

Leica Detection Solutions
Technology to identify
Underground assets

PART OF
HEXAGON

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Geosystems



A TRADITION IN PRECISION

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Leica Geosystems

Who We Are



A global company supporting measurement professionals worldwide

Revolutionizing the world of measurement and survey for nearly 200 years, Leica Geosystems is the industry leader in measurement and information technologies. We create complete solutions for professionals across the planet. Known for innovative product and solution development, professionals in a diverse mix of industries, such as surveying and engineering, building and heavy construction, safety and security, and power and plant trust Leica Geosystems for all their geospatial needs.

With precise and accurate instruments, sophisticated software, and trusted services, Leica Geosystems delivers value every day to those shaping the future of our world.

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Leica Geosystems
Global Presence

Corporate office in **Switzerland**. Sales,
Marketing & Service in **33** countries

More than **3,800 employees** in **46 countries**.
More than **700 employees** dedicated to Sales
& Marketing

more than
100,000
customers served
each year

3 production
facilities on 2
continents

Development centers
on **4** continents

over **260**
service centers in
87 countries

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What is Utility Detection

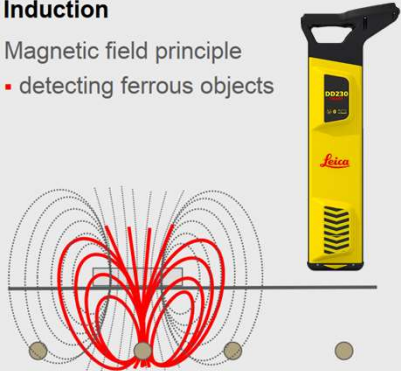
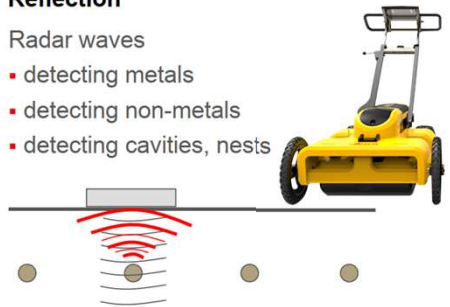
The changing environment and increasing population brings more utilities, which must be continuously maintained and repaired

CHALLENGE:
What are the precise locations of these utilities?

Continuing changing environment and increasing population bring the need to construct more buildings and renovate existing ones – we can see the change easily by looking at the streets, the paint mark show the location of utility, pavement scars.

Utilities, must be maintained or repaired continuously. The main challenge for this change is not knowing the accurate position of the utilities. Without knowing the accurate position of utilities, we can't plan them. The quality of detection and the maps is very important – if the location of the utility is wrongly detected, or if the utility cannot be detected, this can lead to hazardous accidents and damages. In order to protect people and assets, the quality of detection and mapping must be ensured.

Technology

<p>Induction</p> <p>Magnetic field principle</p> <ul style="list-style-type: none">▪ detecting ferrous objects  <ul style="list-style-type: none">+ good accuracy for depth and location+ not influenced by water or soil condition- only metal objects	<p>Reflection</p> <p>Radar waves</p> <ul style="list-style-type: none">▪ detecting metals▪ detecting non-metals▪ detecting cavities, nests  <ul style="list-style-type: none">+ layout for virtually everything+ depth penetration- echo signals difficult to interpret- results greatly affected by base material, spacing of objects- Depth reading accuracy
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This section is where we discuss the two different technologies which Leica offers to the detection market. The + mean that the tool is good at that application and – means poor. Locators are good at finding metallic lines, their depth measurements when used with a transmitter, and the depth accuracy is +/- 5%.

GPR is fantastic at finding everything which is also the worst part of GPR. The user typically have to interpret the return signals which can be difficult, we also have echo signals which make this even harder. Depth accuracy is difficult as we are measuring the two way travel time of a signal. If we think of a laser distance meter where we send a laser beam to a surface, we measure the time it takes to go to the surface and back. We know the density of air so such measurements are very accurate. With GPR, we have no idea what material our signals are traveling through. Software calculates the two-way travel time to make this as accurate as possible but the over all accuracy is approximately +/- 15 – 20%

What is 811



Mandatory before starting an excavation project

Free service

Locates all underground utilities from the street to the service meter

Any utility beyond the service meter is usually considered a private utility

Any digging requires contacting your 811 center, either by calling 811 from anywhere in the U.S. or making your request through your state 811 website. No matter what sort of excavation is happening a call must be made to 811, a new mail box, fence, any time ground is broken even on private property you must call 811.

811 only use EML (electromagnetic Locators) to detect utilities, if the line is plastic they will utilize a map and spray in accordance with it. If a utility isn't part of the 811 program, this utility will not be located, abandoned lines will also not be located. So, during excavation how do you know if you have found the new gas line or the old abandoned gas line? 811 will only mark the new.

What are Private Locates

Necessary when utility/service lines are privately owned (over 65% of all buried utilities inside properties)

Lines typically installed by property owner or builder

Gives additional information such as depth estimates

Has ability to find nonconductive utilities without tracer lines, such as abandoned facilities



Private locates cover all utilities which need to be located. This work typically utilizes EML and also GPR. They will do all they can to locate the utilities within the excavation area. They will supply depth measurements where possible and also have the ability to document. The technology we have in Leica allows the contract to perform these tasks himself, quickly and simply.

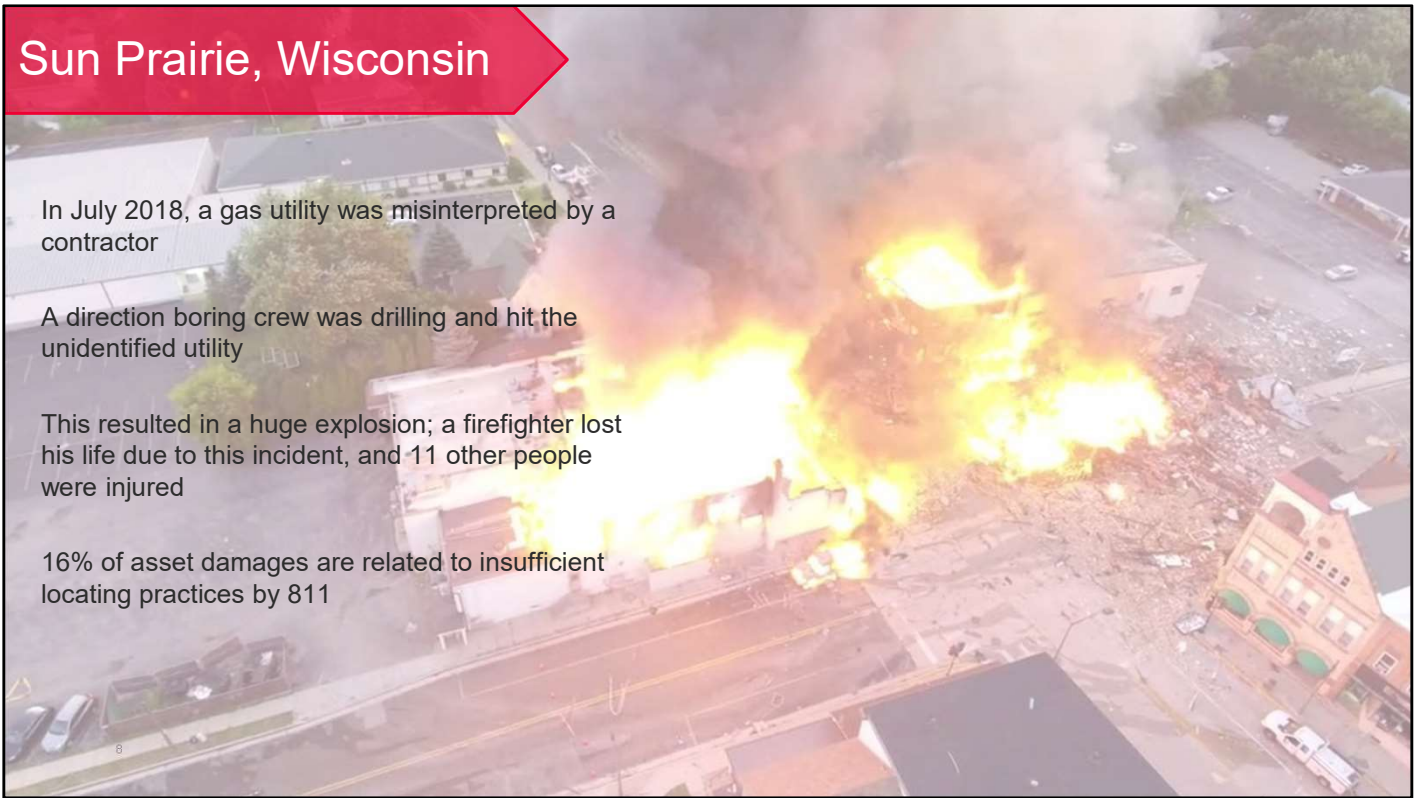
Sun Prairie, Wisconsin

In July 2018, a gas utility was misinterpreted by a contractor

A direction boring crew was drilling and hit the unidentified utility

This resulted in a huge explosion; a firefighter lost his life due to this incident, and 11 other people were injured

16% of asset damages are related to insufficient locating practices by 811



The incident which is show above occurred in 2018. Mistakes happen, they happen not only by contractors but mistakes can also occur with locators also. So, why would a contractor trust only 811 marks? Wouldn't you want to check?

Damage Prevention

Examples of Daily Mis-Marked Line 7' off mark

- A mismarked telecommunication line that was damaged.
- It was 7 ft off the mark.
- This occurred at a sewer project in Montgomery County in May 2017.
- The crew experienced 45 minutes of standby time and management costs contacting the facility owner.
- One resident was left without service.



Mis-Marked Line 32" off mark



Gas Co. marked their old, abandoned steel gas line which excavator found Successfully. Live PVC gas line was not marked and found (and broke) 32" From the mark for the steel gas line. This happened during the winter and 200+ Homes were without heat. Gas Co. won eventual \$100,000+ lawsuit for damages. EVEN MARKS OFF BY INCHES CAN BE A VERY BIG DEAL!

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There are many examples of miss marked utilities, not only is this a danger for individuals that are digging but there are also huge financial implications. Forget about fines and reinstatement costs. On the job cost also need to be taken into account. If / when a utility is hit then works stops, but the people and machines are still present and are still a cost to the business. For example a typically job will have the following

- Superintendent
- Foreman
- Operators x 2
- Laborer
- Pipes Layer
- Equipment
- Rented equipment

Costs

- Approximately \$1,700 / hr

Safety & Damage Prevention

...Putting it all together

- Estimated damage incidents in USA increased from 439,000 to 509,000 in 2018, a 16% increase
 - Actual reported damages hit an all time high of 440,709 incidents
 - Over \$600 Million in Damages in the USA
- 36% of damages with a known cause, were due to excavation issues, 26% due to no notification made, and 24% Locating Issues
- Leading known type of excavation damages = 69% Contractors, 12% Utilities



What is happening within the industry to help reduce the strikes, are 811 improving. Each year the common ground alliance who is responsible for 811 produces the DIRT report. The Damage Incident Reporting Tool (DIRT) details all reported utility strikes, they look at root causes and why the strike occurred. What we can say is that we are hitting more utilities, we are excavating more but only using 811 will not reduce the utility strikes contractors face. It is the perfect starting point, but should be seen as a tool within their tool box, they should check the marks, look for additional utilities which may be present.

The Common ground alliance also produce a best practices document which also support the excavation contractor while digging.

Key Trends and Implications- Detection

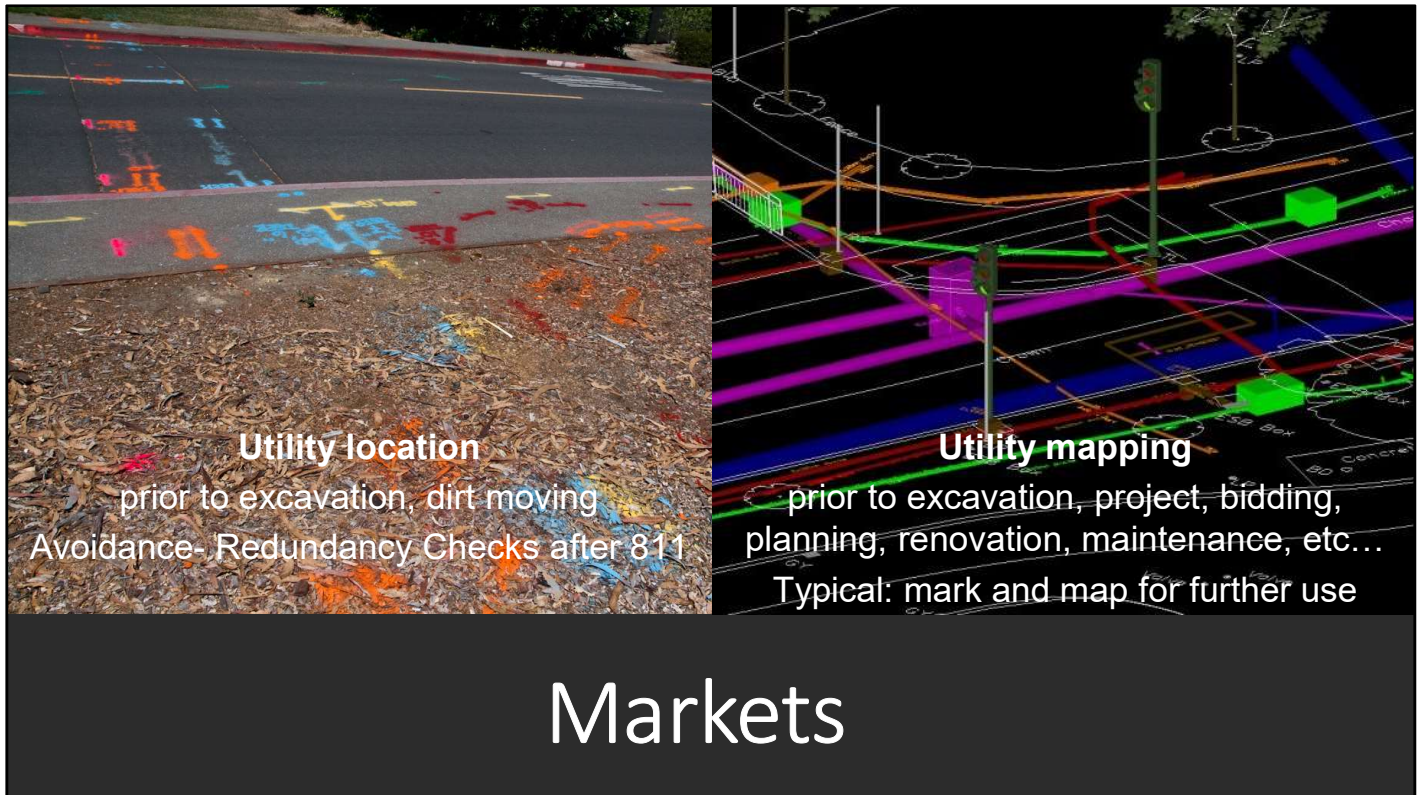
Trend	Implications
<ul style="list-style-type: none">▪ Damage Incidents Increasing Nationally	<ul style="list-style-type: none">▪ Excavators under greater pressures for avoidance
<ul style="list-style-type: none">▪ Reliability for 811 locates inconsistent	<ul style="list-style-type: none">▪ Cost Increases, Safety Hazards & Liabilities facing Contractors and Excavators
<ul style="list-style-type: none">▪ Contractors seeking solutions to avoid utilities and risks	<ul style="list-style-type: none">▪ Technology filling the gaps

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It is also time to point out that we currently have the most efficient machines possible for playing pipe, if this is excavation or drilling. What is interesting that that the volume of pipe been installed by a single machines hasn't increased by the amount of efficiency gains machine manufacture have delivered. These efficiency gains are been lost mainly to utility strikes.



The products which Leica offer serve mainly two markets, this being the utility location or constructions markets. These are contractors / users who which to check 811 marks, check and locate additional utilities which may be present on private property. Their goal is to be as safe as possible during excavation.

The other market is utility mapping. This is where a 3D map will be created for the design phase of a project. All utilities will need to be located, and identify correctly so accurate maps can be created. Such a discipline utilizes multi technologies, not only detection tools but also measurement tools which Leica are the only manufacture to be able to offer system solutions.



Leica DD Locators

Simple, effective utility avoidance solutions

DD120 Utility Locators



For construction professionals who need to understand what is beneath their sites

The new Leica DD120 is a simple, intuitive locator designed to allow operators to detect and avoid buried utilities throughout the construction phase.

Automated pinpointing process improves the detection of utilities, reducing utility damage and improving workforce safety

The DD120 is a basic locator, utilizes power, and radio modes. This means we can use the locator without the transmitter to find power lines under load and potential metallic lines. When used with a transmitter additional metallic lines can be located such a telecom and depth measurements can be taken.

DD130 Utility Locators



For all professionals who need to accurately locate and trace buried utilities

The new Leica DD130 features additional tracing capabilities and increased depth detection in an easy, intuitive product.

Delivers consistent and precise location capabilities for increased user confidence

The DD130 builds on the DD120 - it offers additional frequency modes of 512Hz and 640Hz. These frequencies enable long distance tracing but more importantly, allow users to find the end of sewer inspection cameras which generally produce a 512Hz. The unit also has the added feature of "current measurement". Current measurement is used for target line identification. When the transmitter is connected to the target utility, the locator can measure the transmitted power. If a trace signal is detectable on more than one utility, the signal strength determines the appropriate target line as the highest current reading, which is the line connected to the transmitter.



Leica DD SMART Locators

Simple, effective utility avoidance solutions

DD SMART Utility Locators

DD220 SMART

- Best in class detection performance
- SMART Technology for a connected world
- Depth estimation to 7 metres (23 feet)
- Good-to-Go™ Health check
- IP66 rating - dust and water proof
- 3 Year warranty

This is the updated version of the DD120, has a better detection rate a due to a innovative aerial design, a deeper detection range, and a new 131kHz for find smaller diameter cables. The transmitter must still be used for depth measurements.

DD SMART Utility Locators

DD230 SMART

- Best in class tracing performance
- SMART Technology for a connected world
- Additional tracing frequencies
- Current measurement
- Depth estimation to 10 metres (33 feet)
- Good-to-Go™ Health check
- IP66 rating - dust and water proof
- 3 Year warranty



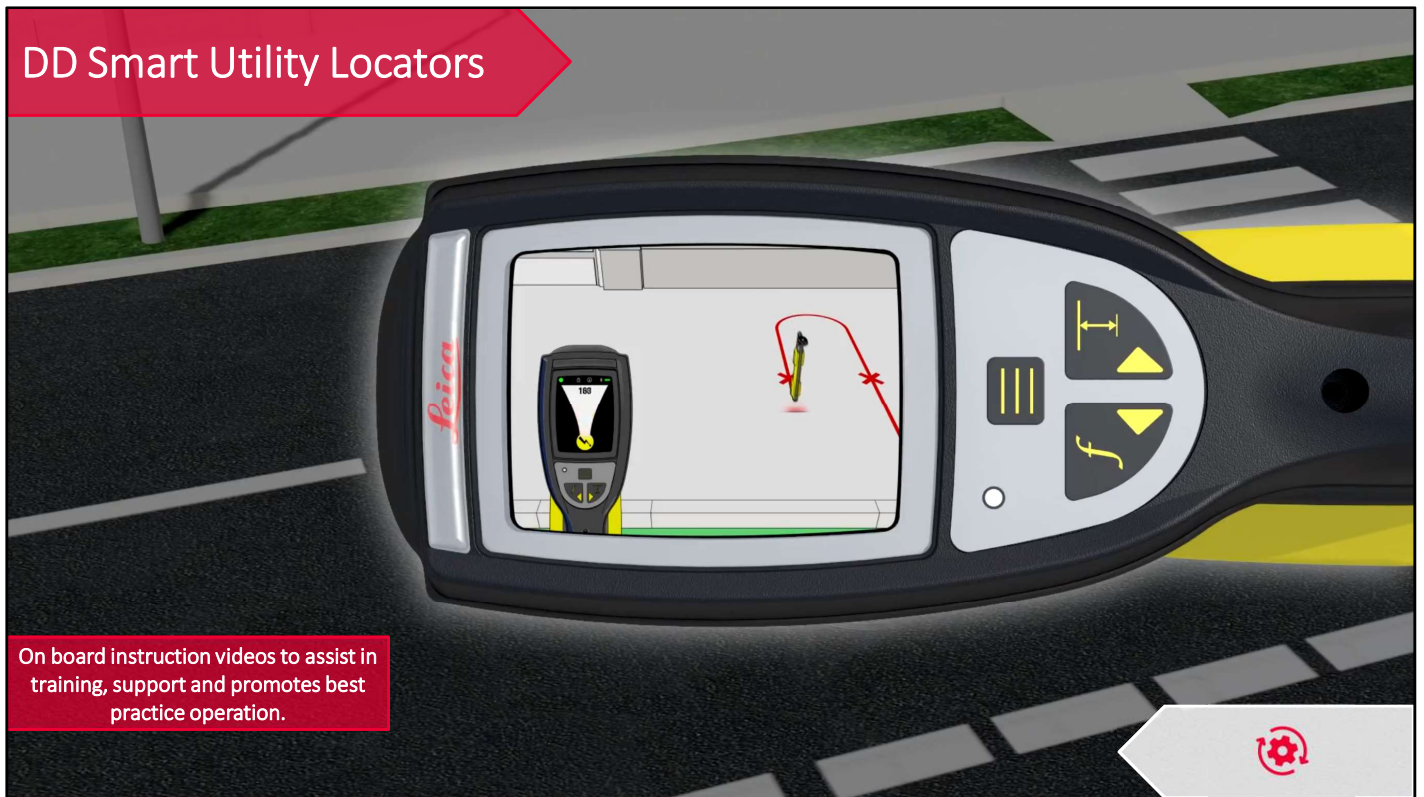
This follows the same protocol as the DD120 – DD130 and includes current measurement and two additional trace frequencies of 512Hz and 640Hz.

DD Smart Utility Locators



The built in icon based navigation menu allows setting to be changed quickly and easily - more importantly, it allows fast access to the health check to ensure the locator is working properly to detect, locate, trace, or avoid utilities. The on-board videos are also accessed from this screen – NEXT SLIDE

DD Smart Utility Locators



On board instruction videos to assist in training, support and promotes best practice operation.

The built-in videos allow users to be simply trained on the different aspects of the locator. These short “how to” videos are conveniently loaded right on the tool and saves contractors from going to YouTube or some other website to find operational instructions.

DD Smart Utility Locators



Simple, numeric and graphical signal strength indicator. Allows utilities to be located faster and more accurately

The Locators, both the DD100 & DD200 series, are fully automated. There are no controls to adjust while detecting utilities. The contractor simply walks forward, watches the bar graph rise (the yellow cone show). The systems also have a numeric and audio indication as well. When the highest number, bar graph reading, or audio is shown, this is then center of the utility.

DD Smart Utility Locators



Overview of the locators - notice the Li-ion batteries which come with a two year warranty.

SMART Technology

Open the door to a connected world

0101
1010

Data Logging

Data stored to internal memory including GPS positioning



GPS

Assists report visualisation, providing a clearer view of site activities



Bluetooth Connectivity

Wireless connection to mobile devices, upload data to cloud based analysis software



USB

Wired connectivity to office based analysis software



What is Smart Technology?

- Data logging - while using the locators, the displayed information is recorded every second. This can best be used training, monitor KPI's, or even in the event of a utility strike, to prove a locator was actually used
- GPS positioning - the GPS data gives the approximate coordinates to within 12ft of where the locator has been used (can't be used for mapping). The data is transmitted from the locator via Bluetooth to a smart phone, and automatically uploaded to the cloud so the data can be access anywhere. It can also be done via cable if the customer prefers.



Utility Detection Systems

Precision solutions for avoidance, traceability & utility mapping

Leica ULTRA

ULTRA Locator

- Large clear display
- Supports 17 user languages
- Multi frequency operation (configurable 50 Hz to 200 kHz)
- Compass style utility direction indication
- Selectable antenna configuration for operator preference
- Direction enabled for superior Utility identification and tracing
- Remote control of transmitter*
- AIM® signal interference monitoring system*
- Offset measuring of distance and depth*

ULTRA Transmitter

- 12 or 5 Watt output power
- Li-ion battery option
- Remote controlled from Locator*
- Dual output operation for faster tracing of multiple utilities*
- External 12 V DC power for extended operation*



The ULTRA is a trace locator designed professionals.

The complexity of this unit increases where the users has to make adjustments to enable them to locate utilities. The compass arrows helps with direction and guides the contractor in the direction of the utility. The unit can be loaded with 100 frequencies.

- On the advanced units, there is a AIM feature which allows the user to select the optimum trace frequency for a particular activity
- Communication to the transmitter up to a working distance of 300ft.

Leica ULTRA



These accessories are design for specific applications:

- If “marker balls” are to be located, the boot is needed to find these particular frequencies
- Clamps and stethoscopes help locate utilities in tight bunches
- The “A” frame allows faults / breakages on the sheath of a power cable to be isolated for needed repairs



Utility Detection Systems – GPR DS2000

Precision solutions for avoidance, traceability & utility mapping

Leica DS2000

Dual Antenna, for shallow and deep service

User can see the small and shallow object and large and deep objects simultaneously.

Data Storage and Post Processing

User can work on the same project next day or post process the data

Easy reparation

Replaceable parts, less waiting time

System solution

Leica tablet, GNSS Rovers and locators for utility surveyors

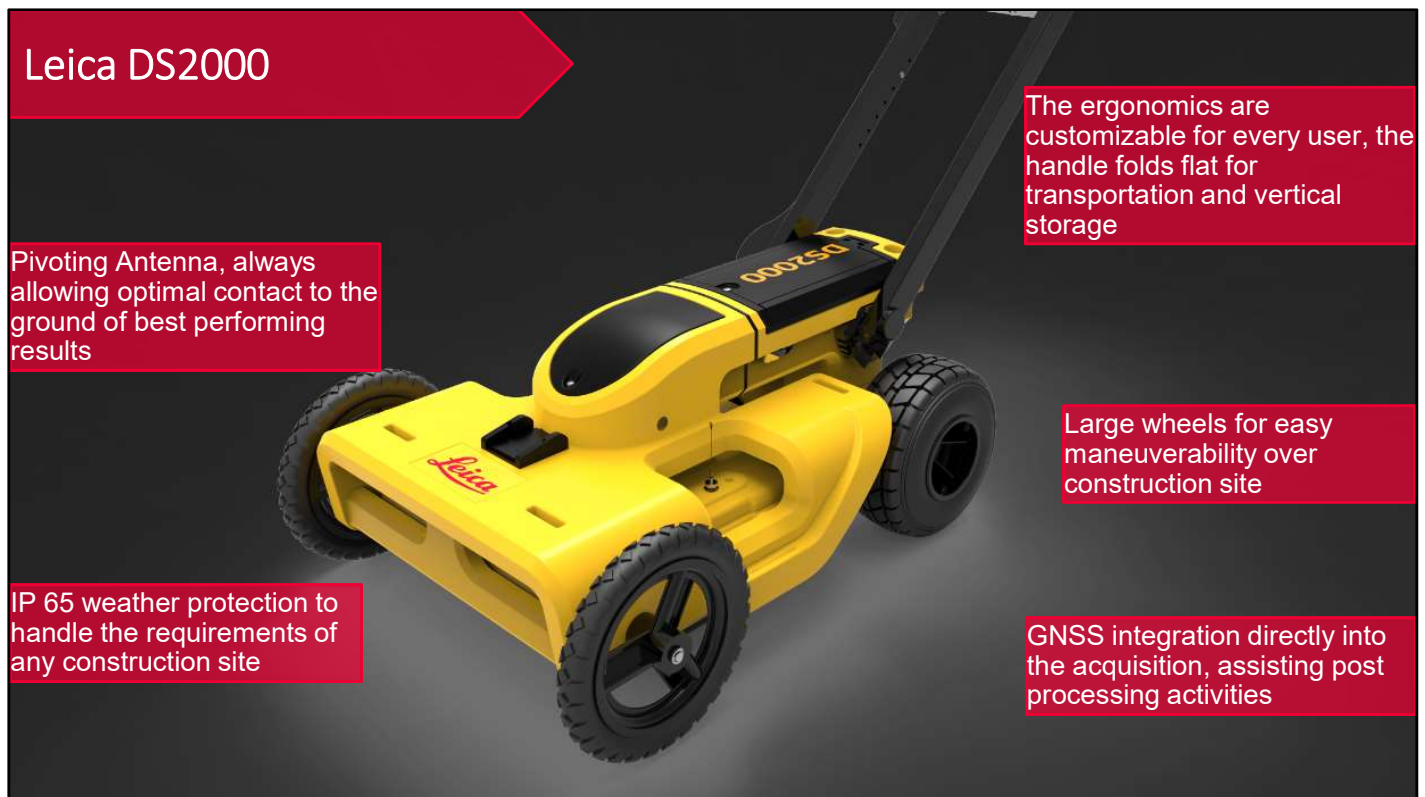


Dual Antenna GPR System

- 700MHz antenna (shallow) – used to find smaller utilities closer to the surface to depths of approx. +/- 5ft
- 250MHz antenna (deep) – used to find larger utilities deeper in the ground (up to 18ft if soil conditions are good)

The system does not need annual service:

- Wheel calibration can be done in the field / antennas are self-calibrating
- Wearable parts, such as the skid plate, can be installed by the contractor (wheels, battery, connecting cables can all be replace in the field)



Pivoting antenna – The unit has a 60 degree tilt left and right, this allows the antenna to maintain contact with the ground. The antenna must be in close contact to the ground as GPR uses “ground coupled antennas”. This tilt is needed due to the size of the unit to support it’s two antennas.

Ergonomics

- Handle is multi positional in height & rake and folds flat for transportation
- The large wheels allow the weight to be spread over soft ground to prevent sinking into the soil
- IP65 rating – water and dust resistant (can be left in the back of truck in a rain storm) / not submersible



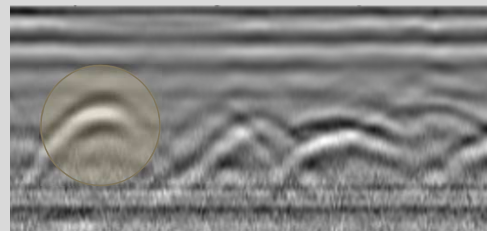
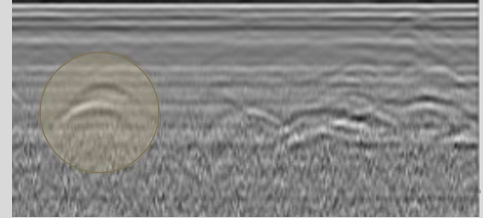
DS2000 GPR Software / 3 main screens

- Left is when GPS or a grid project is being utilized - to better understand our location during data collect
- Two left screens - the shallow antenna is show on top and the deep at the bottom. This is the most important aspect of the software and what use to determine utility location & depth
- Not only does the unit allow us to find and mark where utilities are, we can also digitize these marks during the collection process
- By digitizing these marks, we begin to identify the same utility on multiple passes and the software processes the data to create lines

Leica DS2000 Dual Antenna

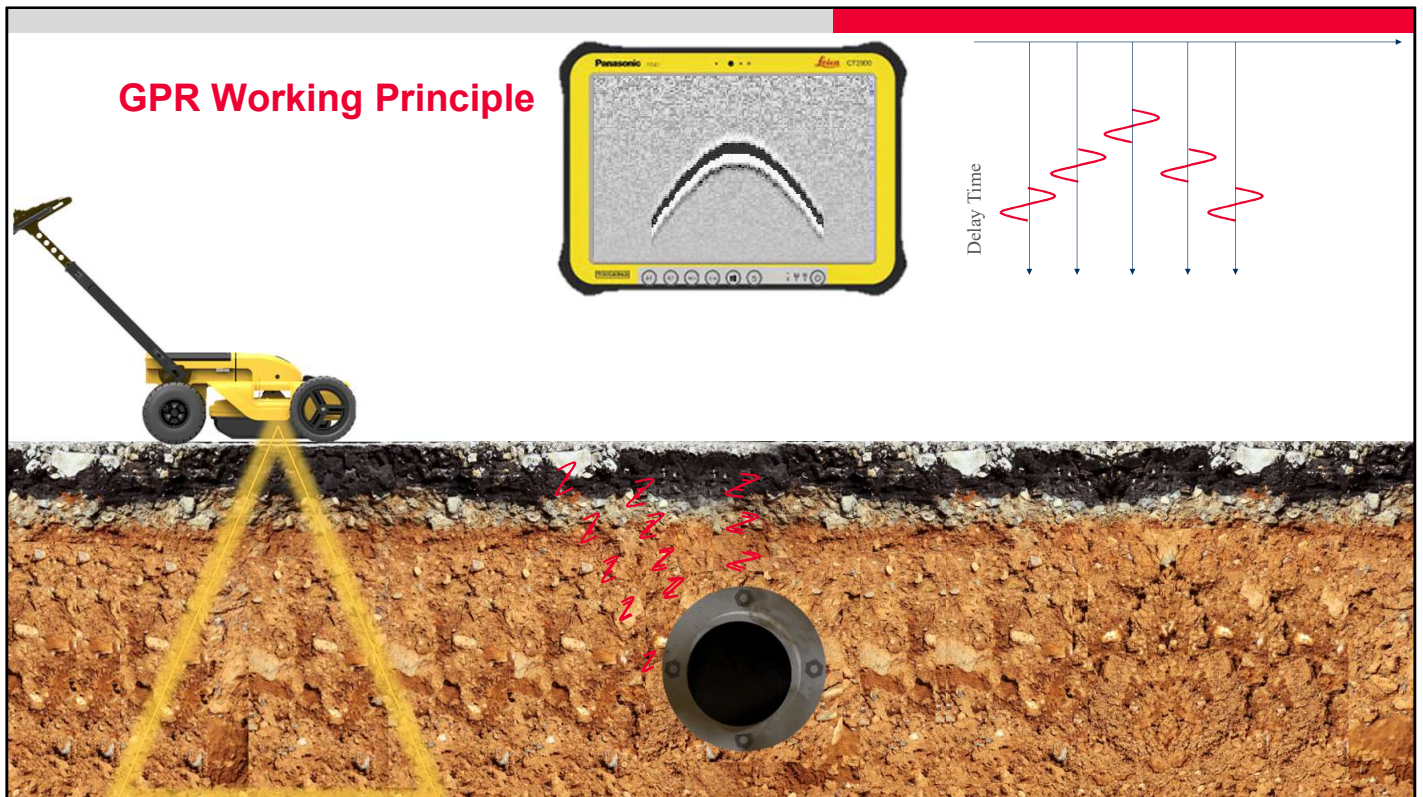
The 700 MHz antenna permits the user to see small shallow targets, up to a depth 6 – 9 ft. (2-3 meters) depending on the soil conditions

The 250 MHz antenna permits the user to see bigger targets situated deeper underground up to 12–15ft (4-5 meters) depending on the soil conditions.



This is showing the importance of a dual antenna system - high frequency (shallow) and low frequency (deep) antenna. As we look at the deep antenna (bottom) it shows one utility line. If we excavate with just this data, we would unknowingly damage the other utility sitting above the original line as shown in the top radar gram.

Due to the shallow antenna, we get a more clear understanding of our excavation area which would avoid asset damage, costly repairs, construction delays.

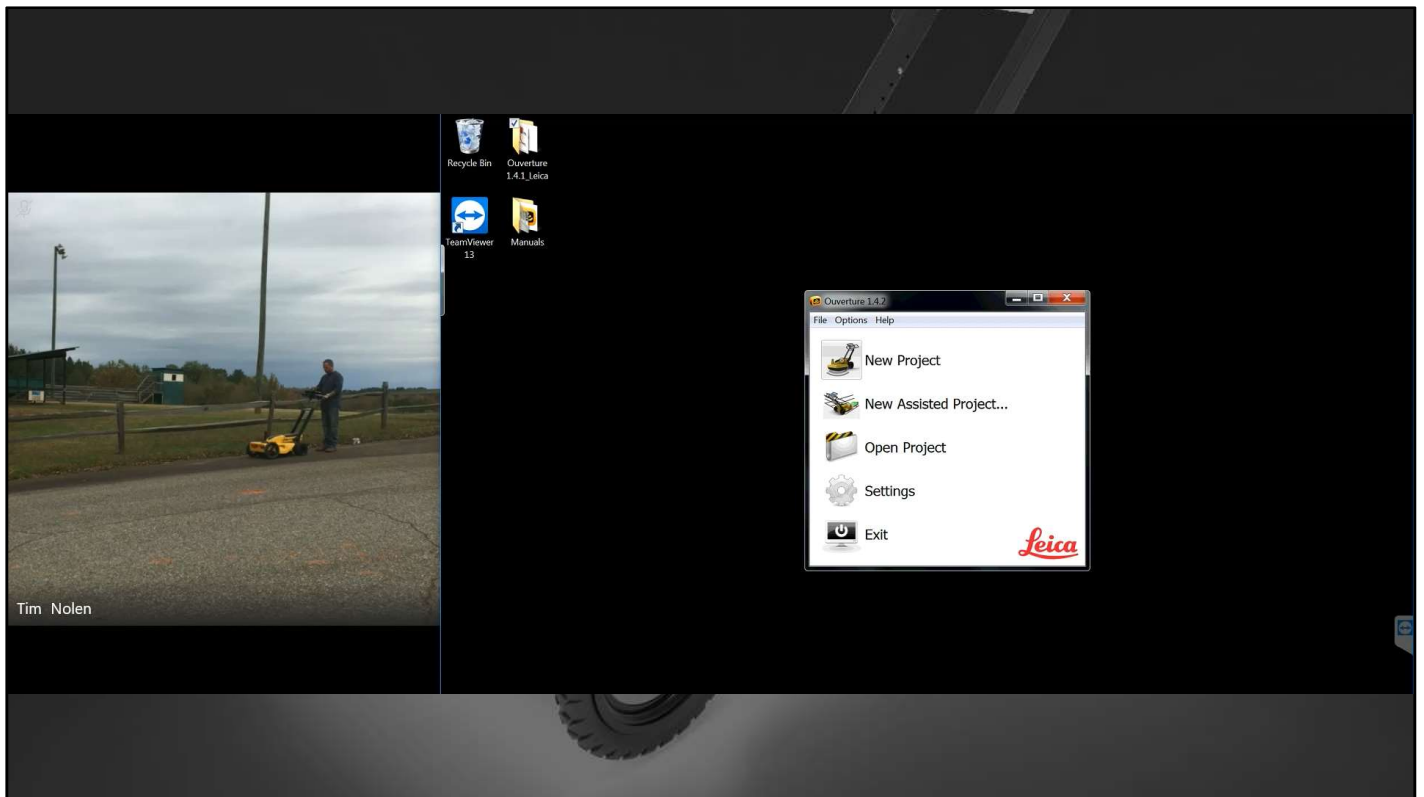


GPR Working Principle

Basic working principle of GPR, a signal is sent from the GPR, we wait for the signal to hit a change in material and bounce back, the GPR measure the time this takes.

If we use the example of a pipe, the edge of the pipe give us our longest time delay / response, at the center our shortest, as we continue to pass over the pipe the time delay increases and this is what gives us the hump or hyperbola.

If the object was flat, such as a junction box, the image of the reflection would also be flat. The radar basically mimics the shape of the object being identified.



This is a video of the DS2000 in real-time. The unit starts by testing and calibrating to local soil conditions. We then press the play button in the upper right corner of the software and walk. When we have passed over our area we pull the unit back, we watch the yellow line as this tracks line and will correctly position us over the detected utilities. Once we are correctly positioned we can conduct a hyperbola fit, which means matching the red hyperbola to the detected one. This then adjusts the expected depth of the utility. At this time we can also code the utility.

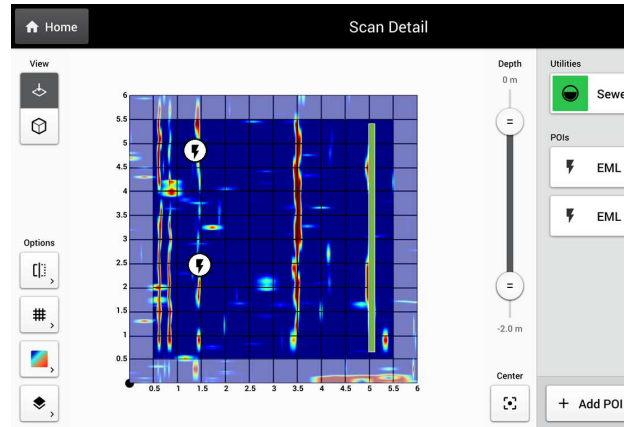
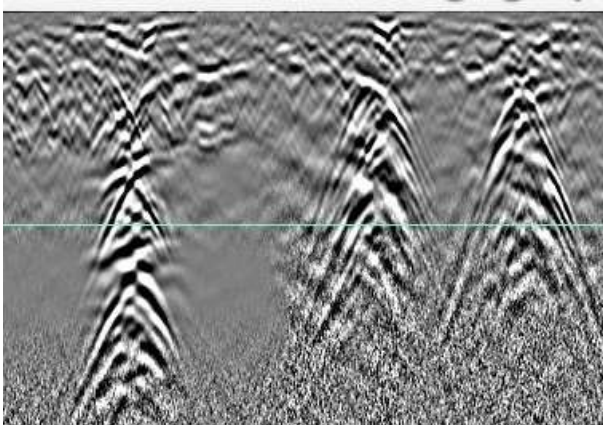


Utility Detection Systems – GPR DSX

Precision solutions for avoidance, traceability & utility mapping

Evolution of underground utility visualisation (GPR) in the field

40 years No changes in data view and interpretation in the field



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The DSX still utilizes GPR technology although we have some limitations on depth. The change has come with the visualization of data. Instead of the traditional radar grams, which all other GPR manufacturers use to detect and mark utilities, we have changed this to give more of a thermal image of an area.

We now can take “depth slices” through the ground so we can visualize the utilities at different depths.



The Unit is smaller than the DS2000 as this is a single antenna unit.

- 600MHz antenna - maximum depth of 6.5 ft. due to algorithms producing the linear objects
- Same protection as the DS2000 / water and dust resistant (not submersible)
- The main aspect of this unit is the software the Dxplore - this allows the acquisition, visualization and interpretation of utilities
- The software also allows the export of DXF files and reporting capabilities / deliverables

Leica DSX

Scan Modes

The maximum grid size is 33 x 33ft

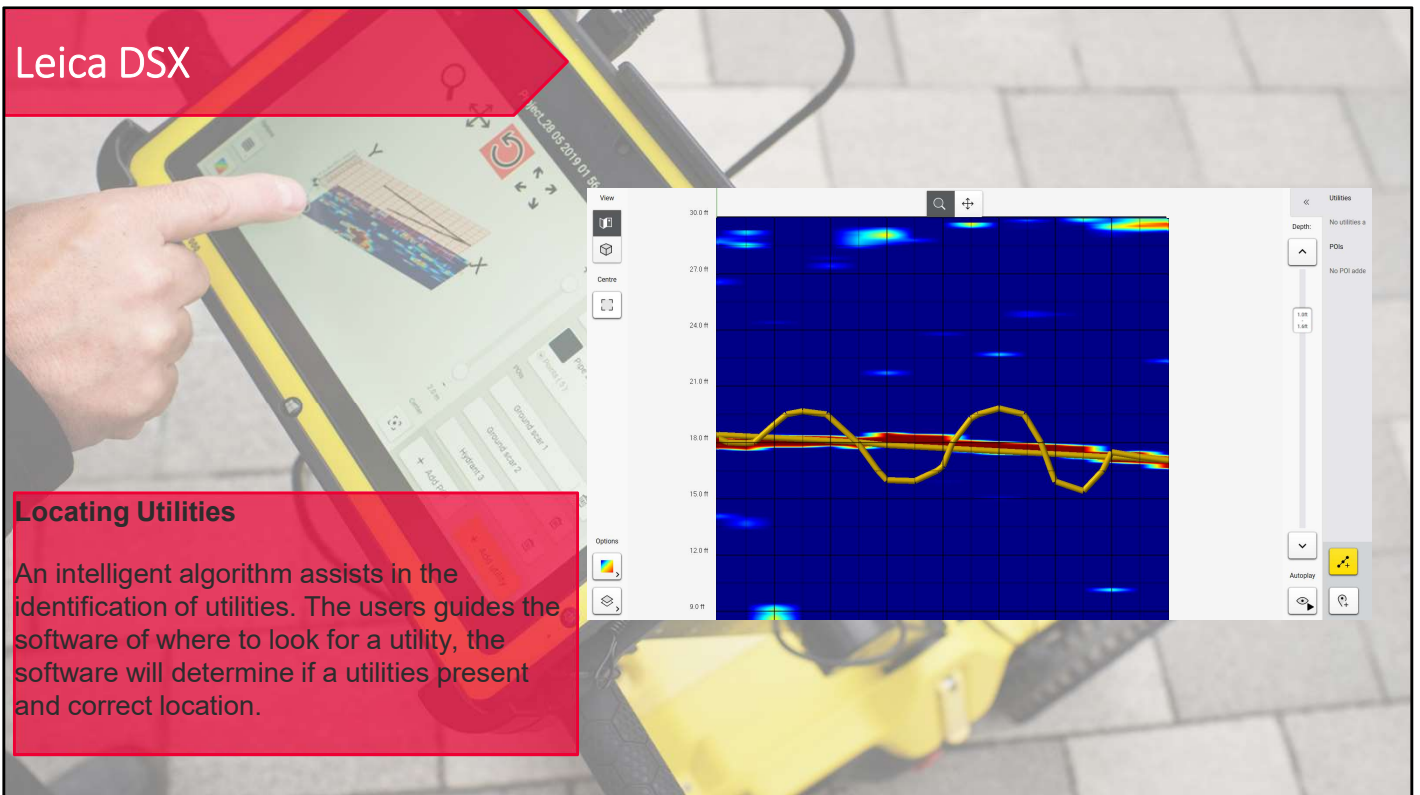
Collection must happen in 2 directions

Scan intervals are 18 inches



For the solution to work we need to collect data in a grid, the grid can be a maximum size of 33 x 33 ft and as small as 12 x 12ft.

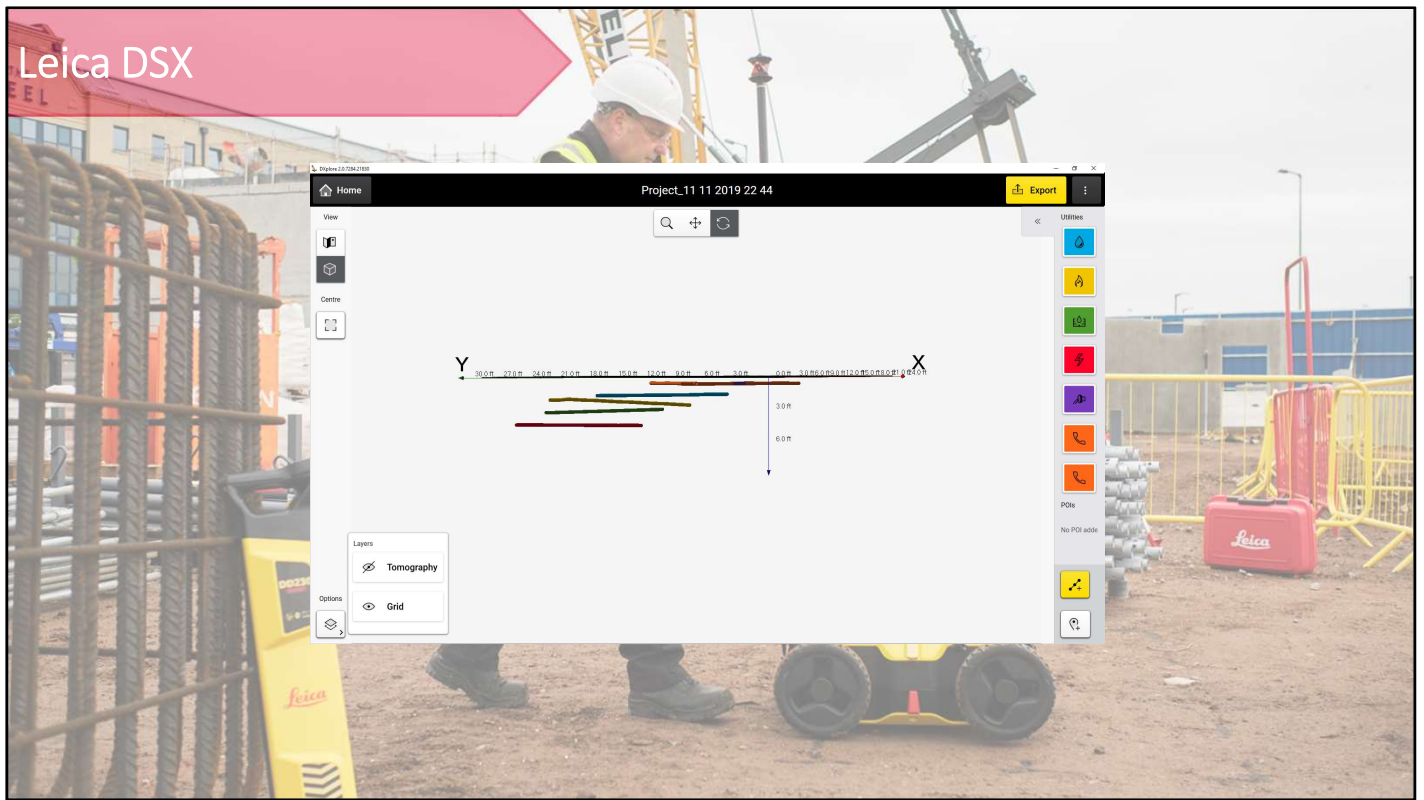
The grid can either be a square or a rectangle but not exceed 33ft in either direct. The collections are done every 18 inches in both directions.



Once the collection has been done we have a visualization of the subsurface. On the right hand side we have a slider bar which allows us to select different depths until linear feature appears. We select “add utility” and swipe our finger over the area where we believe the utility to be. The algorithm will then determine if there was a utility, if so, it will align the utility in the correct place irrespective of how we drew it.

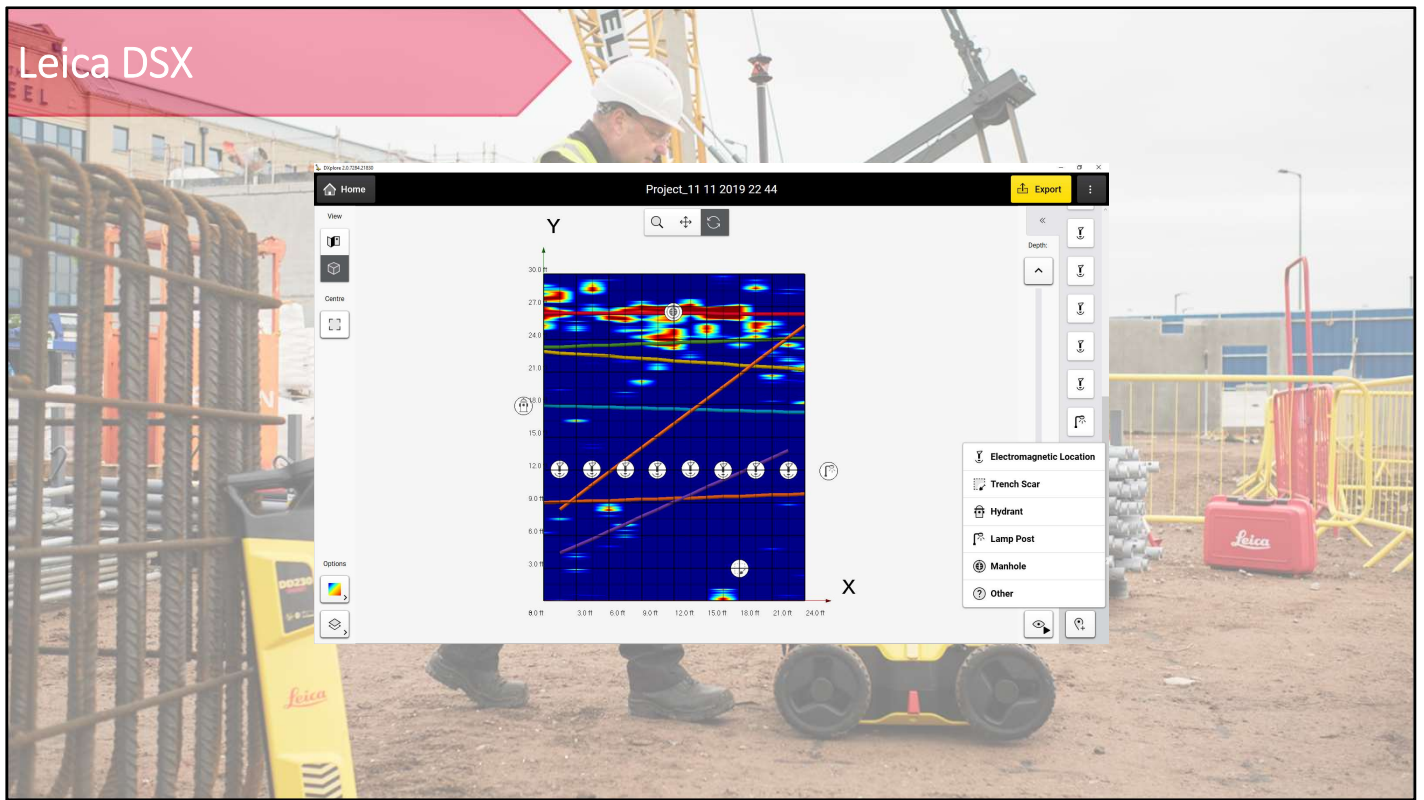
Once all utilities have been drawn we can turn the topographical images off see where the utilities are within our defined grid. These then can be marked out.

Leica DSX



The utilities can be viewed in 3d to enable us to see the different depth of the utilities and how they interreact with each other.

Leica DSX



Additional information can also be added at any time in the form of POI's (point's of interest) – such as manholes & street lights to add more reference points to the data.

Summary



Using the latest technology, detecting underground features becomes a simple and efficient task, increasing your safety and the protection of buried utilities. Our detection solutions provide a truly streamlined process from the field to the office, and back again.

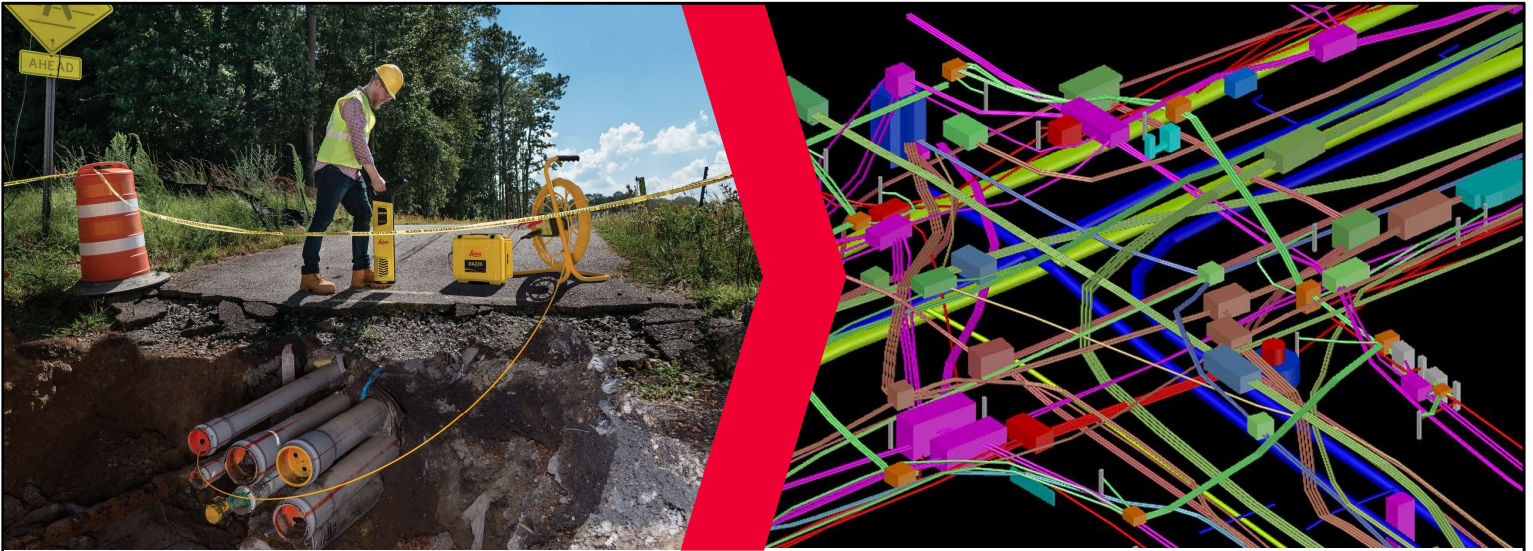
We have direct integration into Machine Control system and output for GIS professions and, DXF outputs for design engineers.

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Surveyors, utility companies and contractors, now more than ever, need accurate, highly reliable, and up-to-date information – available for immediate use. Using the latest technology, detecting underground features becomes a simple and efficient task, increasing your safety and the protection of buried utilities. Our detection solutions provide a truly streamlined process from the field to the office, and back again, able to cover the entire utility detection, avoidance and mapping workflow with integrated solutions.



Thank you for your attention.

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