Ontario Regional
ORCGA
Common Ground Alliance

2013 DIRT Report

Version 7.0

ORCGA Damage Information Reporting Tool

Published June 2014

DIGSAFE.CA

CONTENTS

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MESSAGE FROM THE PRESIDENT
ONTARIO REGIONAL COMMON GROUND ALLIANCE

Dear Damage Prevention Stakeholders,

The Ontario Regional Common Ground Alliance (ORCGA) has collected data since 2005 to better understand the root causes that lead to these events (damages) and to develop public awareness programs to minimize the risk of future events. An ongoing challenge has been to gather data from a broader cross section of industry stakeholders within Ontario. For 2013 (version 7.0), we have been able to increase the number of records submitted. We are also very pleased to report that events (damages) continue on a downward trend.

The importance of our DIRT Report to the damage prevention industry remains a key component in painting an accurate picture of where we are with respect to safety and damage prevention in Ontario. As more industry stakeholder companies submit data into DIRT, we will gain more insight and a clear view of how to enhance our public awareness programs.

I sincerely encourage all our stakeholders to become involved in the DIRT. By providing your data, we will eventually be able to gain a complete understanding of the total number of annual events there are in Ontario. You will also benefit by having a DIRT database from which you can prepare your own statistical report showing how well your company is progressing in its damage prevention efforts.

Once again, our Reporting & Evaluation (R&E) Committee has included a number of impressive enhancements in this version. These changes and the entire report are a result of the work performed by the volunteers from our R&E Committee. Much of the work was spearheaded by Lyndsay McGrath (Enbridge Gas Distribution) who was honoured as one of our three ORCGA 2013 'Members of the Year' for her work on our annual DIRT report. For version 7.0, Lyndsay worked closely with her committee Co-chair, Richard Durrer (Accu-Link Call Centres) and all the members of the R&E committee to produce another outstanding DIRT report.

I would like to extend a sincere thank you to Lyndsay, Richard and the entire Reporting & Evaluation Committee for their work on the 2013 DIRT Report.

Sincerely,

Jim Douglas
(Acting) President & CEO, ORCGA

1.0 INTRODUCTION

The Ontario Regional Common Ground Alliance (ORCGA) is a non-profit organization promoting efficient and effective damage prevention for Ontario's vital underground infrastructure. Through unified approach and stakeholder consensus, the ORCGA fulfills its motto of "Working Together for a Safer Ontario".

We are a growing organization with over 450 organizations as active members and sponsors, and represent a wide cross section of stakeholders:

Electrical Distribution
Electrical Transmission
Engineering
Equipment & Suppliers
Excavator
Homebuilder
Insurance
Land Surveying
Landscape/Fencing
Locator
Municipal & Public Works
Oil & Gas Distribution
One-Call
Railways
Regulator
Road Builders
Safety Organization
Telecommunications
Transmission Pipeline

The ORCGA works to offer practical tools and to foster an environment in which anyone residing or doing business in Ontario is aware of and compliant with best practices in regard to underground infrastructure or disturbance in order to ensure the safest possible environment for the workers and citizens of the province.

The ORCGA welcomes comments and new members on its various committees. In order to submit a suggestion, or to join a meeting, please visit www.orcga.com to learn about the scope of the various committees.

General inquiries about the ORCGA can be made to:

Ontario Regional Common Ground Alliance (ORCGA)
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To learn more about the ORCGA's Dig Safe Program, visit www.digsafe.ca.

The Damage Information Reporting Tool (DIRT) is the result of the efforts made by the ORCGA to gather meaningful data about the occurrence of facility events. An "event" is defined by the DIRT User's Guide as "the occurrence of downtime, damages, and near misses." Gathering information about these types of events give the ORCGA the opportunity to perform analyses of the contributing factors and recurring trends, as well as identify potential educational opportunities with the overall goals of reducing damages and increasing safety for all stakeholders.

The Annual DIRT Report provides a summary and analysis of the known events submitted during the prior year, and as additional years of data are collected, also provides the ability to monitor trends over time. The 2013 Report focuses on the data gathered throughout Ontario during the three year period between 2011 and 2013. This data can be helpful for all stakeholders to use as a benchmark for their damage prevention performance. It identifies current issues facing the industry, region and province wide.

Data Analysis Disclaimer: Industry stakeholders have voluntarily submitted their underground facility event data into DIRT. The data submitted is not inclusive of all facility events that occurred during the report year.

1.1 CASE STUDIES

DIRT 7.0 features case studies of root cause investigations. Root cause investigations assess both the events leading up to the incident, the surrounding conditions, and the event outcomes or learning points. In some of the case studies presented, details may have been modified to protect the privacy of the individuals involved.

1.2 INDUSTRY SPOTLIGHT

The Industry Spotlight section is new to the 2013 DIRT Report. The aim of this section is to provide perspective on recent developments and highlights in the industry as it relates to damage prevention.

1.3 DATA VALIDATION

The numbers and figures in this report are based on current information provided to the ORCGA as of December 31st, 2013.

When reviewing statistics published in this report, it is also important to note that due to retroactive submission by new DIRT users, the volume of facility events submitted by year will be changing with each report.

In addition to the number of records submitted, another important factor is the completeness of those records. Complete records allow for better overall analysis and provide for a more inclusive review of the contributing factors behind the events themselves. Each submitted record contains numerous data elements that are vital to understanding and interpreting the incidents reported in DIRT. When there are small percentages of known data for a specific field, it becomes difficult to perform a meaningful analysis. It is of vital importance that stakeholders align their data collection and reporting practices with those found on the DIRT Field Form. As a way to gauge the overall level of completion of records submitted, the Data Quality Index (DQI) was implemented in 2009 and has been reported again in 2013. The DQI provides a quantitative benchmark for stakeholders or organizations to review the quality of the facility event records that they submit on an ongoing basis. More complete event records lead to a higher overall DQI, and therefore a better, more complete analysis.

When reviewing the statistics published in this report, it is important to note that records with missing data were filtered out, leaving only the events with complete data.

There is potential that more than one report may be submitted for the same event, such as one by the excavator and one by the facility owner. There can be a benefit to this scenario. For example, data may be included on one submission that was omitted on the other. In addition, the way that different Stakeholders interpret the Root Cause of the same event may yield interesting insights. The DIRT system compares each field within each report submitted against the fields of all other reports in DIRT, and calculates the probability that it matches an already submitted event. It becomes more difficult to determine if the DIRT system includes multiple reports for the same event when fewer fields are completed.

2.0 DATA ANALYSIS

2.1 FACILITY EVENT ANALYSIS

In 2013, the DIRT Report increased stakeholder submissions as well as overall stakeholder awareness. In *Figure 1*, which is a measure of DIRT use, it can be seen that between 2012 and 2013 the number of events submitted into DIRT decreased from 4837 to 4757.

Our Goal

Avoid damages within the underground infrastructure network as well as eliminating possible injuries due to these damages.

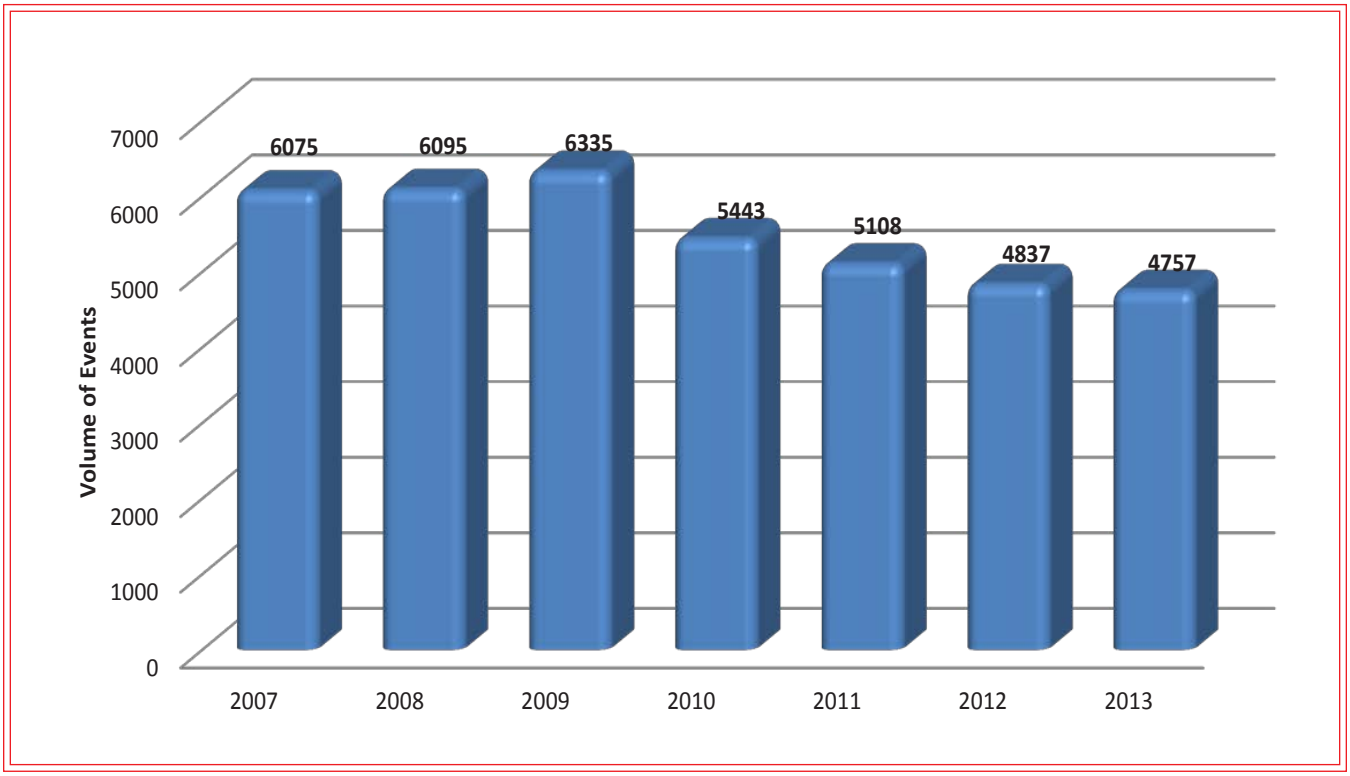


Figure 1: Facility Events Submitted by Year

What if any of these damages hit a line servicing a hospital?

2.2 FACILITY EVENTS SUBMITTED ACROSS ONTARIO

Trends in record submissions remain fairly similar to previous years and do not indicate any significant differences.

2.0

Figure 2 illustrates the number of events for each geographical area over the past three years. Trends in record submissions remain fairly similar to previous years and do not indicate any significant differences. As seen in previous years, Toronto still represents the largest volume of events submitted.

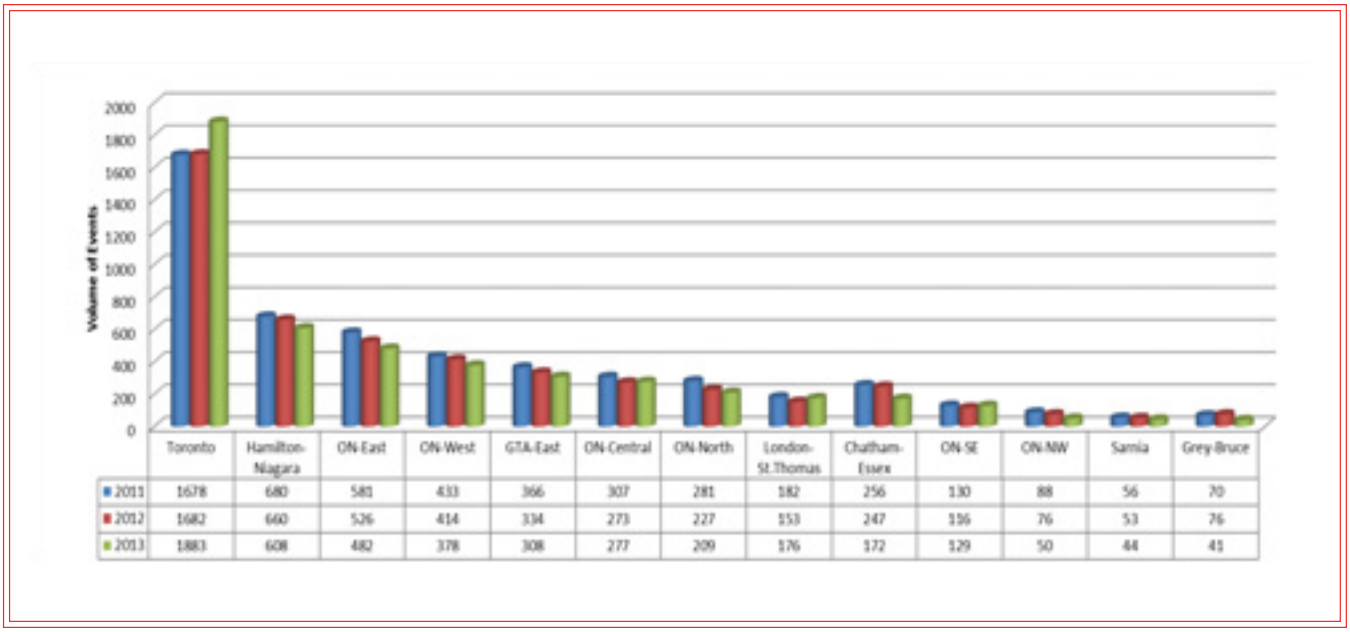


Figure 2: Volume of Events Submitted per Geographical Area

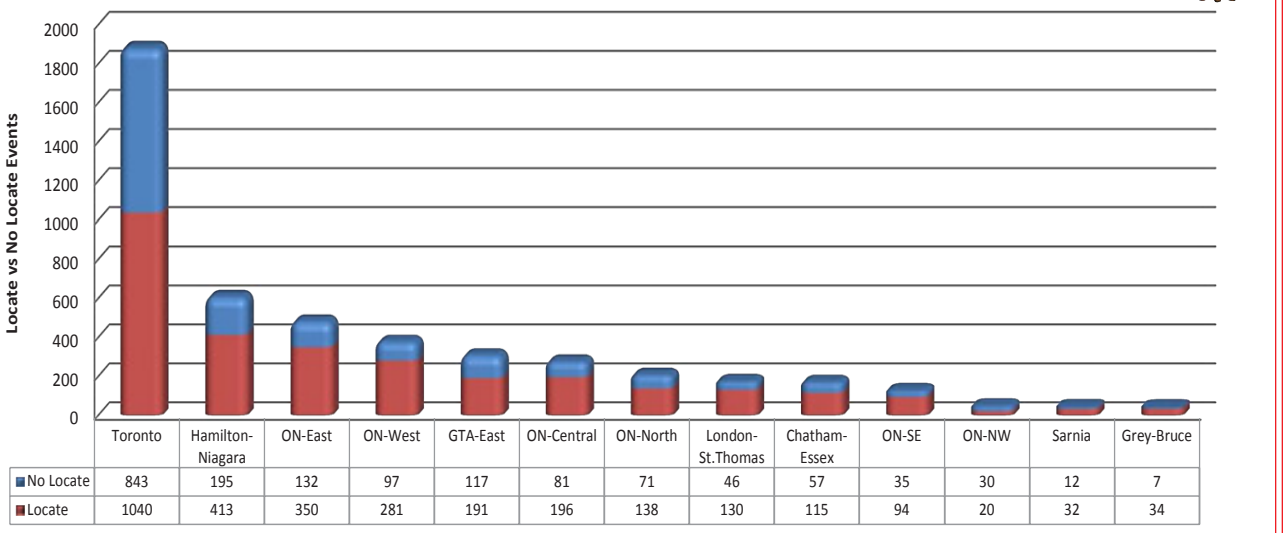
Table 1 shows the geographical breakdown of the total notifications through Ontario One Call.

NEW

Geographical Council	Notifications		
	2011	2012	2013
Chatham-Essex	150,601	161,173	194,218
Grey-Bruce	40,839	55,105	60,901
Hamilton-Niagara	525,311	612,699	741,467
London-St. Thomas	135,932	155,315	177,331
ON-Central	122,080	145,416	170,186
ON-East	266,295	319,315	358,468
GTA-East	141,078	179,170	240,408
ON-North	74,826	106,611	167,965
ON-Northwest (ON-NW)	13,073	30,509	50,147
ON-Southeast (ON-SE)	42,326	73,620	95,330
ON-West	243,774	297,685	410,488
Sarnia	56,392	62,083	71,364
Toronto	917,191	1,242,731	1,641,563

Table 1: Notifications per Geographical Council

Figure 3 illustrates the Locate vs. No Locate number of events by geographic council. We can see below that there are still many instances where a locate was not requested.



	Toronto	Hamilton-Niagara	ON-East	ON-West	GTA-East	ON-Central	ON-North	London-St.Thomas	Chatham-Essex	ON-SE	ON-NW	Sarnia	Grey-Bruce
No Locate	843	195	132	97	117	81	71	46	57	35	30	12	7
Locate	1040	413	350	281	191	196	138	130	115	94	20	32	34

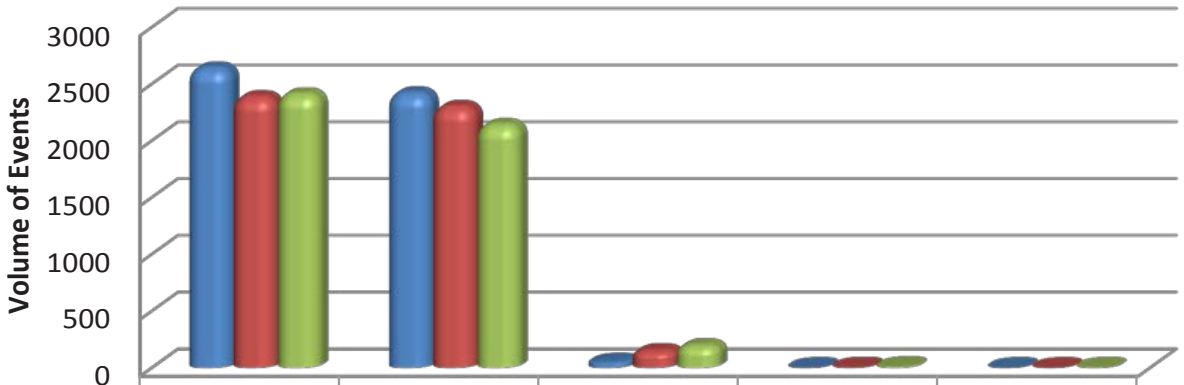
Figure 3: Locate vs. No Locate Events by Geographical Area

Geographical Area	Cities		
Toronto	Peel Toronto	York	
Hamilton-Niagara	Halton Hamilton	Niagara Haldimand-Norfolk	
ON-East	Lanark Prescott Renfrew	Stormont, Dundas & Glengarry Ottawa	
ON-West	Brant Huron Oxford	Perth Waterloo/Wellington	
GTA-East	Durham Kawartha Lakes	Northumberland Peterborough	
ON-Central	Dufferin	Simcoe	
Chatham-Essex	Chatham/Kent	Essex	
ON-North	Algoma Cochrane Greater Sudbury Haliburton	Muskoka Nipissing Parry Sound	Sudbury District Manitoulin Timiskaming
London-St.Thomas	Elgin	Middlesex	
ON-Southeast (ON-SE)	Frontenac Hastings, Leeds & Grenville	Lennox and Addington Prince Edward	
ON-Northwest (ON-NW)	Kenora Rainy River	Thunder Bay	
Grey-Bruce	Bruce	Grey	
Sarnia	Lambton		

Table 2: Geographical Area Breakdown by Region/Municipality/City

2.3 SUBMITTED FACILITY EVENTS BY STAKEHOLDER GROUP

Figure 4 illustrates that as the stakeholder base grows, possibly due to the introduction of the mandatory one call system, so will the number of events submitted. This increase will help support future trend analysis. In 2013, DIRT had its first submissions by a municipality.

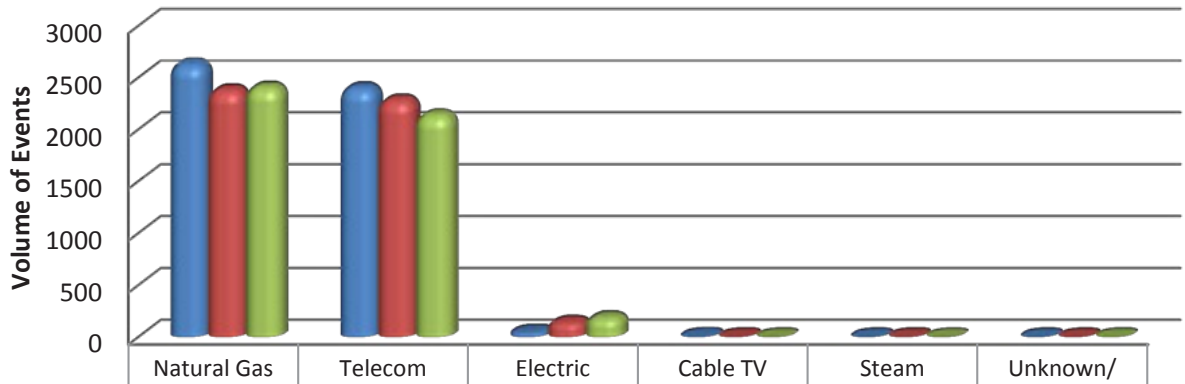


	Natural Gas	Telecom	Electric	Excavator	Municipality
2011	2636	2416	56	0	0
2012	2383	2296	152	6	0
2013	2407	2137	197	13	3

Figure 4: Facility Events Submitted By Year

2.4 SUBMITTED FACILITY EVENTS BY TYPE OF FACILITY OPERATION AFFECTED

Figure 5 illustrates that Natural Gas and Telecommunication continue to be identified as the primary facilities affected in the majority of events reported in DIRT. This aligns with the fact that Natural Gas and Telecommunication stakeholders continue to submit the majority of events.



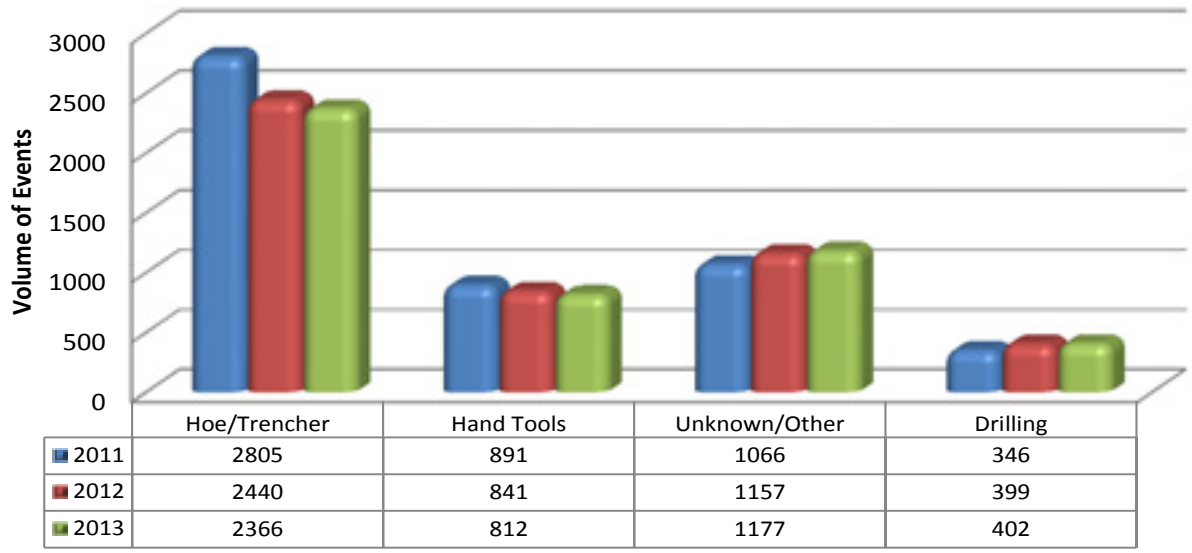
	Natural Gas	Telecom	Electric	Cable TV	Steam	Unknown/ Other
2011	2636	2406	55	9	1	1
2012	2386	2289	152	4	5	1
2013	2412	2143	197	2	0	3

Figure 5: Submitted Facility Events by Type of Facility Affected

Did you know that the backhoe was invented in 1953, and over the past 5 years it has been responsible for over 15,000 damages?

2.5 VOLUME OF EVENTS BY EXCAVATION EQUIPMENT GROUP

Figure 6 illustrates that in 2013 the Hoe/Trencher group continued to account for the largest volume of events in the Excavation Equipment Type category. However, this percentage is decreasing and being replaced by increasing events involving Drilling and events classified as Unknown/Other. It is encouraging to see that excavators are more often adhering to Best Practices for digging in close vicinity to underground facilities.



	Hoe/Trencher	Hand Tools	Unknown/Other	Drilling
2011	2805	891	1066	346
2012	2440	841	1157	399
2013	2366	812	1177	402

Figure 6: Submitted Facility Events by Excavation Equipment Group

Table 3 defines the types of excavation equipment included in each equipment group.

Group	Excavation Equipment Type	
Hoe/Trencher	Backhoe/Trackhoe	Trencher
Hand Tools	Hand Tools	Probing Device
Drilling	Auger Boring	Directional Drilling Drilling
Other	Farm Equipment Grader/Scraper	Milling Equipment Vacuum Equipment

Table 3: List of Equipment Groups

Case Study No. 1

2.0

On an afternoon in the early spring of 2012, a secondary underground hydro cable was hit while doing standard culvert work for a homeowner. The contractor indicates he was hand digging with a shovel at the time of the occurrence. What was meant to be a 'straight forward' job turned into a little bit more.

Summary

The homeowner was upgrading the culvert in the front of his home. A contractor was hired to excavate the ditch. The locate sheet indicated buried hydro cable near the work area. The contractor states he was using a hand shovel at the time of the incident.

Description

The type of work was a culvert repair and upgrade in front of the house. The work extent was from property line to property line. A hydro pole was in the vicinity of the dig location. The company hired to do the work was a bobcat and excavating company with 25 years experience. Culvert work was a standard work activity for this company.

It is mandatory for excavators to contact owners of any underground infrastructure prior to excavation. Completed and valid locates for gas, hydro and telephone were onsite at the time of the incident. The excavation site where the dig in took place indicated there was buried hydro cable near the excavation area.

Work at the site began like any other work day. Traffic cones and signs were erected as workers and equipment would be near and possibly on the road. A quick discussion took place prior to commencing work to review duties and responsibilities of those on site. Work began soon after.

The mini backhoe (bobcat) was being used to widen the culvert. The excavator began digging on the property at the West end of the culvert nearest the driveway and worked his way toward the opposite property line nearing the pole at the East end of the culvert. It was a 'standard' job and work was progressing nicely. The mini backhoe was making quick work of the culvert; swiftly widening the ditch and depositing bucket-fulls of dirt with every sweep.

As the widening of the culvert neared the hydro pole, the contractor indicated that use of the mini backhoe was halted and the excavating proceeded with the use of a hand shovel. During the second plunge of the hand shovel, the worker made contact with a section of underground cable. The worker did not experience/suffer a shock. All work ceased at that moment as the worker noticed a gouge in the cable and was unsure if the gouge was existing or new and because, according to the locate report, that particular area should have been free of underground cables. Moments later, the home owner came outside to advise that his power was 'knocked out'; the contact caused an interruption in service to a small segment of nearby residences.

Without delay, the contractor notified the utility owner to advise them of the incident and that a power interruption had occurred. The contractor did not resume with their excavating efforts. The hydro utility arrived a short time later to assess the situation. The hydro crew noted the location of the contractor's equipment; it was then relocated from the property to make room for the hydro crew to commence their work of repairing the underground cable and restoring power. After a job planning tailboard, identifying and eliminating or controlling all hazards, the hydro crew began their repairs.

As a result of the dig in, the locate reports gave the impression to be incorrect. However, upon further inspection, the hydro crew determined that the secondary underground cable was 'looped', thus making it difficult to locate. The hydro crew explained that in the past (15-20yrs ago), it was standard practice to bury a 'loop' of cable deep in the trench at the pole's end when installing underground cable. It was thought to be advantageous, allowing the cable to flex more easily when the frost set in. This approach is no longer an acceptable method of installing underground cable and is no longer practiced.

Because the underground cable was not fully sliced the hydro crew was able to repair the cable fairly quickly not having to replace it in its entirety. The hydro crew removed the 'loop' in the cable; adhering to current standards and reducing any future potential locate complications. They re-fused the transformer restoring power to the customer's home and the affected neighbours. The crew completed all necessary paperwork and gathered their equipment. The utility owner explained to the excavator that because the 'loop' was unidentifiable at the time of the locate, the excavator would not be held responsible for the repairs. The hydro crew turned the area over to the contractor; he was then able to proceed with his excavation efforts.

This scenario is a good example of how easily our daily work 'routine' can go amiss. Although some jobs seem 'routine', what lies beneath the ground makes every day a dangerous day and should be treated as such. "Complacency is present when our minds no longer remind us of the danger that is present in our activities".

2.6 FACILITY EVENTS BY ROOT CAUSE

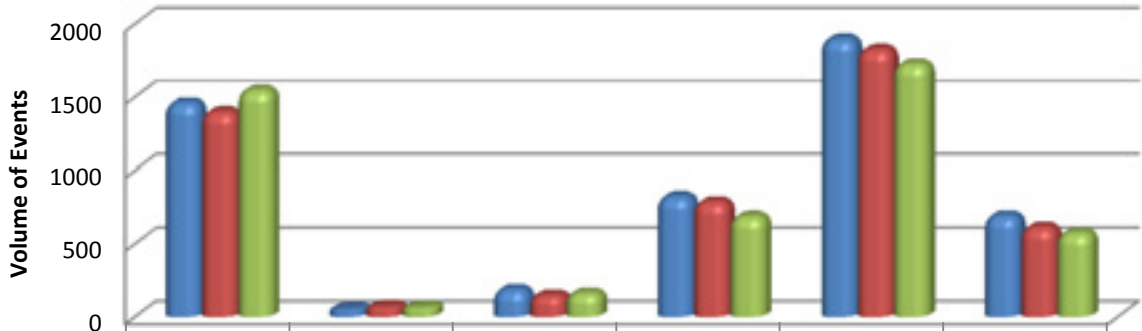
Table 4 details the Root Cause subcategories included in each main category. Refer to the Root Cause Tip Card (Appendix A) for a more detailed breakdown of the meaning of each root cause group. Depending upon which reporting stakeholder submitted data for a facility event, root cause volumes can vary significantly.

Root Cause Category	Root Cause Subcategory	
Excavation Practices Not Sufficient	Failure to maintain clearance Failure to maintain the marks Failure to support exposed facilities Failure to use hand tools where required	Failure to verify location by test-hole (pot-holing) Improper backfilling Unknown subcategory
Locating Practices Not Sufficient	Facility marking or location not sufficient Facility was not located or marked	Unknown Subcategory
Miscellaneous Root Causes	Abandoned facility Data not collected Deteriorated facility	Previous Damage Other One-call centre error
Notification Not Made	No notification made to the one-call centre	
Notification Practices Not Sufficient	Notification to one-call centre made but not sufficient	Wrong information provided
Incorrect Facility Records/Maps	Incorrect facility records/maps	

Table 4: Root Cause Category and Subcategory

In order to develop useful education and marketing tools to improve the Damage Prevention Performance of Ontario, it is important to examine the cause of reported events. To further understand the most common reasons for facility events, the distribution of root cause subcategories can also be examined.

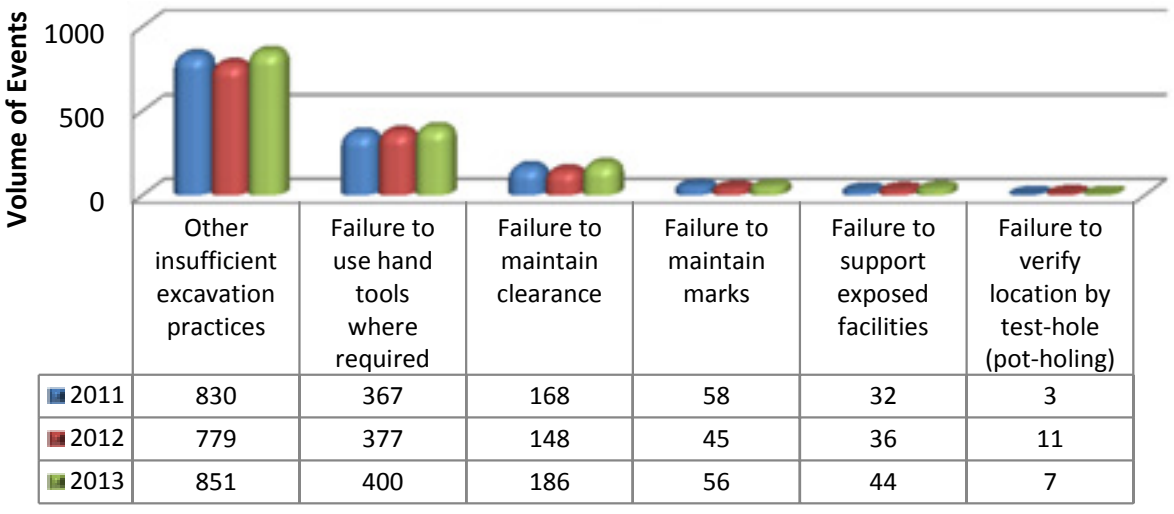
Figure 7 illustrates that the most common cause of events was a result of notifications not being requested through the one-call centre. Damages due to locates have decreased in 2013, and are expected to continue to decrease with the implementation of mandatory one-call.



	Excavation Practices Not Sufficient	Incorrect Facility Records/Maps	Locating Practices Not Sufficient	Miscellaneous Root Cause	Notification Not Made	Root Cause Category
2011	1458	56	187	822	1894	691
2012	1396	71	147	787	1823	613
2013	1544	67	161	687	1723	575

Figure 7: Facility Events by Root Cause Category

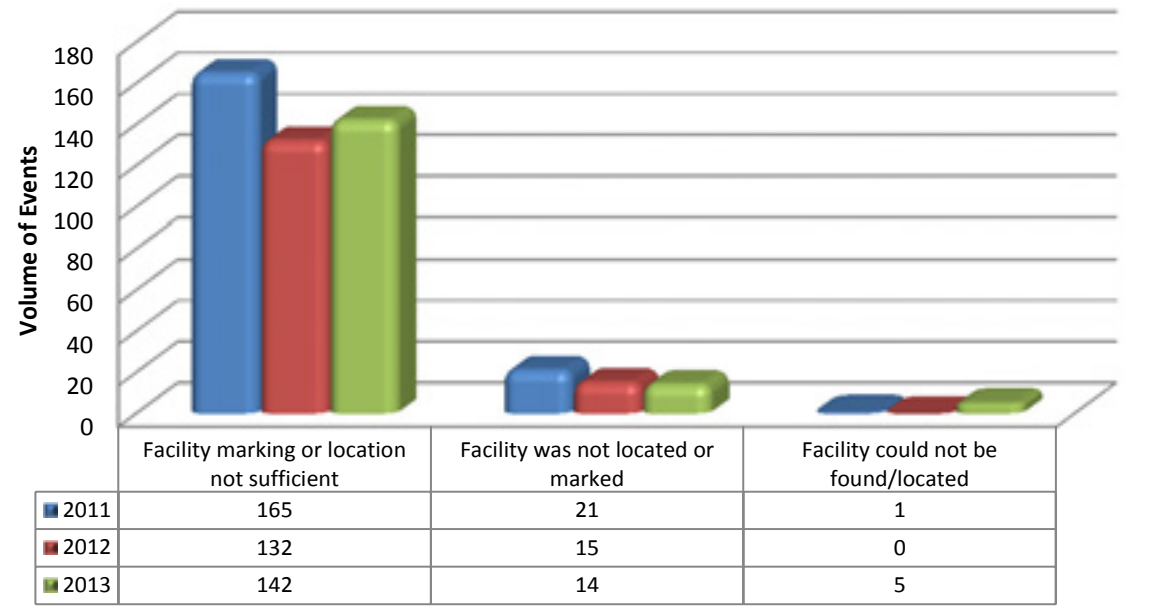
Figure 8 illustrates that the Excavation Practices Not Sufficient root cause group is made up mostly of events caused by other insufficient excavation practices. This root cause subcategory is any other excavator error, which cannot be classified as one of the other five root cause subcategories within the Excavation Practices Not Sufficient root cause group.



	Other insufficient excavation practices	Failure to use hand tools where required	Failure to maintain clearance	Failure to maintain marks	Failure to support exposed facilities	Failure to verify location by test-hole (pot-holing)
2011	830	367	168	58	32	3
2012	779	377	148	45	36	11
2013	851	400	186	56	44	7

Figure 8: Facility Events by Excavation Practices Not Sufficient

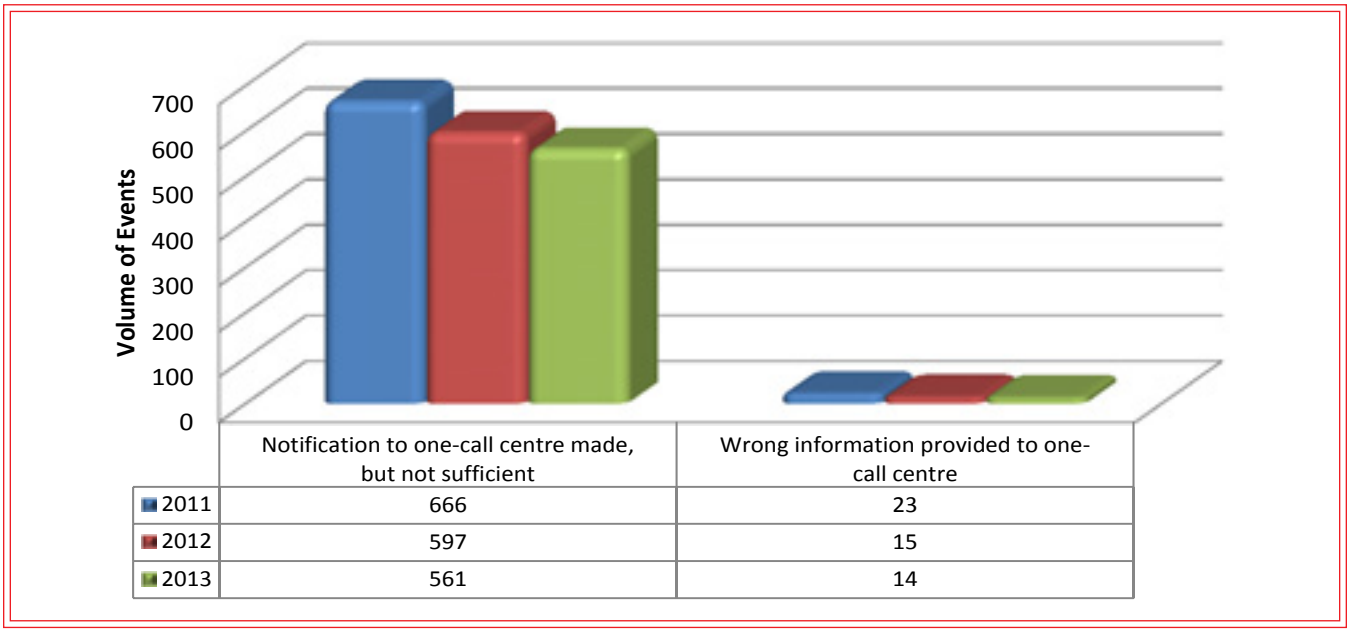
Figure 9 illustrates that DIRT submitters are classifying events caused by locating practices not sufficient more effectively. Refer to Root Tip Card (Pg. 24) for examples of facility marking or location not sufficient events.



	Facility marking or location not sufficient	Facility was not located or marked	Facility could not be found/located
2011	165	21	1
2012	132	15	0
2013	142	14	5

Figure 9: Facility Events by Locating Practices Not Sufficient

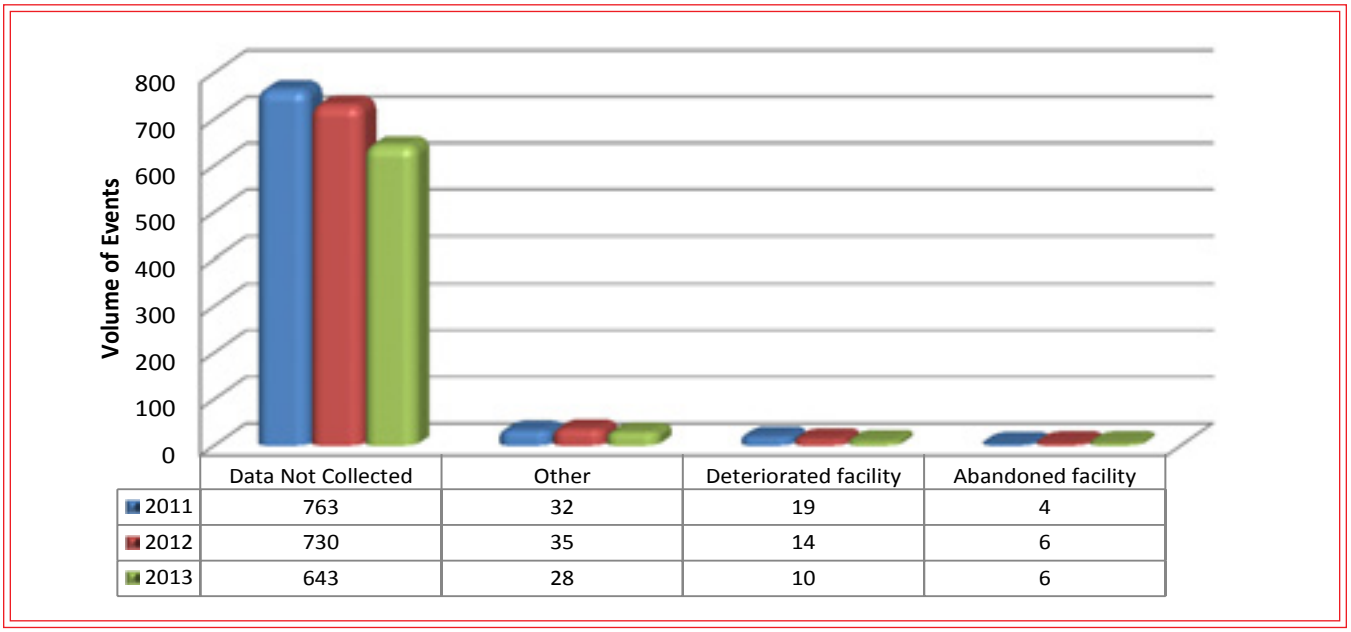
Figure 10 illustrates the need for the one-call requestor to provide more complete and accurate data. Insufficient notification to the one-call centre accounts for the greatest volume of events submitted under the Notification Practices Not Sufficient category. This subcategory includes instances such as missing information or inadequate lead times for a request.



	Notification to one-call centre made, but not sufficient	Wrong information provided to one-call centre
2011	666	23
2012	597	15
2013	561	14

Figure 10: Facility Events by Notification Practices Not Sufficient

Figure 11 illustrates root causes that have no classification. The Data Not Collected subcategory accounts for 13.5% of the total events, and is a measure of all events where a root cause was not selected. Further efforts must be applied to categorize each event.



	Data Not Collected	Other	Deteriorated facility	Abandoned facility
2011	763	32	19	4
2012	730	35	14	6
2013	643	28	10	6

Figure 11: Facility Events by Miscellaneous Root Cause

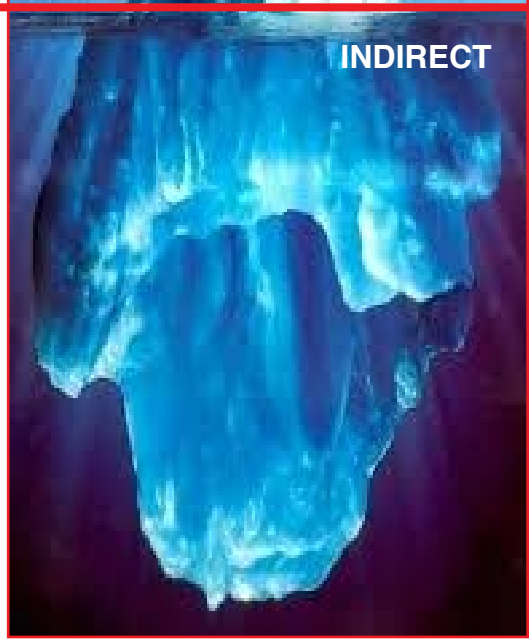
Do you know ALL the costs of a damage?

Property Damage Cost

- Building, tool, merchandise, equipment damage

Injury & Illness Cost

- Medical, compensation cost
- Increased insurance premiums
- Production, service delays and interruptions
- Legal expenses
- Emergency supplies
- Interim equipment rentals
- Wages paid for lost time, overtime, extra supervisory & administrative time
- Cost of hiring/training replacements
- Decreased productivity of injured worker upon return
- Loss of sales
- Damage to Company brand/image



"Data collected allows for in-depth analysis of damages within our excavation communities."

- Bell Canada

Did you know Ontario is the first province in Canada to have a legislated one-call system?

Case Study No. 2

Construction Company Pleads Guilty to Safety Violation

2.0

A construction company was fined $10,000 by the Ontario Court of Justice in Collingwood, Ontario for violating safety regulations under the Technical Standards and Safety Act, 2000.

The construction company pled guilty to not obtaining a locate before excavating as well as damaging a natural gas pipeline. The contractor had been contracted by the homeowner to excavate the property in front of their home in order to lay water and sewer line connections. During the construction, the excavator struck a ½ inch plastic gas service pipeline with a backhoe, causing a natural gas leak.

Following an investigation by the Technical Standards and Safety Authority (TSSA), Ontario's public safety regulator responsible for pipeline safety, the company was charged with failing to obtain a pipeline locate. The construction company was also charged with damaging and interfering with a pipeline when it struck it with a backhoe and crimped it with vice grips. The damage was discovered by a municipal employee the following day.

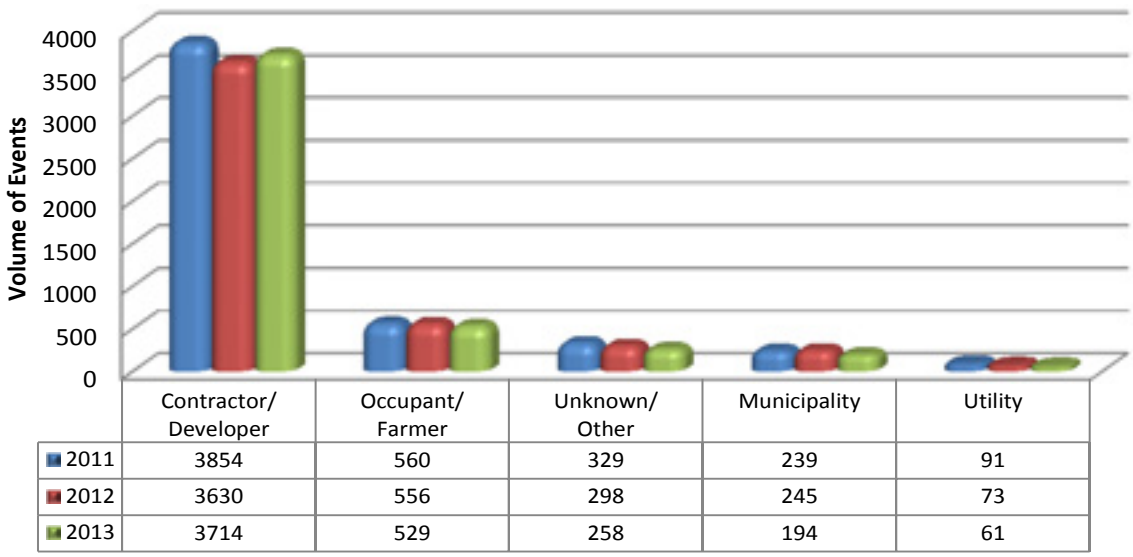
"It was sheer luck that no one was injured in this incident," said John Marshall, Director of TSSA's Fuels Safety Program. "Pipeline strikes can be extremely dangerous and disruptive. They occur too often and TSSA will aggressively prosecute contractors who don't follow the regulations requiring them to obtain locates and endangering public safety," added Mr. Marshall.

TSSA reminds the public that any excavation work must comply with safety requirements, including obtaining a valid pipeline locate from the licence holder or gas utility before breaking ground. Ontario Regulation 210/01 prohibits interfering with or damaging a pipeline and any damage and/or subsequent release of gas should be immediately reported to the Ministry of Environment's Spills Action Centre at 1-800-268-6060 or by contacting TSSA toll-free at 1-877-682-8772.

"Prosecution for non-compliance with Ontario's safety laws is an important part of TSSA's safety mandate," says John Marshall, TSSA's Director of Fuels Safety Program, "and it strongly reinforces our overall objective: to deter violators and increase public safety. While prosecution at times may be required, the TSSA chiefly works with industry stakeholders through cooperation and compliance. It is one of the cornerstones of fuels safety."

2.7 FACILITY EVENTS BY EXCAVATOR GROUP

Figure 12 illustrates that contractors and developers continue to be involved in the majority of the reported events. Additional analysis of these groups is provided within the Multiple Field Analysis section of this report.



	Contractor/ Developer	Occupant/ Farmer	Unknown/ Other	Municipality	Utility
2011	3854	560	329	239	91
2012	3630	556	298	245	73
2013	3714	529	258	194	61

Figure 12: Facility Events by Type of Excavator

"Input into DIRT is a simple process, it enables for an upload of a single file of all quarterly damages."

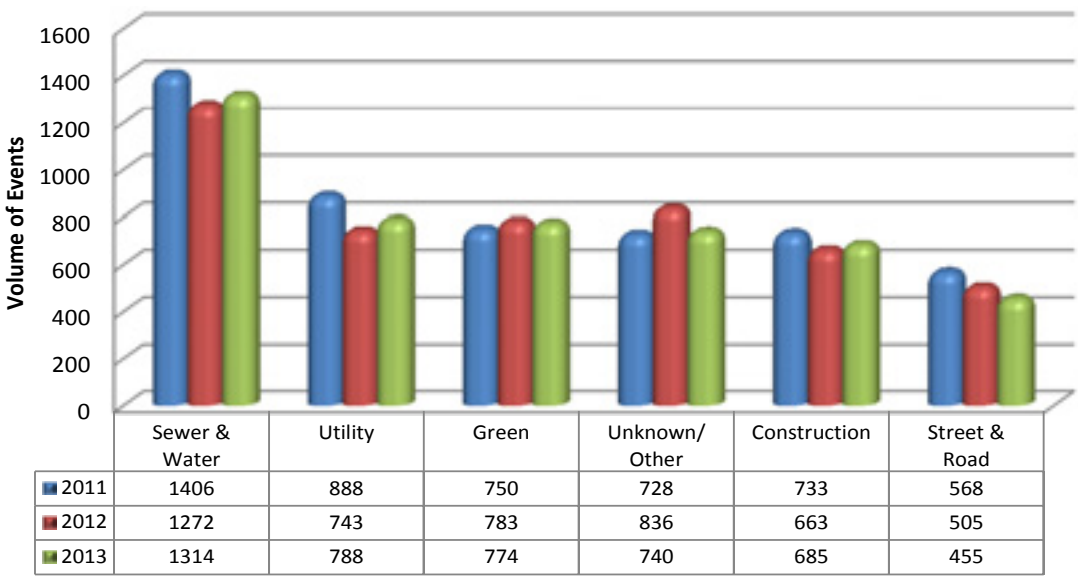
- Bell Canada

"[The DIRT Report] is a valuable resource that has all the pertinent information that is required for our records."

- Enersource

2.8 FACILITY EVENTS BY TYPE OF WORK PERFORMED

Figure 13 illustrates that the Sewer & Water and Utility work type groups continue to be involved in the majority of events. In 2013 we saw a slight increase in the number of events submitted under Sewer & Water.



	Sewer & Water	Utility	Green	Unknown/ Other	Construction	Street & Road
2011	1406	888	750	728	733	568
2012	1272	743	783	836	663	505
2013	1314	788	774	740	685	455

Figure 13: Facility Events Submitted by Type of Work Performed

Table 5 indicates which types of work are included in each group.

Group	Type of Work Performed	
Construction	Bldg. Construction	Grading
	Bldg. Demolition	Site Development
	Driveway	
Green	Agriculture	Landscaping
	Fencing	Waterway Improvement
	Irrigation	
Sewer & Water	Drainage	Water
	Sewer (Sanitary/Storm)	
Street & Road	Curb/Sidewalk	Storm
	Milling	Drain/Culvert
	Pole	Street Light
	Public Transit Authority	Traffic Sign
	Railroad Maintenance	Traffic Signal
	Road Work	
Utility	Cable TV	Natural Gas
	Electric	Telecommunications
	Liquid Pipeline	
Unknown/Other	Data not collected	Unknown/Other

Table 5: List of Work Included in each Work Group

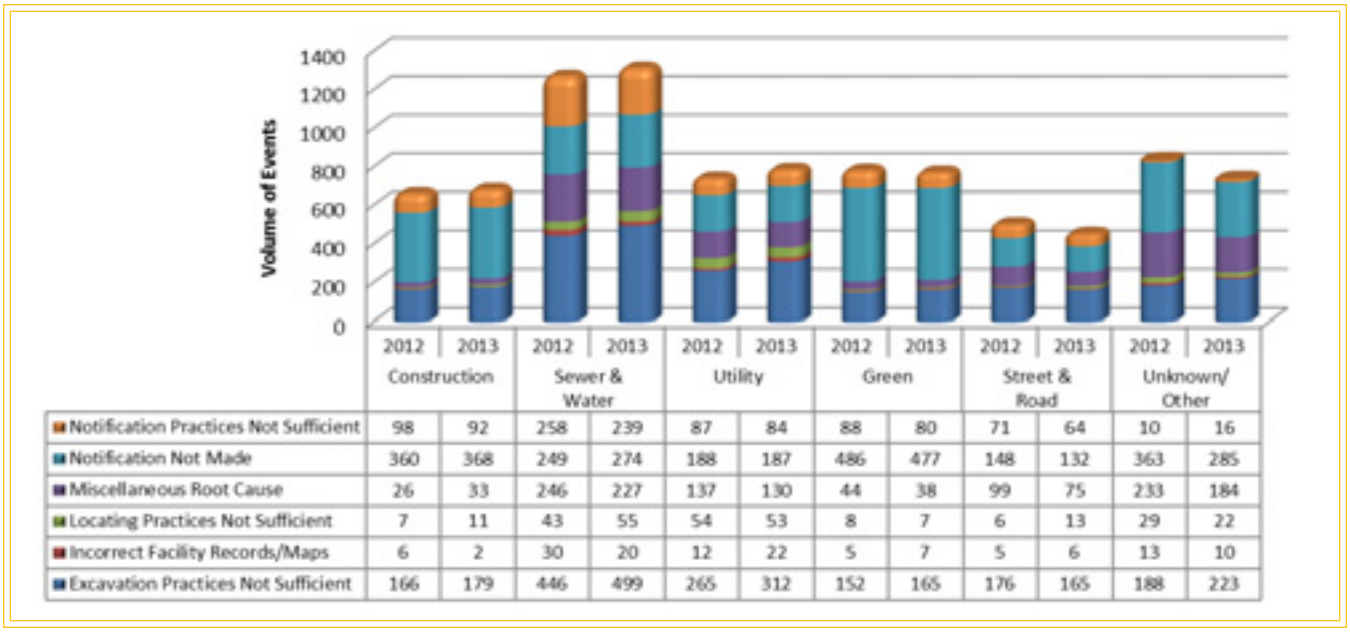
3.0 MULTI-FIELD ANALYSIS

3.1 ANALYSIS OF ROOT CAUSE AND FACILITIES AFFECTED BY TYPES OF WORK

The following charts illustrate the known root causes of events for the six work groups of Sewer & Water, Green, Construction, Utility, Street & Roadwork and Unknown/Other for the years 2012 and 2013.

Figure 14 illustrates that the Green and Construction industries have caused the greatest volume of events due to Notification Not Made. Increased awareness is needed to further reduce the number of events.

Did you know that you have to call for a locate when planting?



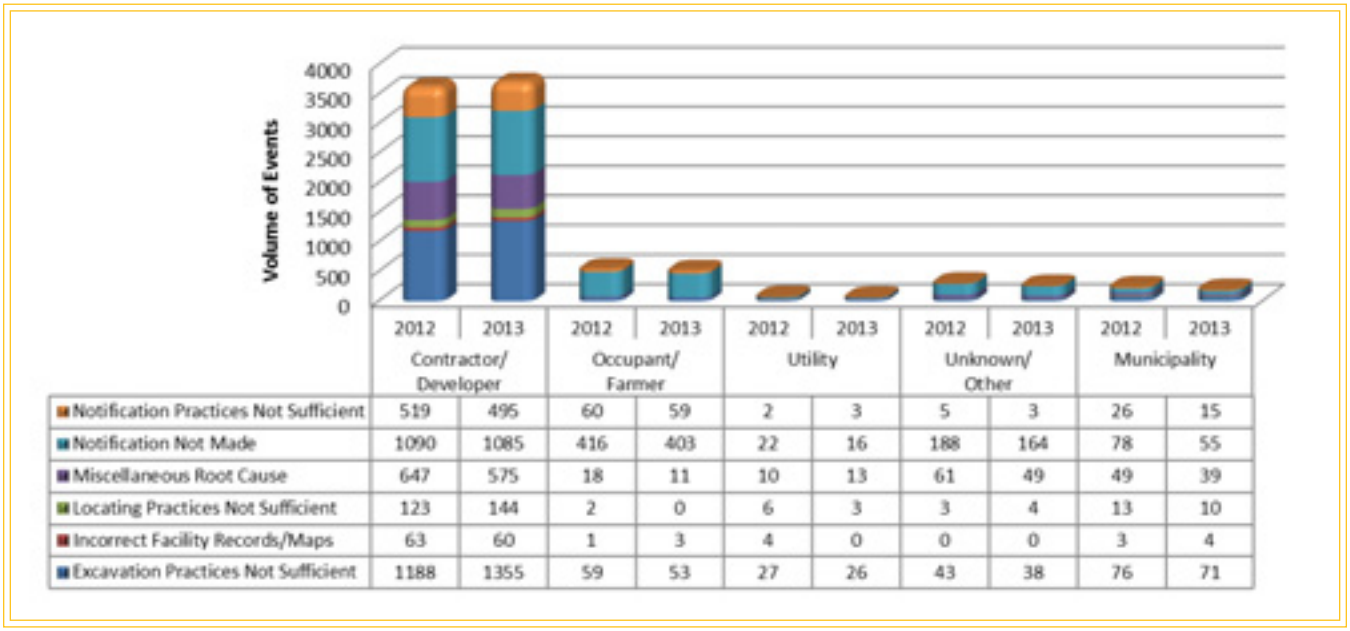
	2012 Construction	2013 Construction	2012 Sewer & Water	2013 Sewer & Water	2012 Utility	2013 Utility	2012 Green	2013 Green	2012 Street & Road	2013 Street & Road	2012 Unknown/ Other	2013 Unknown/ Other
Notification Practices Not Sufficient	98	92	258	239	87	84	88	80	71	64	10	16
Notification Not Made	360	368	249	274	188	187	486	477	148	132	363	285
Miscellaneous Root Cause	26	33	246	227	137	130	44	38	99	75	233	184
Locating Practices Not Sufficient	7	11	43	55	54	53	8	7	6	13	29	22
Incorrect Facility Records/Maps	6	2	30	20	12	22	5	7	5	6	13	10
Excavation Practices Not Sufficient	166	179	446	499	265	312	152	165	176	165	188	223

Figure 14: Facility Events by Root Cause Group and Industry

"DIRT allows for easy uploading of batch damage reports, which can then be used for data manipulation."

- Enbridge Gas Distribution

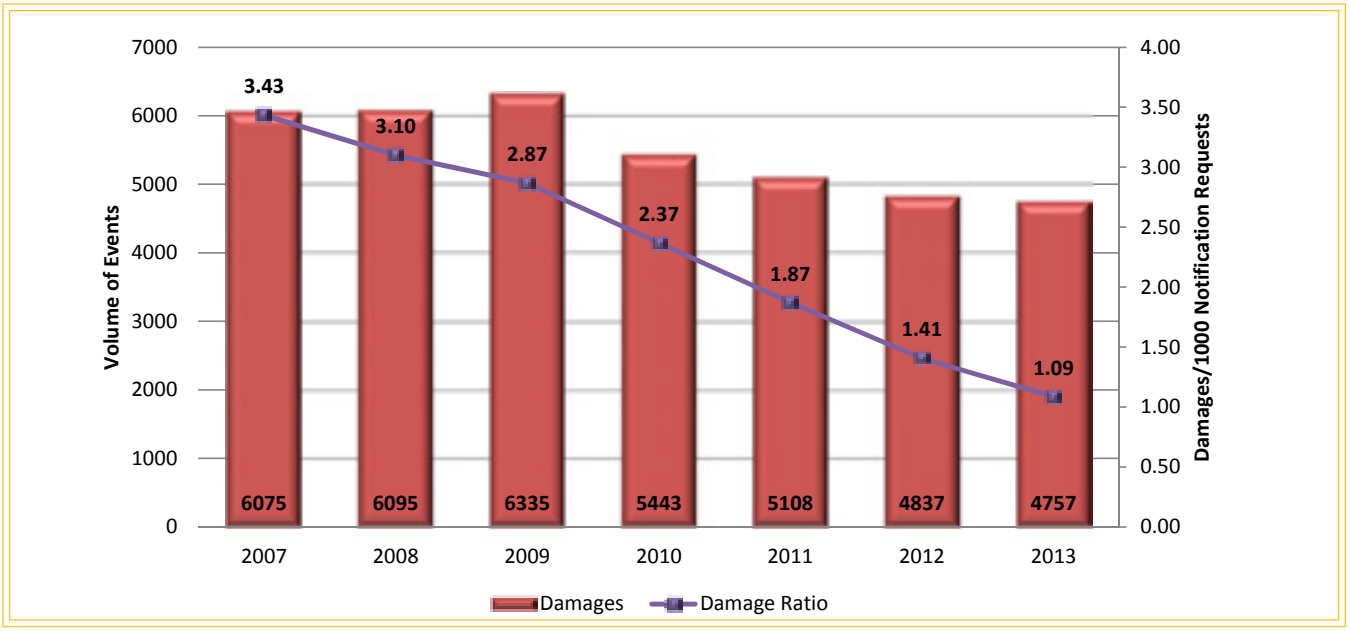
Figure 15 illustrates that the Contractor/Developer excavator type still represents the majority of events submitted under the Excavation Practices Not Sufficient category.



	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
	Contractor/ Developer		Occupant/ Farmer		Utility		Unknown/ Other		Municipality	
Notification Practices Not Sufficient	519	495	60	59	2	3	5	3	26	15
Notification Not Made	1090	1085	416	403	22	16	188	164	78	55
Miscellaneous Root Cause	647	575	18	11	10	13	61	49	49	39
Locating Practices Not Sufficient	123	144	2	0	6	3	3	4	13	10
Incorrect Facility Records/Maps	63	60	1	3	4	0	0	0	3	4
Excavation Practices Not Sufficient	1188	1355	59	53	27	26	43	38	76	71

Figure 15: Facility Events by Root Cause Category and Excavator Type

Figure 16 illustrates that the damage ratio over the past seven years against the volume of events. Industry practice is to measure damage prevention performance by the volume of damages per thousand notifications requested.



Mandatory Legislation has increased notification request base

Figure 16: Damage Ratio - Damages/1000 Notification Requests

4.0 INDUSTRY SPOTLIGHT

THE UNDERGROUND WORLD

By Terry Murphy C.L.P

FIRST GLANCE

At the end of 2012 when I looked at utility hits, it didn't look like we were improving much! Our goal was to reduce hits over 50% in the last three years. The three-year performance on hits was 360, 366 and 326. Did this look like a big improvement?

WHAT WAS WRONG?

Over the last three years, the industry was totally engaged in damage prevention and utility hit reduction. We wrote regular articles in the Landscape Ontario Publication, promoted damage prevention to the LO Board of Directors, had a focus at the Congress Trade Show, asked the Chapters to put it on their agendas for discussion, participated in the annual "ORCGA's Dig Safe" campaigns and attempted to give this issue of utility hit reduction a greater visibility. Why was our performance not better?

STATISTICAL ANALYSIS REVIEW

With any statistical analysis, one has to not only understand the data but zero in on the true stats. If you look closely, the true measure is Hits per 1000 locates, and the improvement was there. Over the last three years the improvement was 36% and over the last four years, the improvement was 60%. Tremendous results!

THE DATA

The annual comparison of hits for the Green Industry (not including waterway improvements) is as follows:

Table 1: Number of Utility Hits

YEAR	AGRICULTURE	FENCING	IRRIGATION	LANDSCAPING	TOTAL
2006	11	365	3	317	697
2007	1	422	3	386	812
2008	0	339	3	393	735
2009	2	365	5	542	914
2010	0	353	3	360	716
2011	0	320	5	360	685
2012	1	389	3	366	759
2013	0	419	1	326	746

Table 2: Total Green Industry Hits & Locate Requests

ITEM	2006	2007	2008	2009	2010	2011	2012	2013
Utility Hits	689	812	735	914	716	685	759	746
Locates/1000	95.83	99.38	108.59	113.98	114.58	125.34	139.53	148.02
Hits/1000	7.19	8.17	6.77	8.02	6.27	5.46	5.43	5.04
% Change		+13.6	-17.2	+18.5	-21.9	-12.0	-1.0	-7.18
Three Year Change							* - 19.62% *	

Table 3: Total Fencing Industry Hits & Locate Requests

ITEM	2006	2007	2008	2009	2010	2011	2012	2013
Utility Hits	366	422	339	365	353	320	389	419
Locates/1000	42.48	42.28	44.18	44.48	40.98	42.30	45.01	44.55
Hits/1000	8.62	9.98	7.76	8.19	8.61	7.48	8.64	9.41
% Change		+9.9	-12.4	+6.8	+5.1	-13.2	+15.5	+8.91
Three Year Change							* +9.29 % *	

Table 4: Total Landscape Industry Hits & Locate Requests

ITEM	2006	2007	2008	2009	2010	2011	2012	2013
Utility Hits	331	390	396	549	360	360	366	326
Locates/1000	53.34	57.10	64.40	60.40	73.61	82.55	94.52	103.47
Hits/1000	6.20	6.85	6.15	7.91	4.93	4.42	3.90	3.15
% Change		+10.2	-10.0	+28.6	-37.6	-10.3	-11.8	-19.23
Three Year Change							* -36.1 % *	

TRUE PERFORMANCE MEASUREMENT

The conclusion indicates that the true performance indicator is a comparison of the actual number of utility hits compared to the number of attempted excavations (Locates). Because the excavation or actual digging number (locate requests) are so large, we will use the Hits per 1000 Locates as the comparison figure. Similar to a batting average in baseball, we compare the actual hits to the number of times at bat (plate appearances) or attempts or chances to get a hit. The actual utility hits are tabulated by the ORCGA in their DIRT Report (Damage Information Reporting Tool) and the actual locate data comes from a separate organization namely, Ontario One Call.

LANDSCAPE INDUSTRY LOCATE DATA

The data is collected in 18 landscape categories over the last several years. This figure captures how many attempted excavations or diggings took place each year in the landscape industry. Last year, there were approximately 95,000 locate requests in our selected 18 categories related to the Landscape Industry sector and almost 140,000 for the Green Industry sector. So you can see that this was a rather exhaustive study.

RESULTS SHOW TREMENDOUS IMPROVEMENT

The results show that as a total Green Industry (Fencing, Agriculture, Irrigation, and Landscaping), we have reduced our Hits per 1000 locates by –36 % over the last three years. In Landscaping, we have reduced our Hits per 1000 locates by – 60.1% over 4 years. When I rejoined the ORCGA Board three years ago, I set out a personal target of a 50% reduction in three years. The landscape industry contractors have worked very hard to achieve this remarkable statistical result. THANK YOU AND CONGRATULATIONS!

Congratulations to all landscape industry contractors for your dedication and “Due Diligence” in obtaining locates and for “Digging Safe” on your projects. Keep it up!

You may contact Terry at tvmurphy@ca.inter.net with any comments, questions or suggestions on the article or any other issue on The Underground World.

5.0 REPORT FINDINGS

5.1 DATA QUALITY INDEX INDICATIONS

Table 10 indicates the Data Quality Index (DQI) for each individual part of the DIRT Field Form. The DQI is a measure of data quality and consists of the evaluation of each organization that submitted records, in addition to the evaluation of each record submitted to DIRT. The overall average DQI is 72.7%.

The weight assigned to the various DIRT parts varies based upon its value in analyzing the event for damage prevention purposes, with root cause receiving the largest weight. The overall DQI for a set of records can be obtained by averaging the individual DQI of each record. The "2013 DQI" column in the table below represents the average of all 4757 submitted events in the 2013 dataset.

DIRT Parts	Relative Weight	2011 DQI	2012 DQI	2013 DQI
A: Who is submitting this information?	5%	100.0	100.0	100.0
B: Date and Location of the event	12%	76.3	76.6	81.2
C: Affected Facility Information	12%	92.1	91.5	92.2
D: Excavation Information	12%	83.6	80.9	80.0
E&F: Notification, Locating and Marking	12%	90.8	90.7	91.1
G: Excavator Downtime	6%	10.7	11.7	11.0
H: Description of Damage	14%	29.4	32.4	29.3
I: Description of the Root Cause	25%	80.5	79.7	79.8
Total Weighted DQI	100%	72.8	72.7	72.7

Table 10: DIRT Submission Parts and DQI

Of the various parts of the damage report, Parts G: Excavator Downtime and H: Description of Damage are often not included, as most of the organizations inputting data into DIRT do not track this information. The DQI for Part G: Excavator Downtime has slightly decreased between 2012 and 2013.

5.2 STATUS & RECOMMENDATIONS

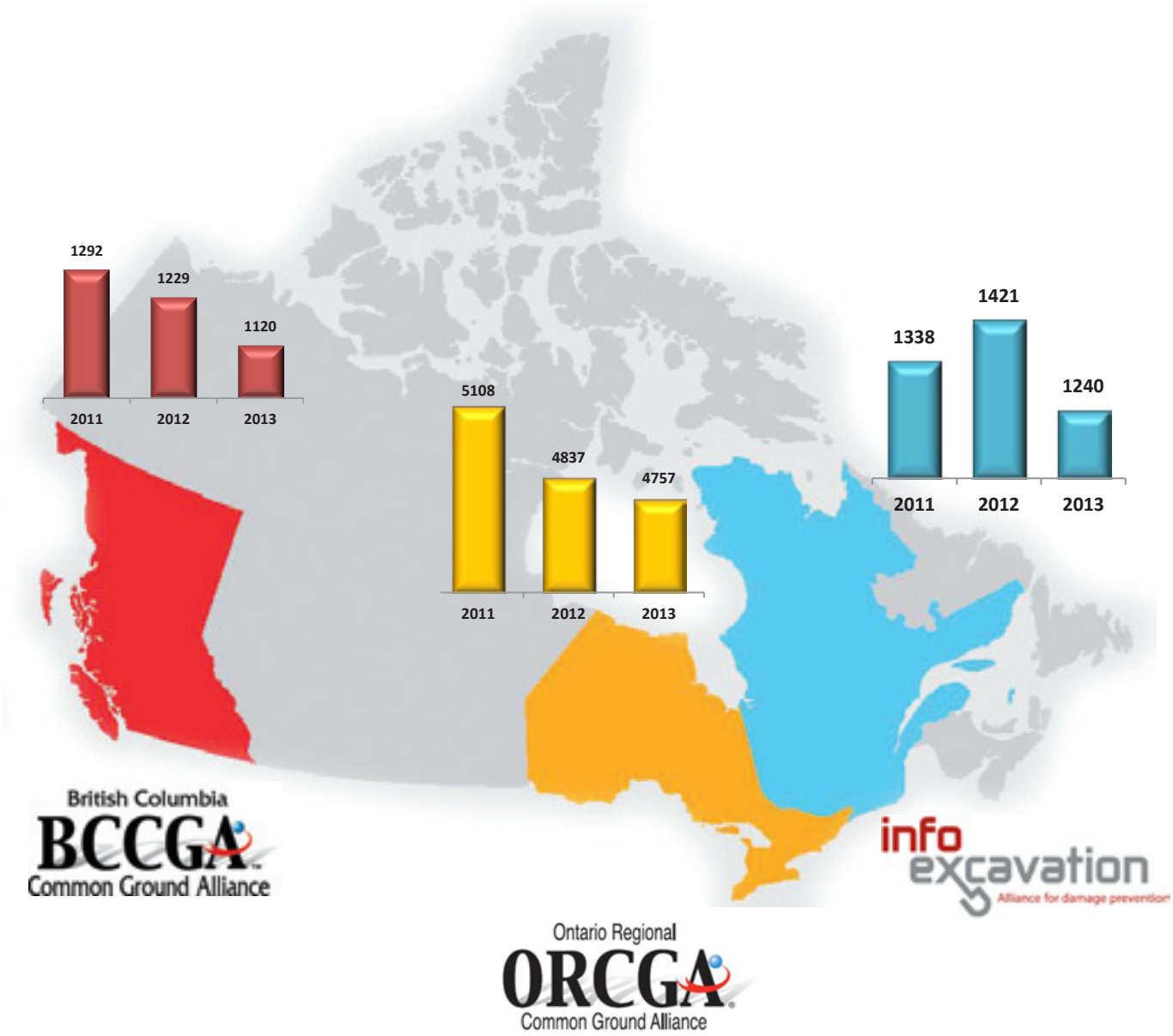
The ORCGA makes recommendations to damage prevention stakeholders based on analysis of the 2013 DIRT Report and are intended to enhance damage prevention efforts and the data collection process with a focus on the overall goal of reducing damages.

In order to increase confidence and clarity in the data, the R&E Committee has created a Root Cause Tip Card (Appendix A). This includes clear descriptions and examples of events that should be considered under each root cause category when reporting events in DIRT.

6.0 REGIONAL PARTNER DATA

The following information was provided by three Canadian Common Ground Alliance (CCGA) Regional partners. This data reflects the volume of events submitted by their members from 2011-2013.

Since 2003, DIRT has been the North American standard for data collection and reporting of underground damage information. The British Columbia Common Ground Allliance (BCCGA) joined the DIRT reporting community in 2011, releasing their first DIRT Report in September 2012. The Quebec Common Ground Alliance (QCCGA) joined DIRT in 2010, with their first report being released the same year.



7.0 EXCAVATOR OF THE YEAR

The Excavator of the Year distinction is presented to an excavator with the best-in-class safe digging practices. Each year a subset of the R&E Committee, consisting of representatives of each of the utilities, is tasked with reviewing each contractor's individual damage ratio. The damage ratio is dependent on the volume of locates, of which each excavator must have a minimum of 500, measured against the number of digging related damages to the underground structure. The recipient of the award is the excavator with the lowest damage ratio who best reflects the type of work in each category represented.

Gas

LINK LINE

Telecommunication

DYNA-CO

Sewer & Water

UTILITY FORCE INC.
UTILITY CONTRACTORS

Landscape

LOMCO
Lanscape Contractors

Homebuilder

Jacques Bédard Excavation Ltd.
Since 1969
824-3208

3006 TENTH LINE ROAD
NAVAN, ONT. K4B 1H8
FAX: 824-4321

Electric

SAFELINE
UTILITY SERVICES INC.

Roadbuilder

A. & F. DICARLO
CONSTRUCTION LTD.

Most Improved

B-LINE
TRENCHING INC.

APPENDIX A: ROOT CAUSE TIP CARD

Root Cause Tip Card

LOCATING PRACTICES NOT SUFFICIENT

Facility could not be found or located

Type of facility or lack of records prevented locating of facility.

Example: Plastic pipelines installed without tracer wire.

Facility marking or location not sufficient

Includes all areas where marking was insufficient.

Example: Locator marked the work zone, but missed a service.

Locator misread the ticket and did not locate the entire work zone.

Locator did not use records or interpreted the records incorrectly.

Locator did not tone correctly.

Facility was outside the tolerance zone.

Facility was not located or marked

No locating or marking was completed prior to excavation activities.

Example: The company received a valid ticket but did not mark, locate, or communicate with the excavator prior to start of work.

Incorrect facility records/maps

Incorrect facility records or maps led to an incorrect locate.

Example: Records show the facility located on the wrong side of the street and ticket was cleared.

Records do not accurately reflect current plant status.

ONE-CALL NOTIFICATION PRACTICES NOT SUFFICIENT

No Notification made to the One-Call Centre

Excavator did not call the one-call centre.

Notification to one-call centre made, but not sufficient

The Excavator contacted the notification centre, but did not provide sufficient information, or the excavator did not provide sufficient notification time according to requirements and guidelines.

Example: Excavator did not wait for the locate to be completed prior to digging.

Excavator was excavating with an expired locate.

Excavator was excavating outside of the located area.

Excavator was excavating without the locate onsite.

Wrong information Provided to the one-call centre

Damage occurred because an excavator provided the wrong excavation information to the notification centre.

Example: Excavator indicated the wrong dig site.

After speaking with the excavator, the locator incorrectly cleared a ticket.

EXCAVATION PRACTICES NOT SUFFICIENT

Failure to maintain marks

The marks deteriorated or were lost and the excavator failed to request that they be restored/refreshed.

Failure to support exposed facilities

Facility damage due to lack of support in accordance with generally accepted engineering practices or guidelines.

Failure to use hand tools where required

Failure to test-hole (pot-hole)

Failure to verify physical location of the facility when working within tolerance zone as defined by accepted practices or guidelines.

Improper backfilling practices

Damage caused by improper materials (ex. Large/sharp rocks) in the backfill or improper compaction of the backfill.

Failure to maintain clearance

Excavator failed to maintain clearance (defined by applicable guidelines, law, and facility owners) from underground facilities when using power/ mechanical equipment.

Other insufficient excavation practices

Excavator errors that do not fall under one of the above.

MISCELLANEOUS ROOT CAUSES

One-Call Centre Error

Includes all issues related to the centre such as incorrectly entered data, ticket transmission failures, et al.

Example: This would include damages that occurred because the centre's database registry had not been updated to reflect correct location of underground facilities. The one-call centre system crashed and failed to deliver the ticket.

Abandoned Facility

Damage related to abandoned facilities.

Example: The abandoned facility may have been located, instead of the active facility. This does NOT include when an abandoned facility is thought to have been located, but it is found to be active after the excavation exposed the facility or damaged it.

Deteriorated Facility

Those situations in which an excavation disrupts the soil around the facility resulting in damage, failure or interruption of service. However, the deterioration and not the excavation caused the facility damage.

Previous Damage

Damage occurred during previous excavation.

Example: Pipe coating was damaged during a previous excavation and was not reported. Subsequently, a corrosion leak occurred, or subsequent excavation at the site revealed the damage to the pipe.

Data Not Collected

Damage occurred, but Root Cause was not identified.

Example: Damage Investigator did not indicate a Root Cause.

APPENDIX B: DAMAGE INFORMATION REPORTING FIELD FORM

Rev: 2/1/2012
'*' indicates a Required Field

Damage Information Reporting Tool (DIRT) - Field Form

Part A – Who is Submitting This Information

Who is providing the information?

☐ Electric ☐ Engineer/Design ☐ Equipment Manufacturer
☐ Excavator ☐ Insurance ☐ Liquid Pipeline ☐ Locator ☐ Natural Gas
☐ One-Call Center ☐ Private Water ☐ Public Works ☐ Railroad
☐ Road Builders ☐ State Regulator ☐ Telecommunications ☐ Unknown/Other

Name of the person providing the information:

Part B - Date and Location of Event

***Date of Event:** (MM/DD/YYYY)
***Country** ***State** ***County** **City**
Street address **Nearest Intersection**
***Right of Way where event occurred**

Public: ☐ City Street ☐ State Highway ☐ County Road ☐ Interstate Highway ☐ Public-Other
Private: ☐ Private Business ☐ Private Land Owner ☐ Private Easement
☐ Pipeline ☐ Power /Transmission Line ☐ Dedicated Public Utility Easement
☐ Federal Land ☐ Railroad ☐ Data not collected ☐ Unknown/Other

Part C – Affected Facility Information

***What type of facility operation was affected?**

☐ Cable Television ☐ Electric ☐ Natural Gas ☐ Liquid Pipeline ☐ Sewer (Sanitary Sewer)
☐ Steam ☐ Telecommunications ☐ Water ☐ Unknown/Other

***What type of facility was affected?**

☐ Distribution ☐ Gathering ☐ Service/Drop ☐ Transmission ☐ Unknown/Other

Was the facility part of a joint trench?

☐ Unknown ☐ Yes ☐ No

Was the facility owner a member of One-Call Center?

☐ Unknown ☐ Yes ☐ No

Part D – Excavation Information

***Type of Excavator**

☐ Contractor ☐ County ☐ Developer ☐ Farmer ☐ Municipality ☐ Occupant
☐ Railroad ☐ State ☐ Utility ☐ Data not collected ☐ Unknown/Other

***Type of Excavation Equipment**

☐ Auger ☐ Backhoe/Trackhoe ☐ Boring ☐ Drilling ☐ Directional Drilling
☐ Explosives ☐ Farm Equipment ☐ Grader/Scraper ☐ Hand Tools ☐ Milling Equipment
☐ Probing Device ☐ Trencher ☐ Vacuum Equipment ☐ Data Not Collected ☐ Unknown/Other

***Type of Work Performed**

☐ Agriculture ☐ Cable Television ☐ Curb/Sidewalk ☐ Bldg. Construction ☐ Bldg. Demolition
☐ Drainage ☐ Driveway ☐ Electric ☐ Engineering/Survey ☐ Fencing
☐ Grading ☐ Irrigation ☐ Landscaping ☐ Liquid Pipeline ☐ Milling
☐ Natural Gas ☐ Pole ☐ Public Transit Auth. ☐ Railroad Maint. ☐ Road Work
☐ Sewer (San/Storm) ☐ Site Development ☐ Steam ☐ Storm Drain/Culvert ☐ Street Light
☐ Telecommunication ☐ Traffic Signal ☐ Traffic Sign ☐ Water ☐ Waterway Improvement
☐ Data Not Collected ☐ Unknown/Other

Part E – Notification

***Was the One-Call Center notified?**

☐ Yes (If Yes, Part F is required) ☐ No (If No, Skip Part F)

If Yes, which One-Call Center?
If Yes, please provide the ticket number

Part F - Locating and Marking

***Type of Locator**

☐ Utility Owner ☐ Contract Locator ☐ Data Not Collected ☐ Unknown/Other

***Were facility marks visible in the area of excavation?**

☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other

***Were facilities marked correctly?**

☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other

Part G – Excavator Downtime

Did Excavator incur down time?
☐ Yes ☐ No
If yes, how much time?
☐ Unknown ☐ Less than 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 or more hours Exact Value _____

Estimated cost of down time?
☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____

Part H – Description of Damage

***Was there damage to a facility?**
☐ Yes ☐ No (i.e. near miss)
***Did the damage cause an interruption in service?**
☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other
If yes, duration of interruption
☐ Unknown ☐ Less than 1 hour ☐ 1 to 2 hrs ☐ 2 to 4 hrs ☐ 4 to 8 hrs ☐ 8 to 12 hrs ☐ 12 to 24 hrs
☐ 1 to 2 days ☐ 2 to 3 days ☐ 3 or more days ☐ Data Not Collected Exact Value _____
Approximately how many customers were affected?
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 10 ☐ 11 to 50 ☐ 51 or more Exact Value _____
Estimated cost of damage / repair/restoration
☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____
Number of people injured
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____
Number of fatalities
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____

*Part I – Description of the Root Cause

***Please choose one**

One-Call Notification Practices Not Sufficient
☐ No notification made to the One-Call Center
☐ Notification to one-call center made, but not sufficient
☐ Wrong information provided to One Call Center

Excavation Practices Not Sufficient
☐ Failure to maintain marks
☐ Failure to support exposed facilities
☐ Failure to use hand tools where required
☐ Failure to test-hole (pot-hole)
☐ Improper backfilling practices
☐ Failure to maintain clearance
☐ Other insufficient excavation practices

Locating Practices Not Sufficient
☐ Facility could not be found or located
☐ Facility marking or location not sufficient
☐ Facility was not located or marked
☐ Incorrect facility records/maps

Miscellaneous Root Causes
☐ One-Call Center error
☐ Abandoned facility
☐ Deteriorated facility
☐ Previous damage
☐ Data Not Collected
☐ Other

Part J – Additional Comments

Visit DIRT at www.cga-dirt.com

APPENDIX C: GLOSSARY OF TERMS

Abandoned Line or Facility: Any underground or submerged line or facility no longer in use.

Backfill: To fill the void created by excavating.

CCGA: The Canadian Common Ground Alliance's (CCGA) primary role is to manage damage prevention issues of national interest that Regional Partners consider best addressed through a single voice.

CGA: The Common Ground Alliance (CGA) is a member-driven association dedicated to ensuring public safety, environmental protection, and the integrity of services by promoting effective damage prevention practices.

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 the housing for the line device or facility.

Demolition Work: The partial or complete destruction by any means of a structure served by, or adjacent to, an underground line or facility.

DIRT: Damage Information Reporting Tool.

Downtime: Lost time reported by a stakeholder on the Damage Information Reporting Tool (DIRT) field form for an excavation project due to failure of one or more stakeholders to comply with applicable damage prevention regulations.

DQI: The Data Quality Index (DQI) is a measure of data quality and consists of the evaluation of each organization that submitted records, in addition to the evaluation of each record submitted to DIRT.

Event: The occurrence of an underground infrastructure damage, near miss, or downtime.

Excavate or Excavation: Any operation using non-mechanized or mechanized equipment, demolition or explosives in the movement of earth, rock or other material below existing grade.

Excavator: Any person proposing to excavate or engaging in excavation or demolition work for himself or for another person.

Facility: An underground or submerged conductor, pipe or structure used in providing electric or communications service (including, but not limited to, traffic control loops and similar underground or submerged devices), or an underground or submerged pipe used in carrying, providing, or gathering gas, oil or oil product, sewage, storm drainage, water, or other liquid service (including, but not limited to, irrigation systems), and appurtenances thereto.

Facility Owner/Operator: Any person, utility, municipality, authority, political subdivision, or other person or entity who owns, operates, or controls the operation of an underground line/facility.

Grade: The surface of the earth (i.e., ground level) upon which a structure is built or prepared.

Joint Trench: A trench containing two or more underground infrastructures that are buried together by design or agreement.

Locate (noun): The provision of location information by an underground facility owner (or their agent) in the form of ground surface markings and/or facility location documentation, such as drawings, mapping, numeric description or other written documentation.

Locate (verb): The process of an underground plant owner/operator or their agent providing information to an excavator which enables them to determine the location of a facility.

Locate Request: A communication between an excavator and one call centre personnel in which a request for locating underground facilities is processed.

Locator: A person whose job is to locate underground infrastructure.

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

Notification: Ticket data transmitted to underground infrastructure owner by the One Call Centre.

One Call Center: A system through which a person can with only one phone call or other communications, notify multiple facility owners/operators of proposed excavations.

ORCGA: The Ontario Regional Common Ground Alliance (ORCGA) is a Regional Partner of both the Common Ground Alliance (CGA) and the Canadian Common Ground Alliance (CCGA). It is a non-profit organization promoting efficient and effective damage prevention for Ontario's vital underground infrastructure.

Person: Any individual or legal entity, public or private.

Public: The general population or community at large.

Root Cause: The primary reason an event occurred.

Test Hole: Exposure of a facility by safe excavation practices used to ascertain the precise horizontal and vertical position of underground lines or facilities.

Ticket: All the data required from an excavator by the One Call Centre to transmit a valid Notification to the buried infrastructure owner (Member).

Ticket number: A unique identification number assigned by the one call center to each locate request.

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

Vacuum Excavation: A means of soil extraction through vacuum where water or air jet devices are commonly used for breaking the ground.

DAMAGE INFORMATION REPORTING TOOL (DIRT)

An online database application used to capture information pertaining to underground infrastructure damage

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