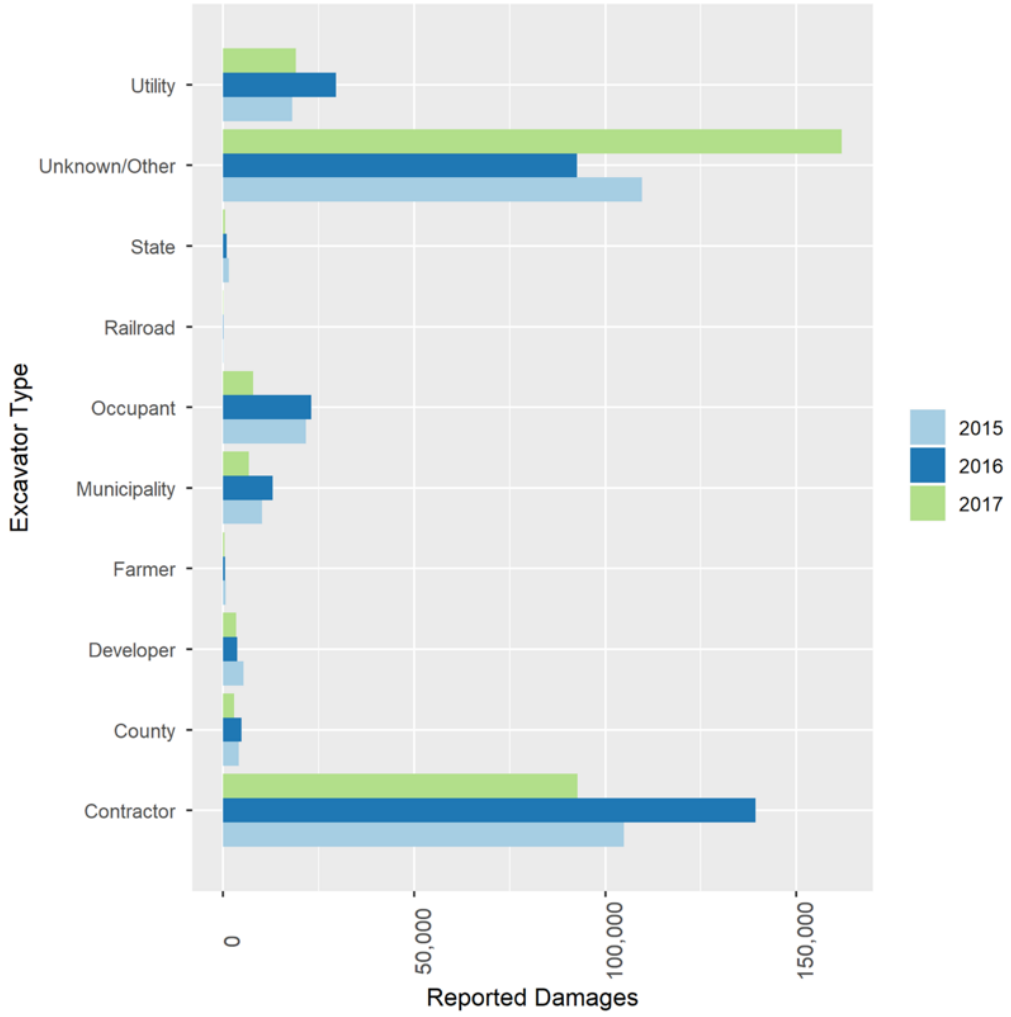


Figure 16—Damages by excavator type for consistently reporting entities in Canada and the U.S., 2015 to 2017

# FACILITIES AFFECTED AND DAMAGED

Figure 17 shows reported damages by facility damaged for known data (unknown data is excluded due to the relatively low contribution—about 5% of all reported damages). In 2017, the most commonly damaged facility was Telecommunications (49%). This was followed by Natural Gas (28%) and Cable Television (11%).

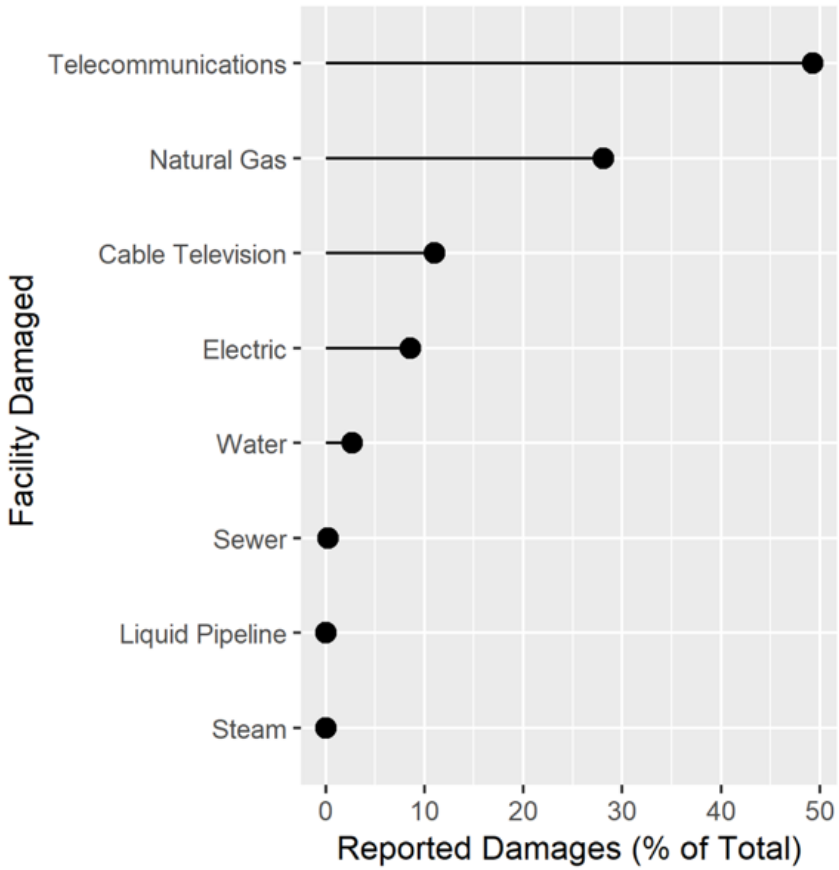


Figure 17 - Reported damages by facility damaged, known data, in Canada and the U.S., 2017

The type of affected facilities includes Distribution, Service Drop, Transmission, and Gathering. Figure 18 demonstrates the relationship between facilities affected and facilities damaged. The majority of reports involve Telecommunications and Natural Gas Service/Drops and Distribution.

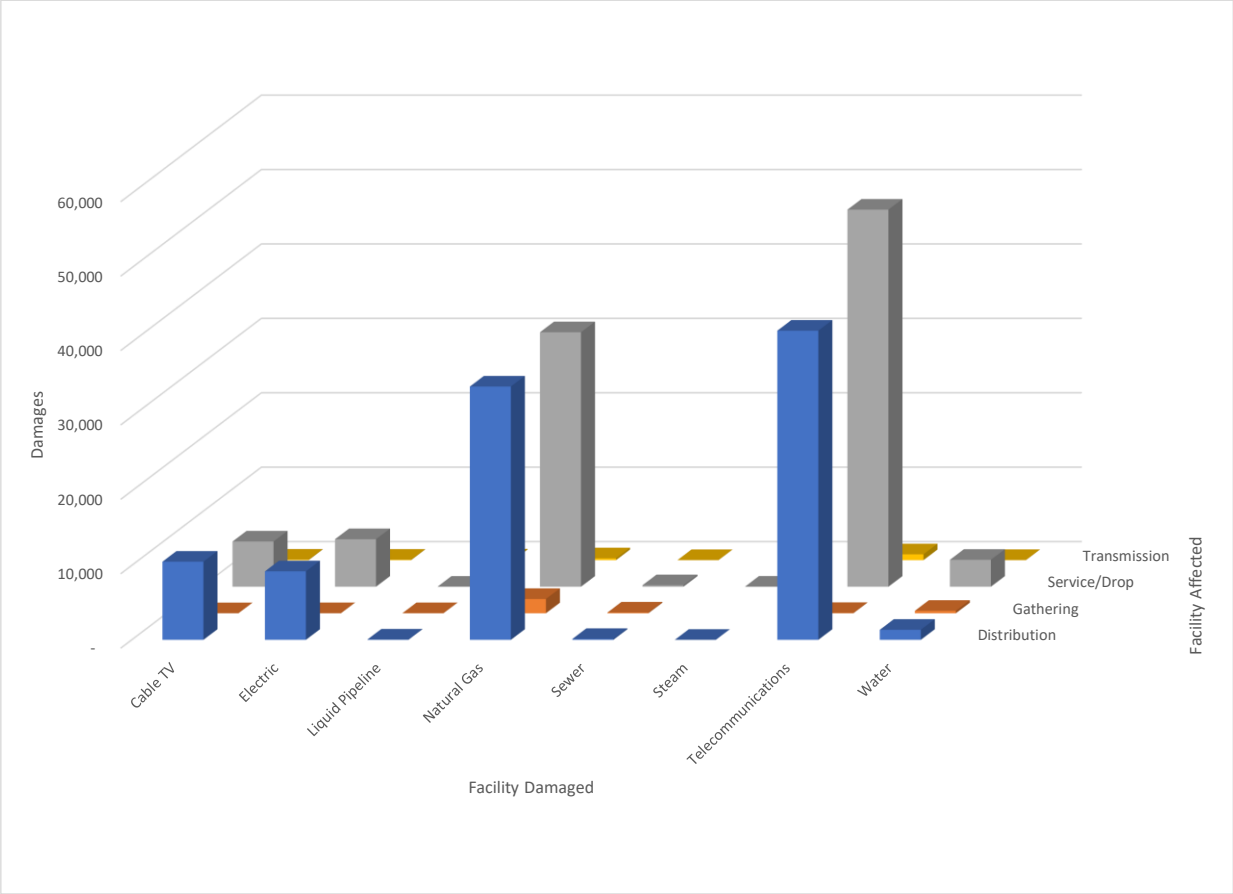


Figure 18 - Reported damages by facility damaged and facility affected, known data, in Canada and the U.S., 2017

## Facilities Damaged by Reporting Stakeholder

The type of facility damaged varies by reporting stakeholder. Excavators report 91% (10 of 11) of damages to Steam, 50% of damages to Sewers, 30% of damages to Water, and 10% of damages to Electric Facilities. Locators report 81% of damages to Telecommunications and Cable Television, 69% of damages to Electric Facilities, 50% of damages to Water, and 33% of damages to Natural Gas Facilities. Liquid Pipeline and Natural Gas reporting stakeholders do the most self-reporting of their own damaged facilities. Liquid Pipeline stakeholders entered 74% of the damages to Liquid Pipelines, while Natural Gas stakeholders reported 59% of the damages to Natural Gas Facilities.

## Facilities Damaged by Root Cause

Figure 19 demonstrates the relationship between damaged facilities and root cause. Excavation Practices Not Sufficient is the dominant root cause for most damaged facilities (Cable Television, Natural Gas, Electric, Telecommunications, Water). For Liquid Pipelines, Notification Not Made is the dominant root cause.

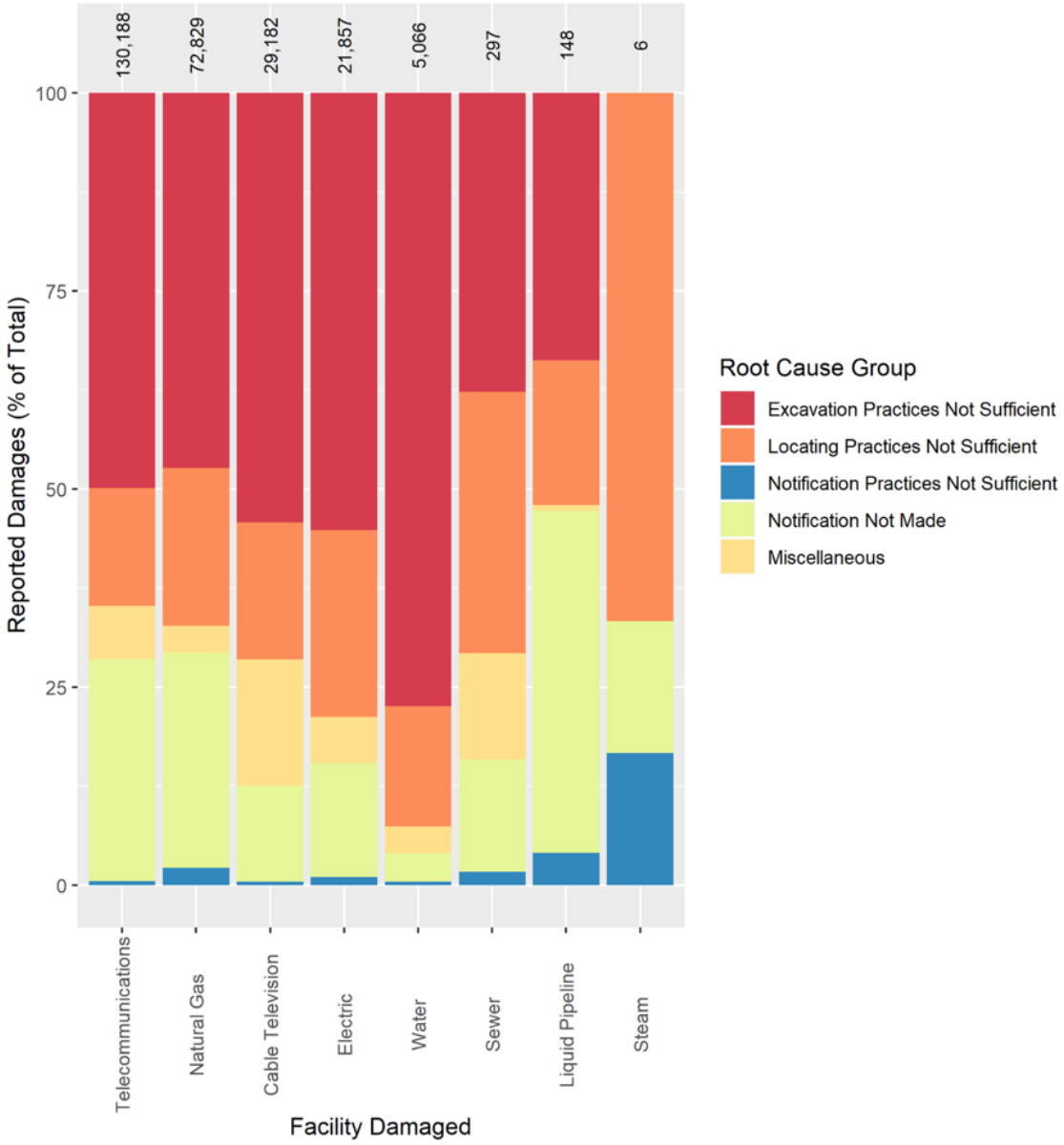


Figure 19—Reported damages to facilities damaged by root cause, known data, in Canada and the U.S., 2017

## Facilities Damaged Over Time

Facilities damaged for consistently reporting stakeholders over time is presented in Figure 20. Here, known and unknown data are presented. The figure demonstrates the significant contribution of damages to Telecommunications and Natural Gas in the last three years, with an increase in reported damages to Telecommunications between 2016 and 2017 and a decrease in reported damages to Natural Gas over the same period. The decline in the contribution of unknown data between 2016 and 2017 is a promising trend.

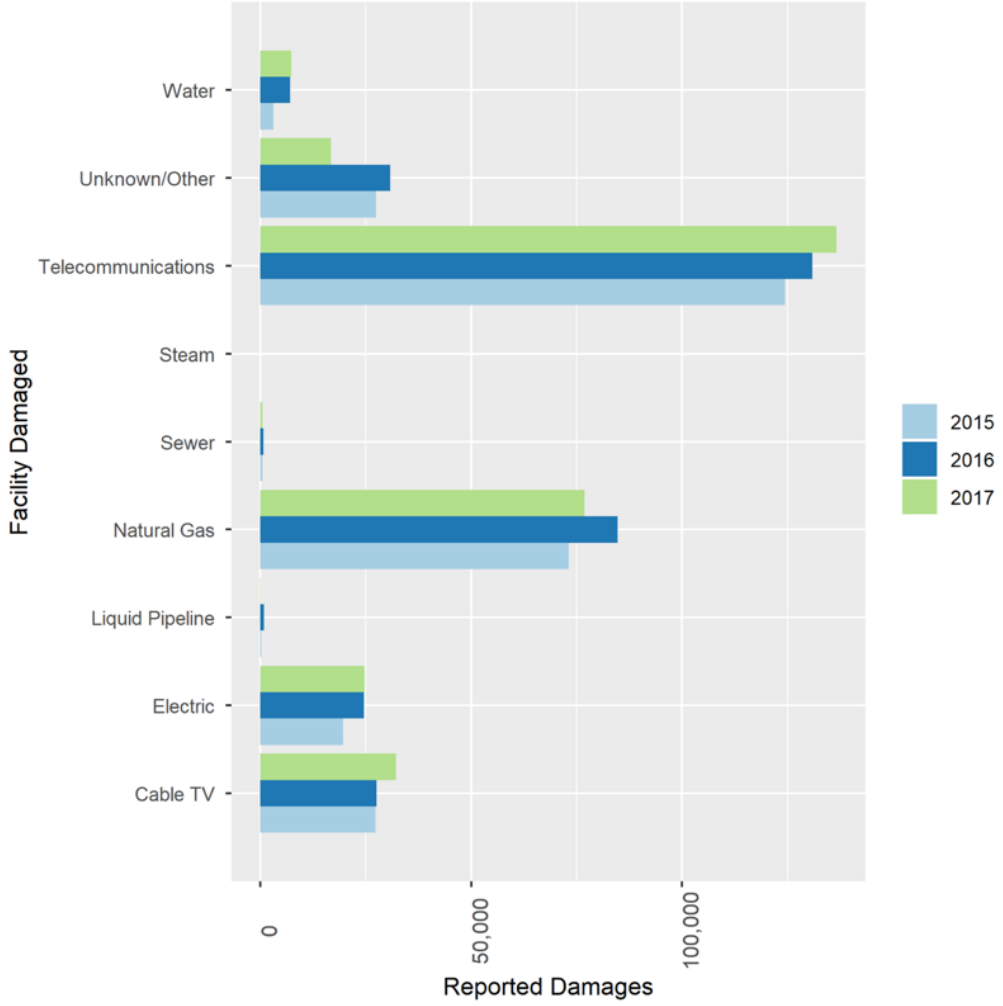


Figure 20—Reported damages by affected facilities for consistently reporting entities, in Canada and the U.S., 2015 to 2017

# CALL BEFORE YOU DIG AWARENESS

Each year a national survey is conducted to test the use and awareness of call before you dig (CBYD), including 811, services. The survey focuses on census regions within the U.S. as shown in Figure 21.

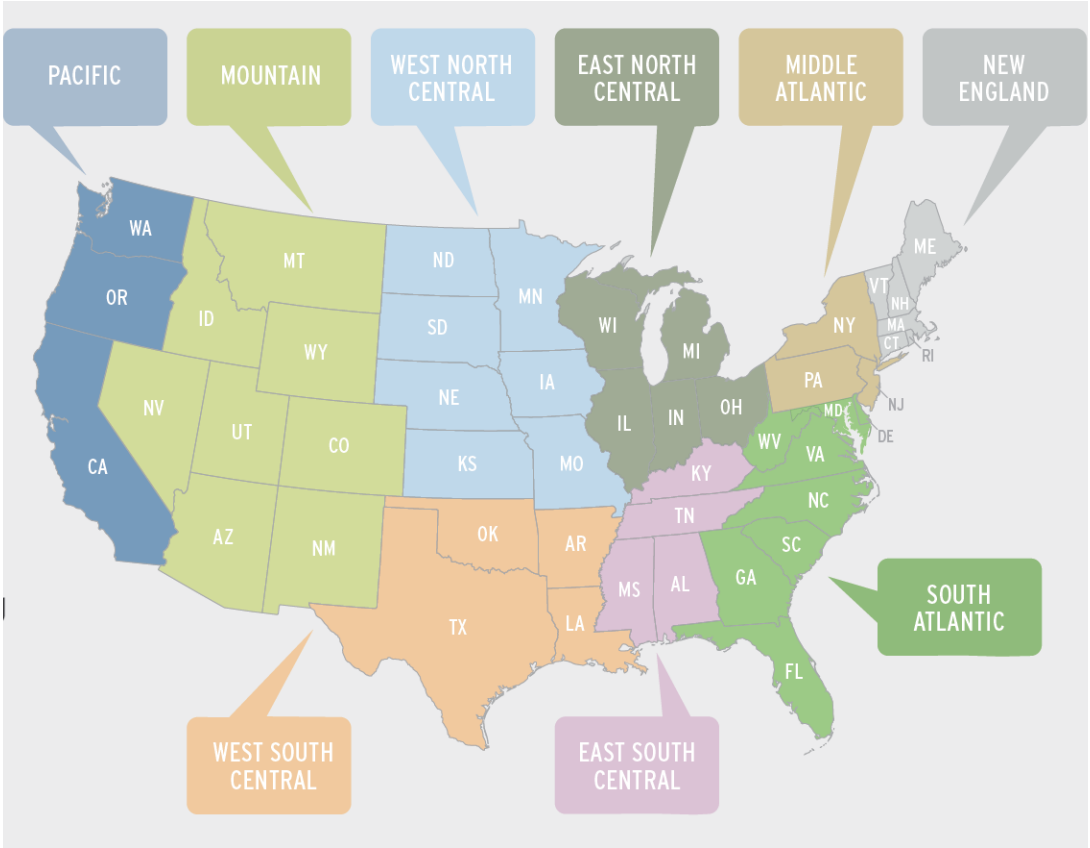


Figure 21—Census regions used in the annual call before you dig survey

This section of the 2017 DIRT report considers the trends in CBYD use and awareness from the 2017 and 2018 surveys in relation to reported damages on a regional basis. Figure 22 presents survey results, along with the trend in reported damages for residential stakeholders (excavator type labeled Occupants in the DIRT database). This is the most relevant stakeholder group in relation to the survey, which is focused on the general population and is thus unlikely to capture a high proportion of damage prevention industry stakeholders.

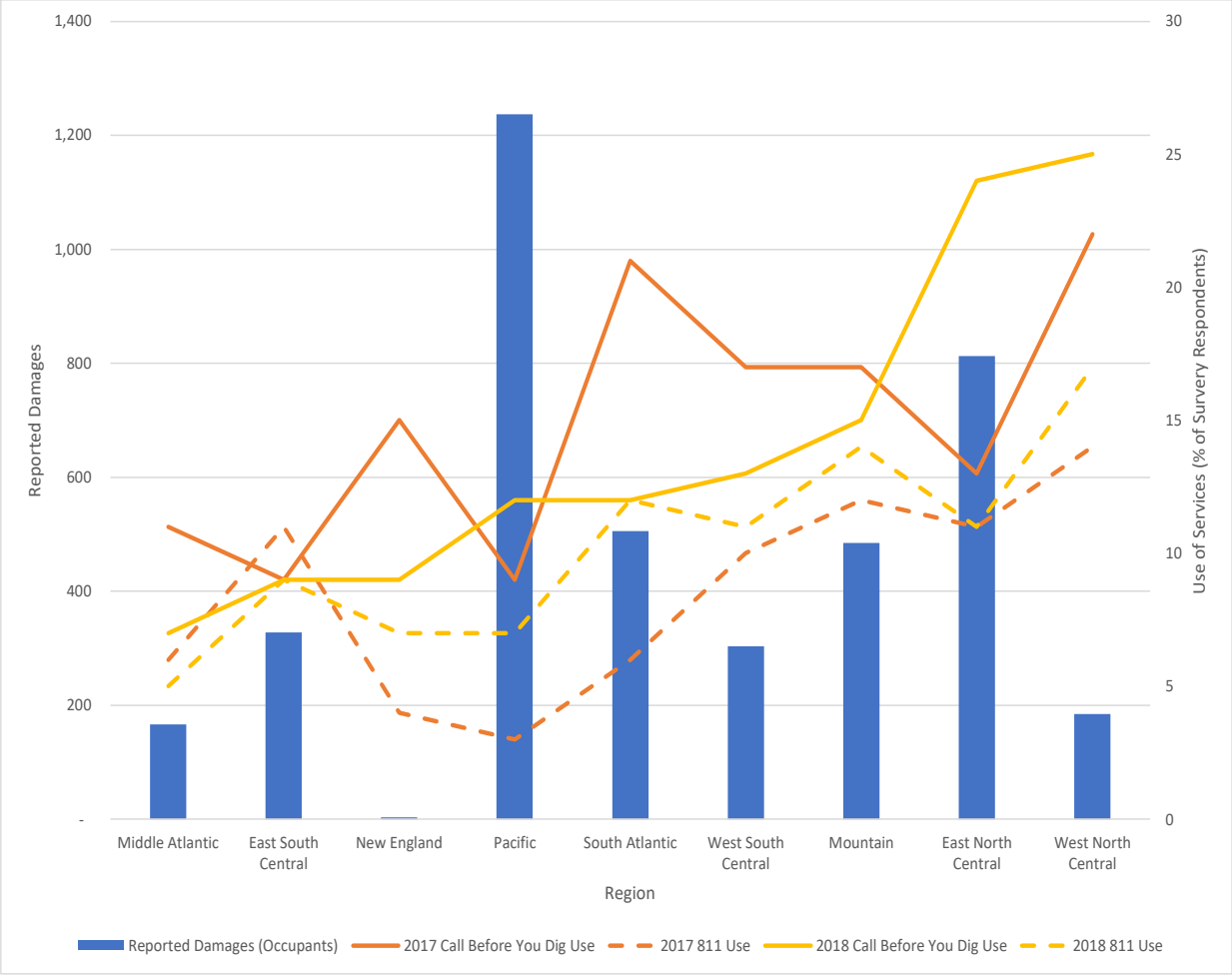


Figure 22—Use of CBYD and 811 services in 2017 and 2018 in relation to 2017 damages with Occupant as excavator type

Ideally, one would like to see an inverse relationship between damages and use of CBYD services; the lower the damages, the higher the use of CBYD services and vice versa. Such a relationship is indeed observed in several census regions (i.e., Pacific, South Atlantic, West North Central, and West South Central).

Figure 23 demonstrates survey results for awareness of CBYD services in relation to damages due to Notification Not Made. Here again one would hope to see an inverse relationship between the two sets of variables, such that lower damages due to Notification Not Made correlate with higher awareness of CBYD services, and vice versa. This relationship appears to exist in West North Central, East South Central, West South Central, and Middle Atlantic.

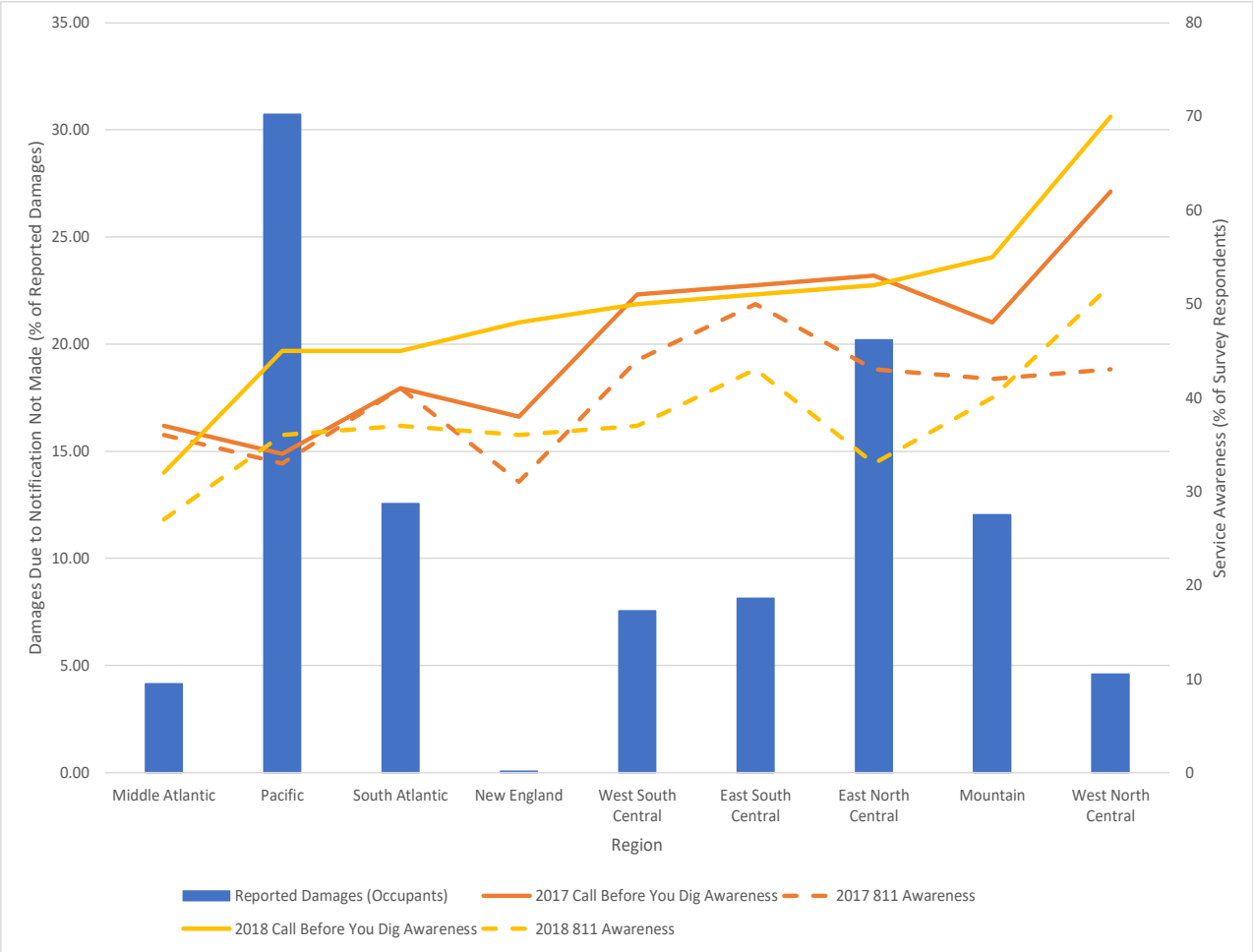


Figure 23 - Awareness of CBYD and 811 Services in 2017 and 2018 in relation to 2017 damages due to Notification Not Made

# CONCLUSION

This report summarizes the damage data submitted via DIRT in 2017. Damage data is presented over time and geographically. Cross tabulations of the data demonstrate the relationships between key variables (e.g., root cause of reported damages by reporting stakeholder). The DIRT database is a highly useful source of data and information pertaining to damage events in Canada and the U.S. The details contained within the database are critical for guiding education, awareness, and damage prevention initiatives.

To ensure that maximum value is derived from each event entered into DIRT, efforts should be directed toward minimizing the amount of "unknown" data entries. This is particularly a concern for excavator type where the proportion of the unknown data is significant. Investing in training and awareness around DIRT and how to use it may reduce the amount of unknown data, allowing for more informed conclusions to be drawn on data trends and characteristics in the future.

To inform conclusions on the extent to which stakeholders are employing DIRT, it would be useful to have a reliable estimate of the size of the potential user base that exists in Canada and the U.S. Knowing the total potential user base could have a significant impact on understanding and interpreting the trends and characteristics of the DIRT data.

Because submissions to DIRT are largely undertaken on a voluntary basis, it is difficult to interpret trends in reported damages over time. Changes from one year to the next may be due to a change in actual damages or due to a change in the number and combination of stakeholders employing DIRT. To allow for comparisons in damages over time with a high degree of confidence, this year's report presents time trends for consistently reporting stakeholders—stakeholders that have been employing the database on a consistent basis over the last three years. The damages reported by the consistently reporting stakeholders represent a significant portion of the total damages reported through DIRT. This means that the trends in damages over time from the consistently reporting stakeholders are a solid representation of the trend in total damages. This also implies that a high proportion of stakeholders that were reporting in 2015 are still reporting in 2017. Furthermore, the difference between the two datasets (total reported damages versus damages reported by consistently reporting stakeholders), is minimal but has increased since 2015. The increase could be attributed to either a decline in damages from the consistently reporting stakeholders, or a growing number of other stakeholders reporting through DIRT.

In 2018, a refined approach was employed to identify the subset of states deemed to be substantially reporting damage events. The new resulted in 10 states qualifying as substantially reporting. These states were used to estimate the total number of damage events taking place in the U.S. for 2015, 2016, and 2017.

# APPENDIX A: 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 the DIRT database 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 in the U.S. 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 in the following sections.

## Substantially Reporting States

The first step in the process was to establish a consistent method to identify a substantially reporting state. While actual damages are unknown for all states, for the purpose of guiding this assessment, a target of reporting at least 70% of actual damages was defined.

To establish whether a state meets this threshold, a certainty scoring process was employed. Damages were divided into seven groups according to the facility damaged: cable tv, electric, liquid pipeline, natural gas, sewer, telecommunications, and water. For each facility damage group, states were ranked on a scale and assigned points as follows: 'Likely or definitely substantially reporting' = 1 point, 'Maybe substantially reporting' = 0.5 points, 'Definitely not substantially reporting' = 0 points. Weightings were determined largely through expert opinion and by considering the following variables:

- Percentage reported via Virtual Private DIRT applications
- The existence of damage reporting legislation
- The combination of reporting stakeholders

Points for each state were then summed across damage facility groups. The total possible score for a given state was seven points. The initial scoring was then verified through a series of one-on-one discussions with subject matter experts in the individual states. Through those discussions, several state scores were adjusted and refined. Ten states, listed below, scored more than four of the seven points. For the purpose of producing a predictive model, two cut-offs for what qualifies as a substantially reporting state were explored:

- 4 out of 7 points, capturing the top 10 states
- 4.5 out of 7 points, capturing the top 5 states

Table A1 - Substantially reporting states and their score

| State | Score |
|---|---|
| Georgia | 6.5 |
| Pennsylvania | 5.5 |
| New Mexico | 5.0 |
| Illinois | 4.5 |
| Kansas | 4.5 |
| Colorado | 4.0 |
| Florida | 4.0 |
| Texas | 4.0 |
| Virginia | 4.0 |
| Connecticut | 4.0 |

While this new process has yielded some excellent new insight into which states are "substantially reporting," it is possible that even those states chosen may not have achieved the benchmark goal of 70% reporting. However, the process does establish a continuum of states, from low to high, of DIRT reporting that reflects damages occurring in those states. Through the process, there was a general consensus that sewer and water damages are under-reported everywhere, and natural gas and telecommunications are fairly well represented.

## Statistical Method

The predictive model was built using data associated with the two cut-off levels (4 of 7 points and 4.5 of 7 points). Predictive models were developed independently for the 2015, 2016, and 2017 years. The conceptual framework assumes that damages are broadly influenced by the total number of excavations, conditions at the work site, rules governing excavation in the state, and behavior/experience/competence (Figure A1). Data for the first three categories were available; however, no data was available for behavioral/experience/competence factors.

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 by a t-test 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 as well as nominal variables. The specification with quadratic variables accounts 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. Though the quadratic specifications yielded certain informative results, the analysts chose not to use them for predictive purposes because they generated unreasonable estimated damage counts.

The same procedures were used to run models for the two sets of substantially reporting states. However, in this appendix only the larger dataset of 10 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). Furthermore, certain estimated damage counts based on the smaller set of substantially reporting states were unreasonably large. For these reasons, the 10 states were used as the substantially 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.

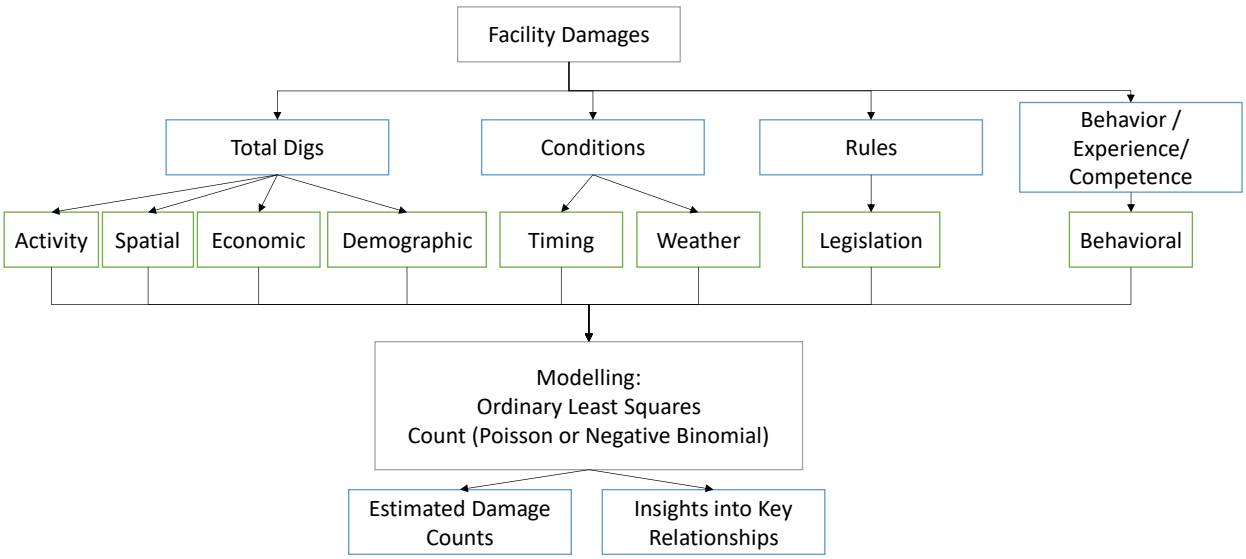


Figure A1: Conceptual framework of damage counts and possible outputs of modeling process

## 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 A1 are summarized in Table A2. 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 A2 - Variables considered (Type categories correspond to those in conceptual model)

| Type | Variable |
|---|---|
| Activity | ▪ Total construction spending in state by month<br>▪ Construction employment in state by month (total and per capita)<br>▪ Outgoing transmissions from one call center(s) in state in the year[a]<br>▪ Total residential unit construction in state by month<br>▪ Gross domestic product for construction by state and month (per capita and total)<br>▪ Gross domestic product for utilities by state and month (per capita and total) |
| Weather[b] | ▪ Mean precipitation in state by month<br>▪ 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)<br>▪ 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 (2017)<br>▪ Population change from 2016 to 2017<br>▪ Population density in state (2017) |
| Legislation | ▪ Tolerance zone in inches<br>▪ Hand dig, vacuum, or soft excavation within tolerance zone (hand dig clause) |
| Spatial | ▪ Area of state in kilometers[c] |
| Economic | ▪ Unemployment rate in state by month<br>▪ Total employment in state by month<br>▪ Gross domestic product for all industries by state and month |

[a] 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. 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, so this variable was dropped from the analysis.

Before running the models, variance inflation factors (VIFs) were calculated and used to check for high correlation between 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 A3). Variables with the highest VIF scores were iteratively dropped.

Table A3: Checking for multicollinearity variance inflation factors[a]

| **Variable** | **2017** | | **2016** | | **2015** | |
|---|---|---|---|---|---|---|
| | Initial | Reduced | Initial | Reduced | Initial | Reduced |
| Population | 17,239 | | 15,517 | | 21,189 | |
| Employment | 14,521 | | 16,245 | | 25,784 | |
| Construction employment | 641 | | 936 | | 1,995 | |
| Population change | 71 | | 232 | 5 | 385 | |
| Construction employment per capita | 62 | 2 | 74 | | 85.72 | 5 |
| Hand dig clause | 60 | | 50 | 5 | 47 | 4 |
| Total residential unit construction | 45 | | 67 | | 49 | |
| Transmissions | 44 | 1 | 22 | 7 | 24.76 | 3 |
| Tolerance interval | 31 | | 16 | 6 | 15 | 3 |
| Unemployment rate | 25 | 2 | 8 | 5 | 7 | 4 |
| Population density | 13 | 2 | 11 | 2 | 11 | 2 |
| Total construction spending | 12 | 6 | 19 | | 4 | 3 |
| Mean temperature | 11 | 4 | 20 | 5 | 9 | 7 |
| Winter (Jan, Feb, Mar.) | 7 | 6 | Omitted | 5 | Omitted | 7 |
| Fall (Oct, Nov, Dec.) | 4 | 3 | 9 | 4 | 5 | 4 |
| Spring (Apr, May, Jun.) | 2 | 2 | 4 | 2 | 5 | 2 |
| Summer (Jul, Aug, Sep.) | Omitted | Omitted | 8 | Omitted | 7 | Omitted |
| Mean precipitation | 2 | 2 | 2 | 2 | 2 | 2 |
| Mean VIF | 1,929 | 3 | 1,955 | 4 | 2,919 | 4 |

[a] Rounded to the nearest integer

The analysts used a rule of thumb of a VIF score of 10 as a cut-off value for when to stop dropping variables. Although there were still some issues after removing the most collinear variables, multicollinearity 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 A4: Regression results for the final count models of facility damages

| Variable | Poisson Count Coefficients[a] | | |
|---|---|---|---|
| | 2017 | 2016 | 2015 |
| Constant | 4.58841***<br>(0.4610575) | 5.146535***<br>(0.2155254) | 8.301317***<br>(0.8659892) |
| Construction spending total | | | 0.00000517*<br>(0.00000306) |
| Population change | | -0.00000383***<br>(0.00000146) | |
| Population density | | | -0.0042612**<br>(0.0021191) |
| Transmissions | 0.0000000524***<br>(0.00000000819) | 0.000000172***<br>(0.0000000372) | 0.000000113***<br>(0.0000000141) |
| Spring and summer | -0.3651772**<br>(0.1504601) | -0.2838454***<br>(0.0988685) | |
| Mean temperature | 0.032051***<br>(0.0071174) | 0.0268825***<br>(0.0051069) | 0.0166688***<br>(0.0018208) |
| Total employment in construction per capita | | | -111559.3***<br>(39309.74) |
| Hand dig clause | | -1.152784***<br>(0.2592687) | -1.636223***<br>(0.3911967) |
| Model statistics | | | |
| N | 120 | | |
| Log pseudolikelihood | -16,195.66 | -7,608.79 | -7,654.93 |
| Pseudo r2 | 0.76 | 0.91 | 0.88 |

***, **, * 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

Table A4 presents the best models for the top 10 substantially reporting states for the 2015, 2016, and 2017 data. Model fit, as indicated by the pseudo $R^2$ measure, was best for 2016, followed closely by 2015 and then more distantly 2017. For 2017, the models suggest 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. For 2016, the models indicate that damages increase with outgoing transmissions and the mean monthly temperature for the state (similar to 2017). However, for 2016, the results suggest that damages decrease with population declines (from 2015 to 2016), are lower for spring and summer relative to fall and winter, and are lower for states with a hand dig clause. In terms of 2015, the model suggests that damages increase with the total amount of money spent on construction, outgoing transmissions, and mean monthly temperature in the state. Conversely, damages in 2016 are lower in states with higher population density and higher per capita employment in construction and in states with a hand dig clause. These results are largely expected. For instance, it is sensible that damages increase with outgoing transmissions because transmissions reflect dig 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. In other words, holding activity constant, there are fewer damages during the spring and summer. The negative coefficients observed for population change and construction employment per capita in the 2016 and 2015 models, respectively, are not expected.

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 A5). This process assumes that reported damages in the defined substantially reporting states approximate total actual damages in those states and that the estimated relationships in Table A4 hold for the states not included in these models. Though there is variation from year to year, the estimated damages are not terribly different from 2015 to 2017.

Table A5: Estimated damage counts for the united states (top 10 states), rounded to the nearest 1,000

| Year | Estimated Total U.S. Damages |
|---|---|
| 2017 | 439,000 |
| 2016 | 416,000 |
| 2015 | 378,000 |

To examine the strength of the relationship between the data for the substantially reporting states and the broader DIRT database, the substantially reporting state dataset was compared with the broader database for a number of key variables. Results of that examination are presented below for reporting stakeholders, root cause, excavator type, and facilities damaged. In general, the examination revealed that the substantially reporting state dataset is a strong representation of the larger DIRT database.

## Reporting Stakeholder for Substantially Reporting States

Table A6 illustrates the percentage of reported damages for all states in relation to those for the substantially reporting states. The data exhibits a high degree of alignment between all states and the substantially reporting states. In both cases, Locator, Natural Gas, and Excavator are the dominant reporting stakeholders.

Table A6 – Reported damages for all states in relation to the substantially reporting states, 2017

| Reporting Stakeholder | Percentage of Reported Damages—All States | Percentage of Reported Damages—Substantially Reporting States |
|---|---|---|
| One Call | 3.18 | 0.00 |
| Electric | 0.52 | 0.38 |
| Engineer/Design | 0.00 | 0.00 |
| Excavator | 10.87 | 12.32 |
| Insurance | 0.00 | 0.00 |
| Liquid Pipeline | 0.15 | 0.20 |
| Locator | 64.67 | 66.08 |
| Equipment Manufacturer | 0.00 | 0.00 |
| Natural Gas | 14.27 | 13.63 |
| Private Water | 0.02 | 0.01 |
| Public Works | 0.30 | 0.30 |
| Railroad | 0.00 | 0.00 |
| Federal State/Regulator | 2.07 | 2.98 |
| Road Builders | 0.02 | 0.02 |
| Telecommunications | 3.47 | 4.00 |
| Unknown/Other | 0.47 | 0.07 |

## Root Cause for Substantially Reporting States

Root cause data for the substantially reporting states is presented in Table A7 along with root cause data for all states. As was the case with the reporting stakeholder data, the root cause data for the substantially reporting states is a strong representation of the dataset for all states. The percentage of damages attributed to any given root cause for all states is comparable to that for the substantially reporting states.

Table A7 – Root cause for all states in relation to the substantially reporting states, 2017

| Root Cause Group | Percentage of Reported Damages—All states | Percentage of Reported Damages—Substantially Reporting States |
|---|---|---|
| Excavation Practices Not Sufficient | 52.3 | 53.7 |
| Notification Not Made | 24.5 | 22.8 |
| Notification Practices Not Sufficient | 0.99 | 0.99 |
| Locating Practices Not Sufficient | 16.8 | 16.7 |
| Miscellaneous | 5.39 | 5.8 |

## Excavator Type for Substantially Reporting States

Table A8 presents excavator type data for all states in relation to the same data for the substantially reporting states. Here again, the distribution of damages across excavator types for the substantially reporting states is consistent with that for all states.

Table A8 – Excavator type for all states in relation to the substantially reporting states, 2017

| Excavator Types | Percentage of Reported Damages—All states | Percentage of Reported Damages—Substantially Reporting States |
|---|---|---|
| Contractor | 31.85 | 28.12 |
| County | 0.92 | 0.78 |
| Developer | 1.16 | 1.15 |
| Farmer | 0.10 | 0.06 |
| Municipality | 2.61 | 2.42 |
| Occupant | 2.74 | 1.93 |
| Railroad | 0.01 | 0.02 |
| State | 0.16 | 0.11 |
| Unknown/Other | 54.20 | 58.93 |
| Utility | 6.24 | 6.48 |

## Facilities Damaged for Substantially Reporting States

Table A9 considers facilities damaged for substantially reporting states in relation to that for all states, demonstrating once again the strong alignment between the two datasets. In both cases, the majority of damages occur to Telecommunications and Natural Gas.

Table A9—Facilities damaged for all states in relation to the substantially reporting states, 2017

| Facilities Damaged | Percentage of Reported Damages—All states | Percentage of Reported Damages—Substantially Reporting States |
|---|---|---|
| Cable Television | 10.45 | 10.20 |
| Electric | 8.12 | 7.73 |
| Liquid Pipeline | 0.05 | 0.05 |
| Natural Gas | 26.58 | 20.68 |
| Sewer | 0.24 | 0.36 |
| Steam | 0.00 | 0.00 |
| Telecommunications | 46.64 | 50.67 |
| Unknown/Other | 5.38 | 7.20 |
| Water | 2.54 | 3.10 |

# APPENDIX B: DAMAGES BY REPORTING STAKEHOLDER

Table B1—Reported damages by reporting stakeholder, complete dataset, 2017

| Reporting Stakeholder | Reported Damages | |
|---|---|---|
| | Reported Damages | Percentage of Total |
| One Call | 6,281 | 1.98 |
| Electric | 4,096 | 1.29 |
| Engineer/Design | 9 | 0.00 |
| Excavator | 22,280 | 7.04 |
| Insurance | 13 | 0.00 |
| Liquid Pipeline | 545 | 0.17 |
| Locator | 207,587 | 65.60 |
| Equipment Manufacturer | 1 | 0.00 |
| Natural Gas | 52,233 | 16.51 |
| Private Water | 154 | 0.05 |
| Public Works | 1,353 | 0.43 |
| Railroad | 4 | 0.00 |
| Federal State/Regulator | 3,442 | 1.09 |
| Road Builders | 60 | 0.02 |
| Telecommunications | 16,702 | 5.28 |
| Unknown/Other | 1,684 | 0.53 |
| Total Damages | 316,444 | |

# APPENDIX C: GROUPINGS USED IN REPORT

Table C1—Root cause groupings used in this report

| Group | Root Cause |
|---|---|
| Excavation practices not sufficient | Marks faded or not maintained |
| | Failure to maintain clearance |
| | Failure to use hand tools where required |
| | Excavator dug prior to verifying marks by test hole (pothole) |
| | Excavator failed to protect/shore support facilities |
| | Improper backfilling practices |
| | Other excavation practices not sufficient |
| Locating Practices Not Sufficient | Facility was not located or marked |
| | Facility marking or location not sufficient |
| | Incorrect facility records/maps |
| | Facility could not be found/located |
| Unknown | Data not collected |
| | Other |
| Miscellaneous | One call center error |
| | Deteriorated facility |
| | Abandoned facility |
| | Previous damage |
| Notification Practices Not Sufficient | Wrong information provided |
| | Notification to one call center made but not sufficient |
| Notification Not made | No notification made to one call center/811 |

Table C2—Work performed groupings used in this report

| Group | Root Cause |
|---|---|
| Agriculture | Agriculture |
| Construction/Development | Construction |
| | Site Development |
| | Grading |
| | Drainage |
| | Driveway |
| | Demolition |
| | Engineering |
| | Railroad |
| | Waterway |
| Energy | Natural Gas |
| | Electric |
| | Steam |
| | Liquid Pipe |
| Fencing | Fencing |
| Landscaping | Landscaping |
| Sever/Water | Sewer |
| | Water |
| Street/Roadway | Roadwork |
| | Curb/Sidewalk |
| | Storm Drainage |
| | Milling |
| | Pole |
| | Traffic Signals |
| | Traffic Signs |
| | Street Lights |
| | Public Transit |
| Telecom | Telecommunications |
| | Cable TV |

# APPENDIX D: EXCAVATION INFORMATION

Table D1—Top 20 combinations of excavator, work performed, and equipment used, including unknown data, in Canada and the U.S., 2017

| Excavator | Work Performed | Equipment Used | Unique Damages |
|---|---|---|---|
| Unknown/Other | Unknown/Other | Unknown/Other | 120,152 |
| Contractor | Unknown/Other | Unknown/Other | 22,596 |
| Utility | Unknown/Other | Unknown/Other | 8,510 |
| Contractor | Unknown/Other | Backhoe/Trackhoe | 5,343 |
| Contractor | Water | Backhoe/Trackhoe | 4,812 |
| Unknown/Other | Unknown/Other | Backhoe/Trackhoe | 4,750 |
| Contractor | Sewer | Backhoe/Trackhoe | 4,624 |
| Unknown/Other | Water | Trencher | 4,321 |
| Municipality | Unknown/Other | Unknown/Other | 3,295 |
| Unknown/Other | Sewer | Trencher | 3,196 |
| Unknown/Other | Unknown/Other | Hand Tools | 2,963 |
| Unknown/Other | Cable TV | Trencher | 2,565 |
| Contractor | Cable TV | Trencher | 2,555 |
| Contractor | Water | Trencher | 2,376 |
| Contractor | Electric | Backhoe/Trackhoe | 2,262 |
| Contractor | Sewer | Trencher | 2,219 |
| Unknown/Other | Fencing | Auger | 2,162 |
| Contractor | Natural Gas | Trencher | 2,104 |
| Unknown/Other | Landscaping | Boring | 2,081 |
| Contractor | Natural Gas | Backhoe/Trackhoe | 2,056 |

Figure D1 depicts the relative contribution of known and unknown data to reported damages by excavator, work performed, and equipment used. The circle on the left represents the percentage of damages for which all three variables (excavator, work performed, and equipment used) are unknown (38%). The center of the three circles on the right represents the portion of the reported damages where all three variables are known (25%). The intersections between two of the variables (excavator and work performed; excavator and equipment; equipment used and work performed) represent the

portion of damages where two of the three variables are known (i.e., for 4% of damages, excavator and work performed are known; for 12% of damages, work performed and equipment used are known; and for 4% of damages, equipment used and excavator are known). The outer percentages (not overlapping) represent the portion of damages where only one variable is known (i.e., for 12% of damages, excavator is the only known variable; for 1% of damages, work performed is the only known variable; and for 4% of damages, equipment used is the only known variable).

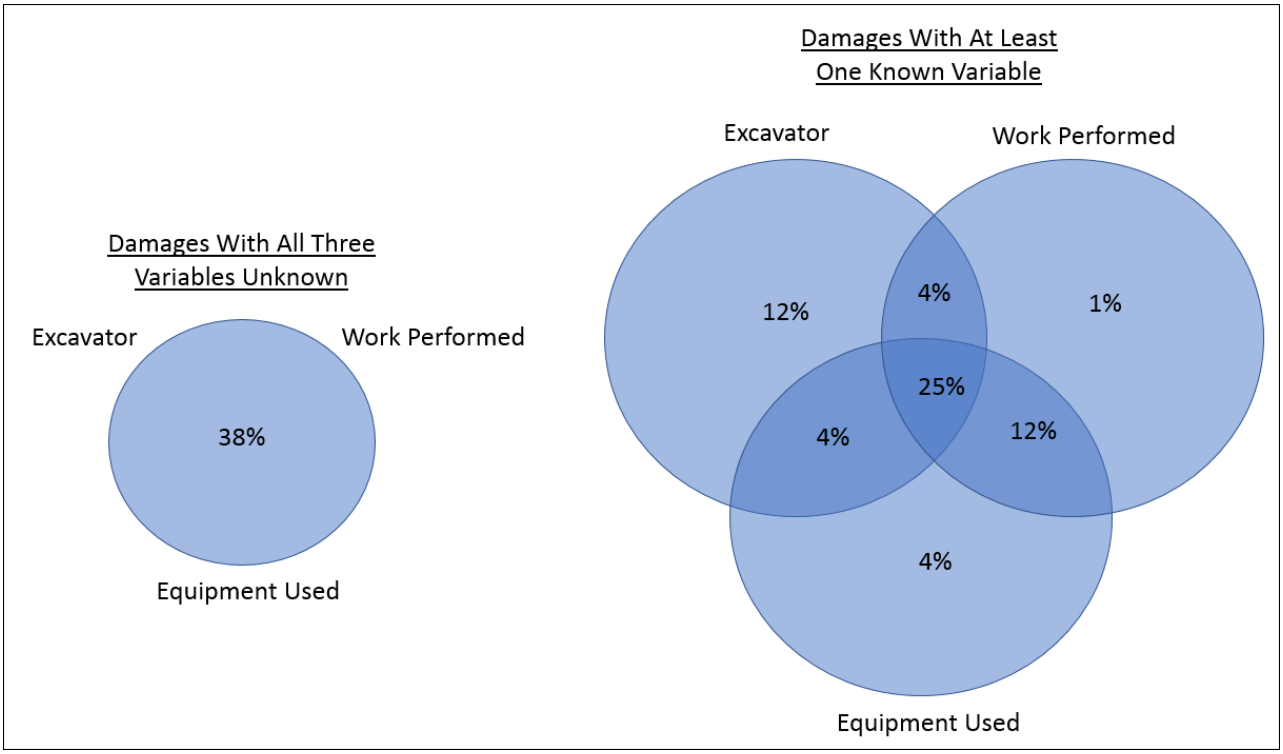


*Figure D1—Percentage of damages by excavator, work performed, and equipment used, known and unknown data*

# 2017 CGA DIRT
# Analysis & Recommendations

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