

Facility Locating & Markout



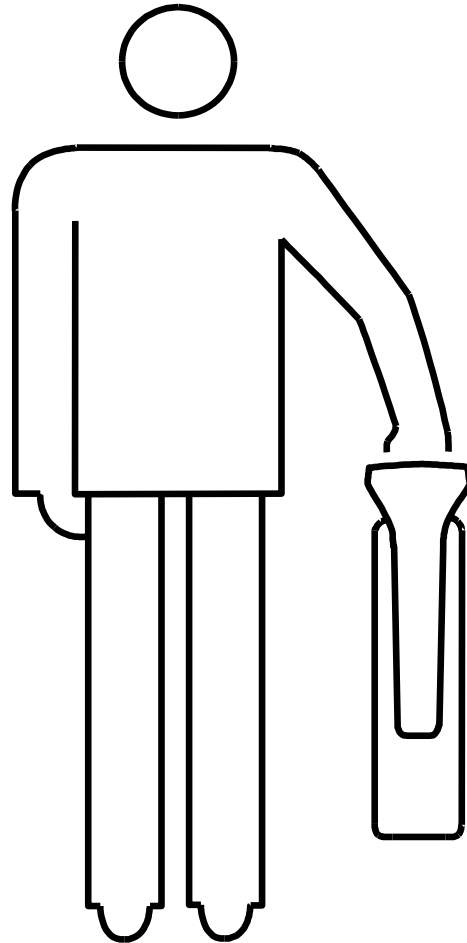
Presented By:

Eric Denslow

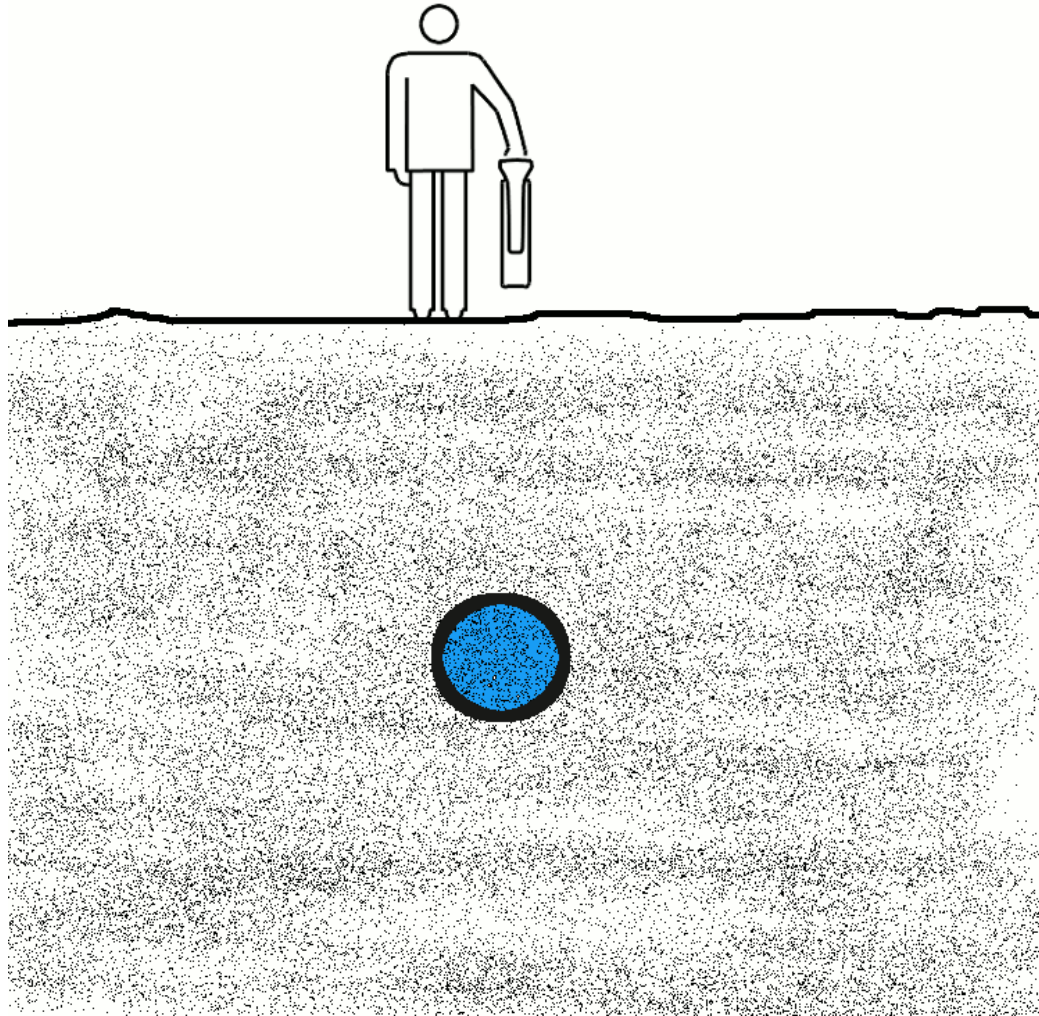
from



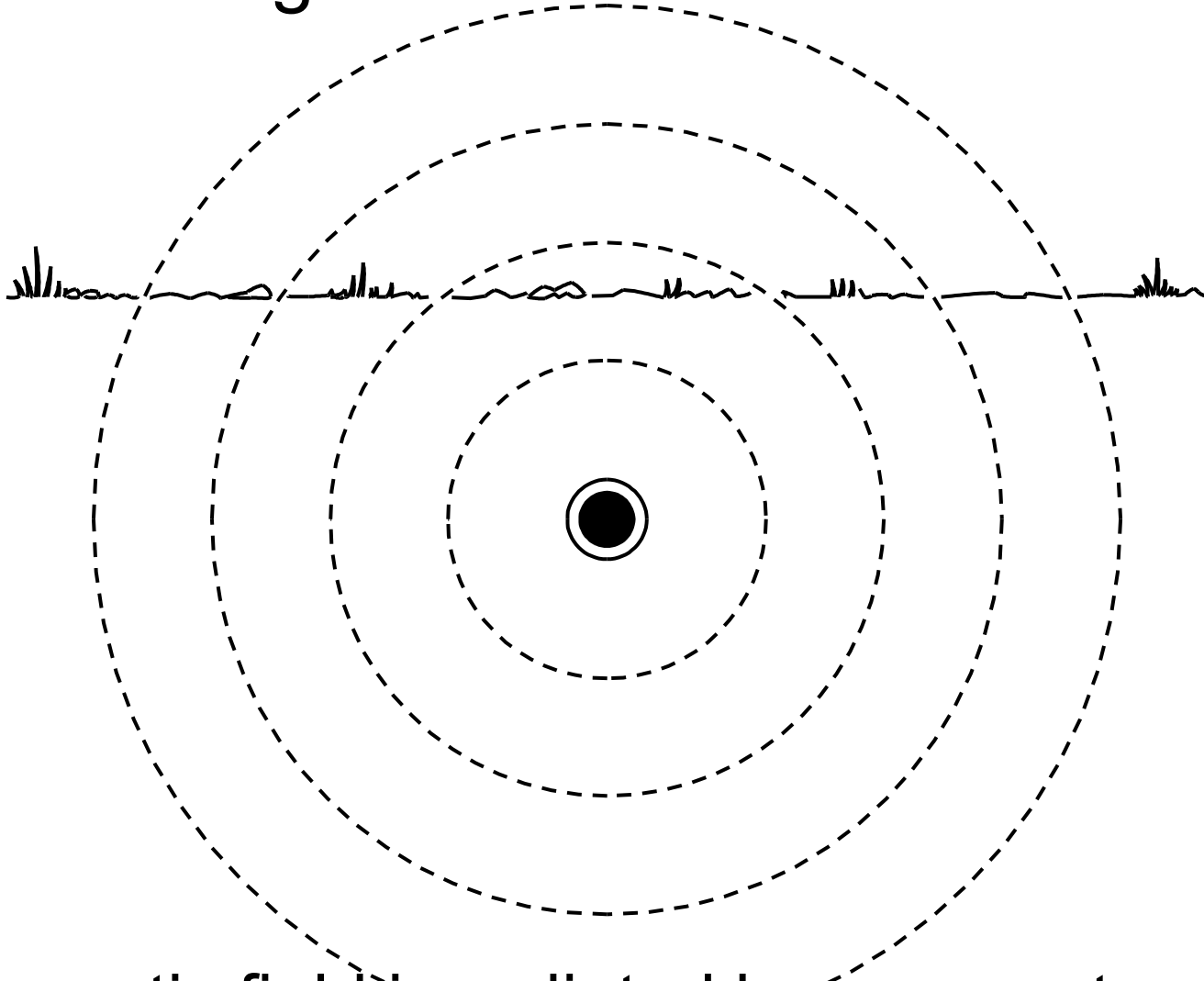
Pipe and Cable Locators don't find pipes and cables.....



....they find electro-magnetic fields.



What is a Magnetic Field ?



A magnetic field is radiated by a current carrying conductor.

BURIED CONDUCTORS
DON'T MOVE, BUT THE
FIELDS WE'RE TRACING
ARE SUBJECT TO.....

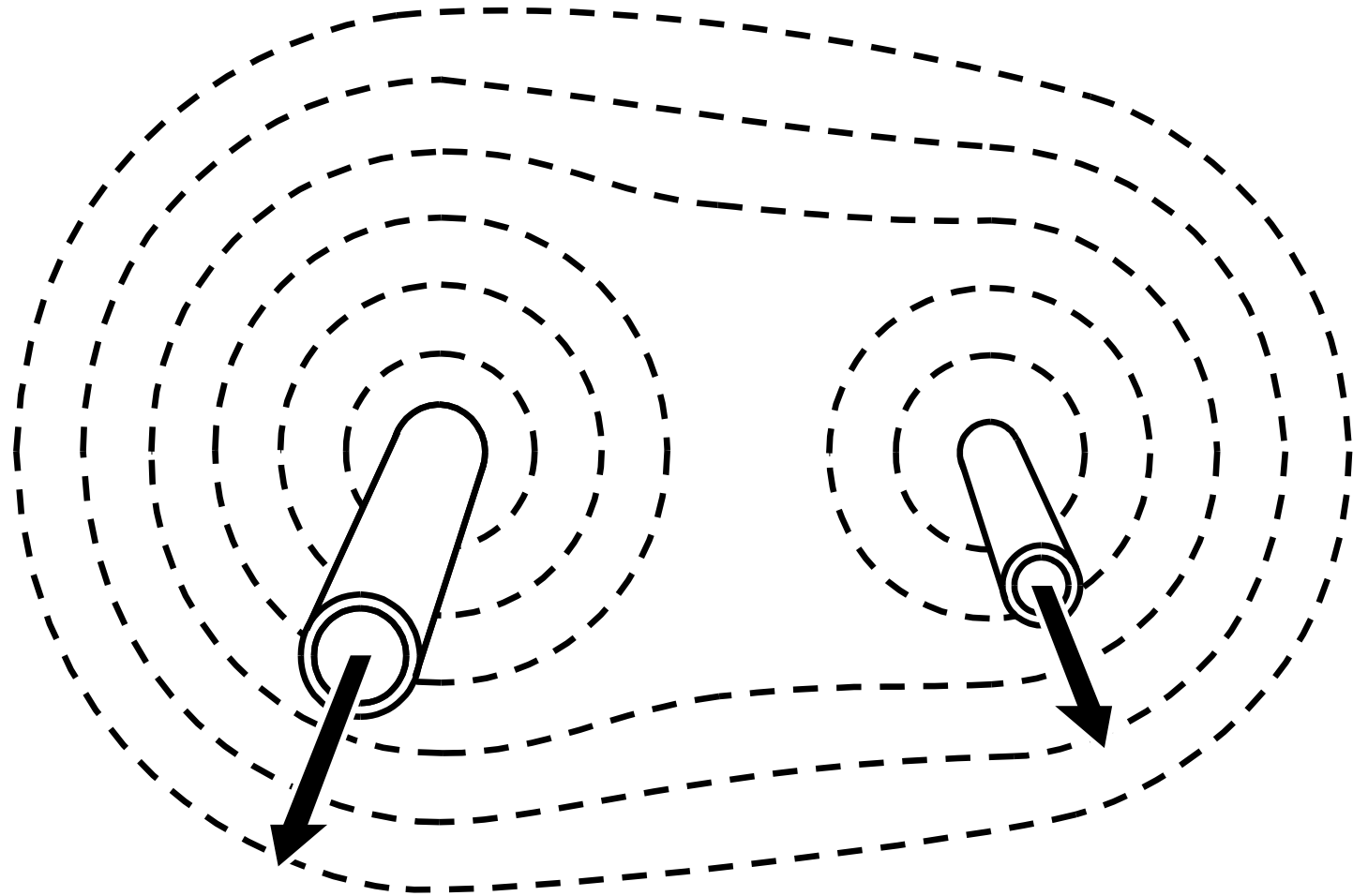
.....**DISTORTION**

.....**DISTORTION**

AFFECTED BY

- 1. METHOD OF SIGNAL APPLICATION**
- 2. GROUNDING**
- 3. PEAK AND NULL**
- 4. CONGESTION**
- 5. FREQUENCY APPLIED**

Distortion



When the conductors are close together, the magnetic fields can interfere with each other, causing a distorted field which is no longer cylindrical. This can lead to poor locate results and inaccurate measurements.

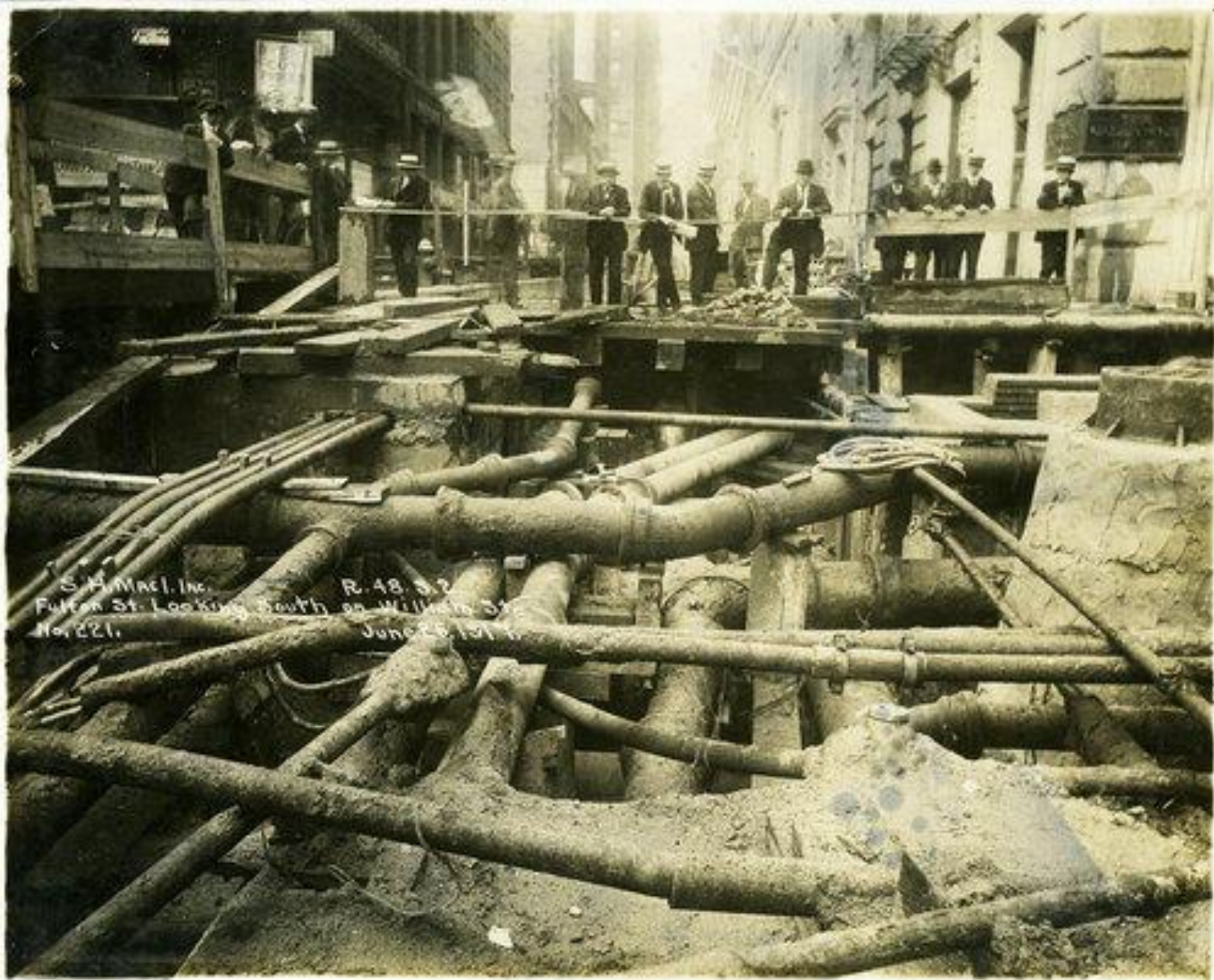
Distortion

Little Congestion



Distortion

Big Congestion



Congestion



Which Frequency?

Low

Less than 1khz

- Very Long Range
- No Induction
- Little "Spillage"

Mid

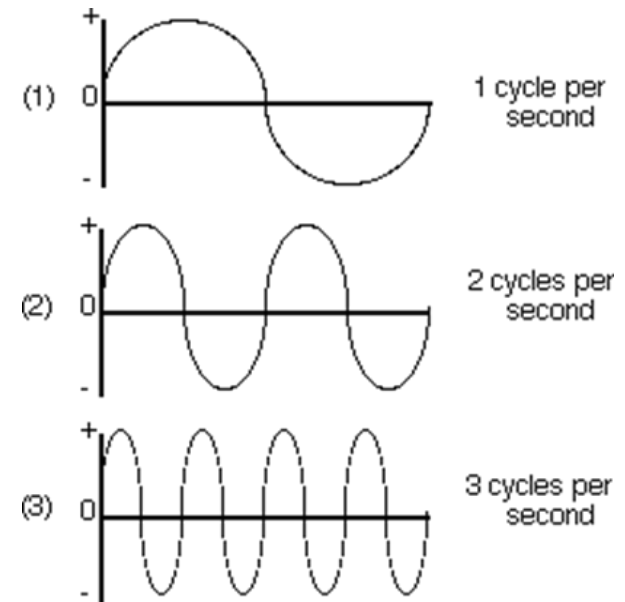
1-50khz

- Good Induction
- Shorter Range
- Reasonable "Spillage"

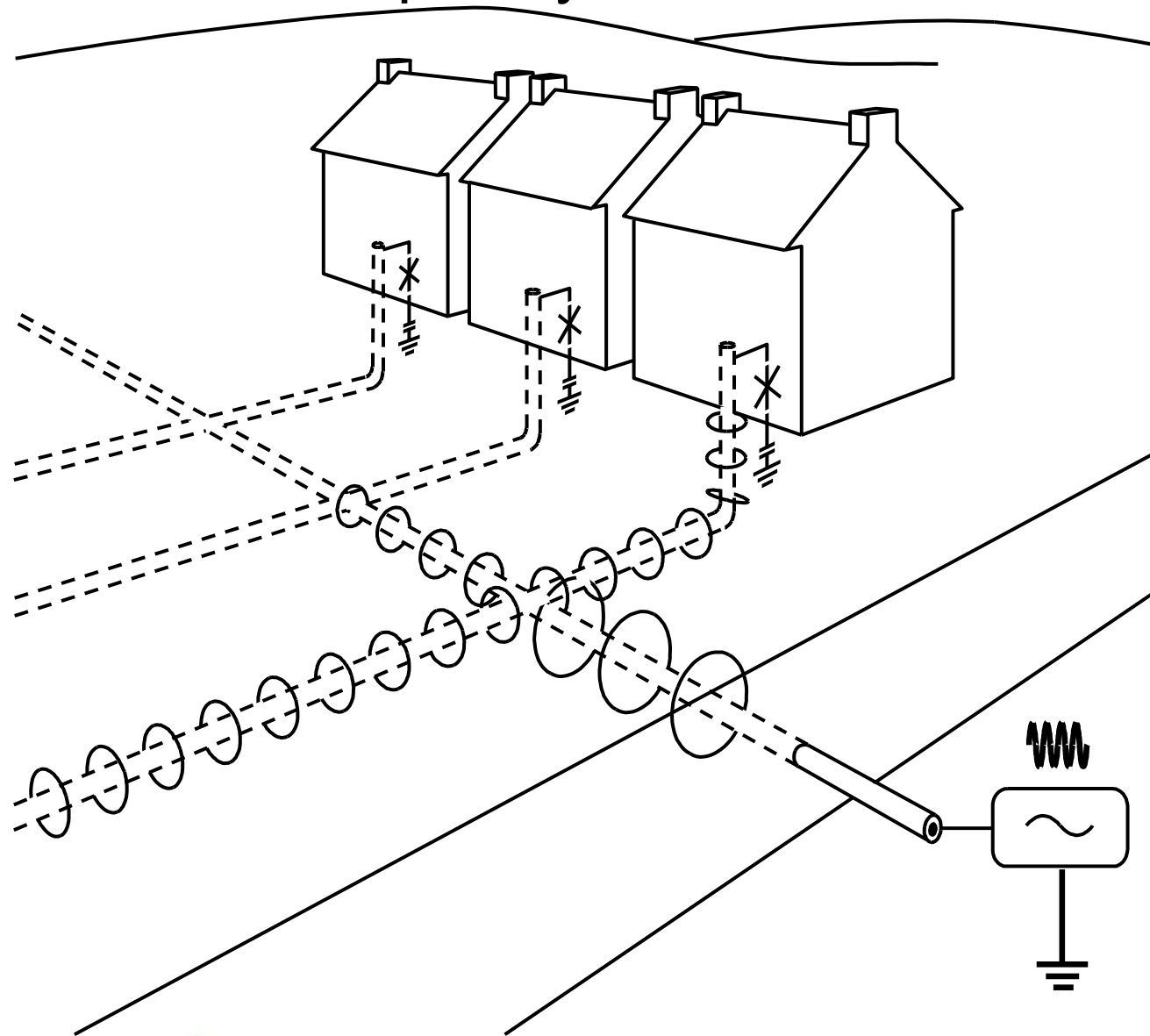
High

50khz+

- Short Range
- Excellent Induction
- Severe "Spillage"

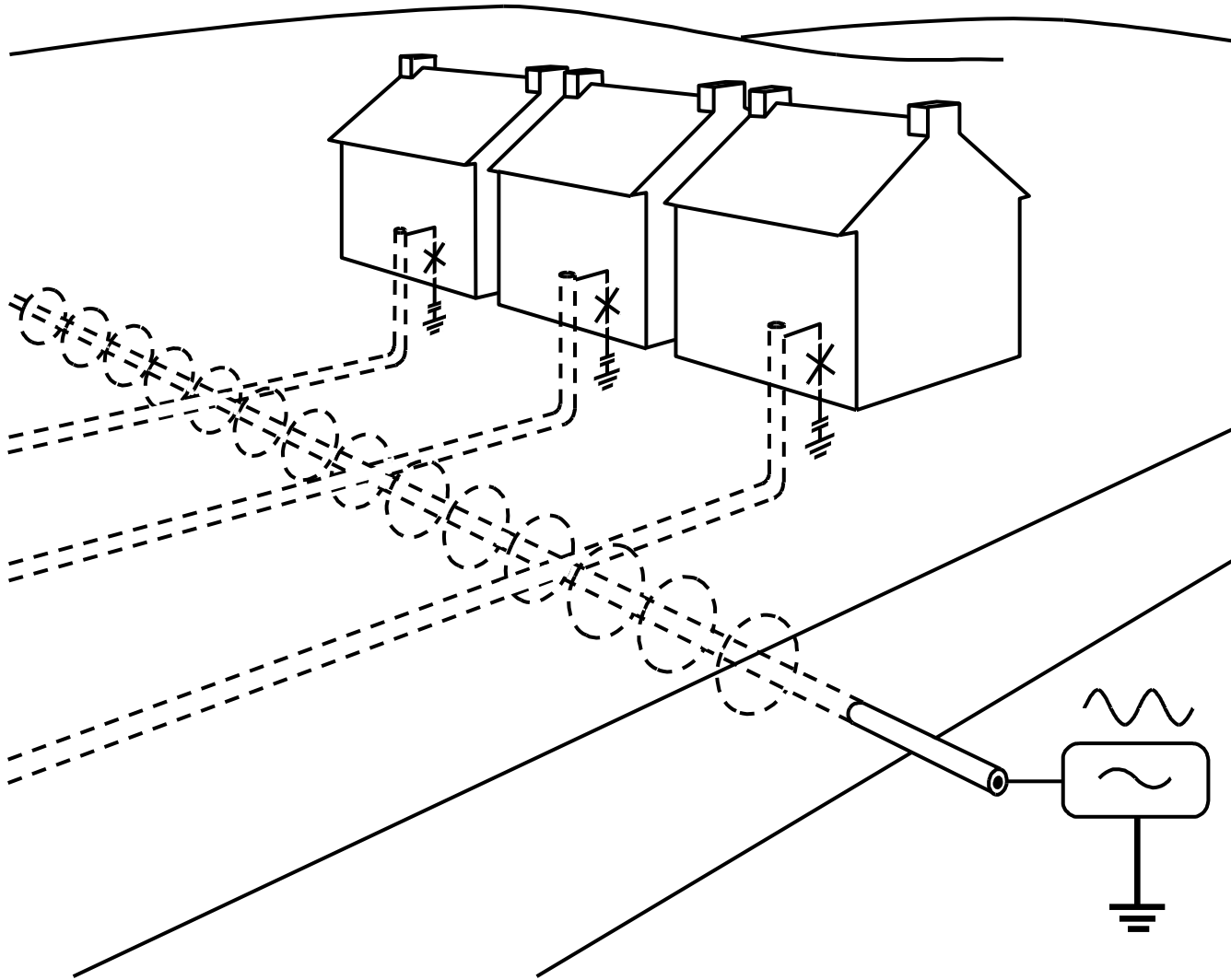


Which Frequency?



High frequency may locate service drops which are not grounded at the termination point but range on main line is reduced and may induce onto crossing services.

Which Frequency?



Low frequency tends to keep to main line, does not induce onto copying lines and bypassing service drops which are not grounded at the termination point.

Divining Rods



Line Locators

Split Box



- **Single Frequency**
- **Single Mode**
- **Low Power Output**
- **Depth Estimation**

Basic



- **Single Frequency**
- **Single Mode**
- **Left / Right Guidance**
- **Depth Readout**

Full Featured



- **Multi-Frequency**
- **Multi-Mode**
- **High Power Output**
- **Depth Readout**
- **Bluetooth Interface**
- **GPS Capabilities**

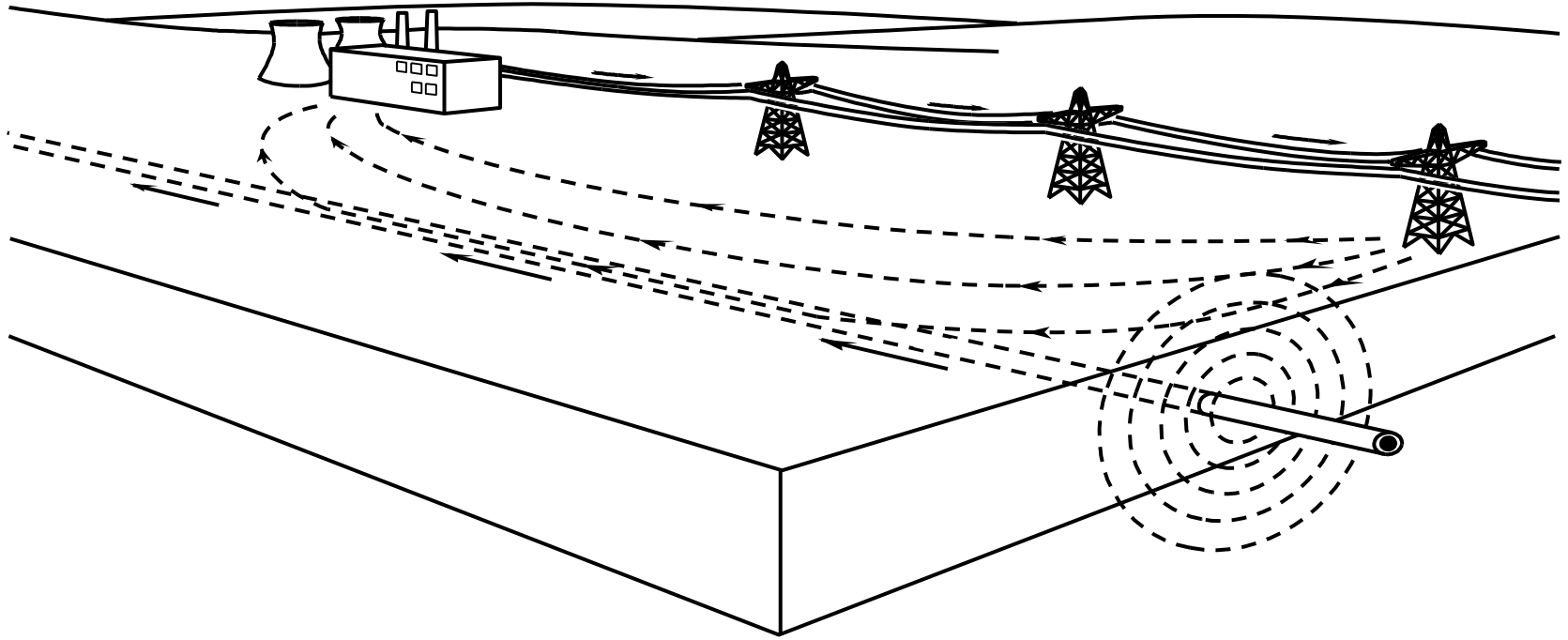
THREE WAYS TO LOCATE A BURIED CONDUCTOR;

**1. LOOK FOR A FIELD THAT'S
ALREADY ON IT.**

2. PUT A FIELD ON IT.

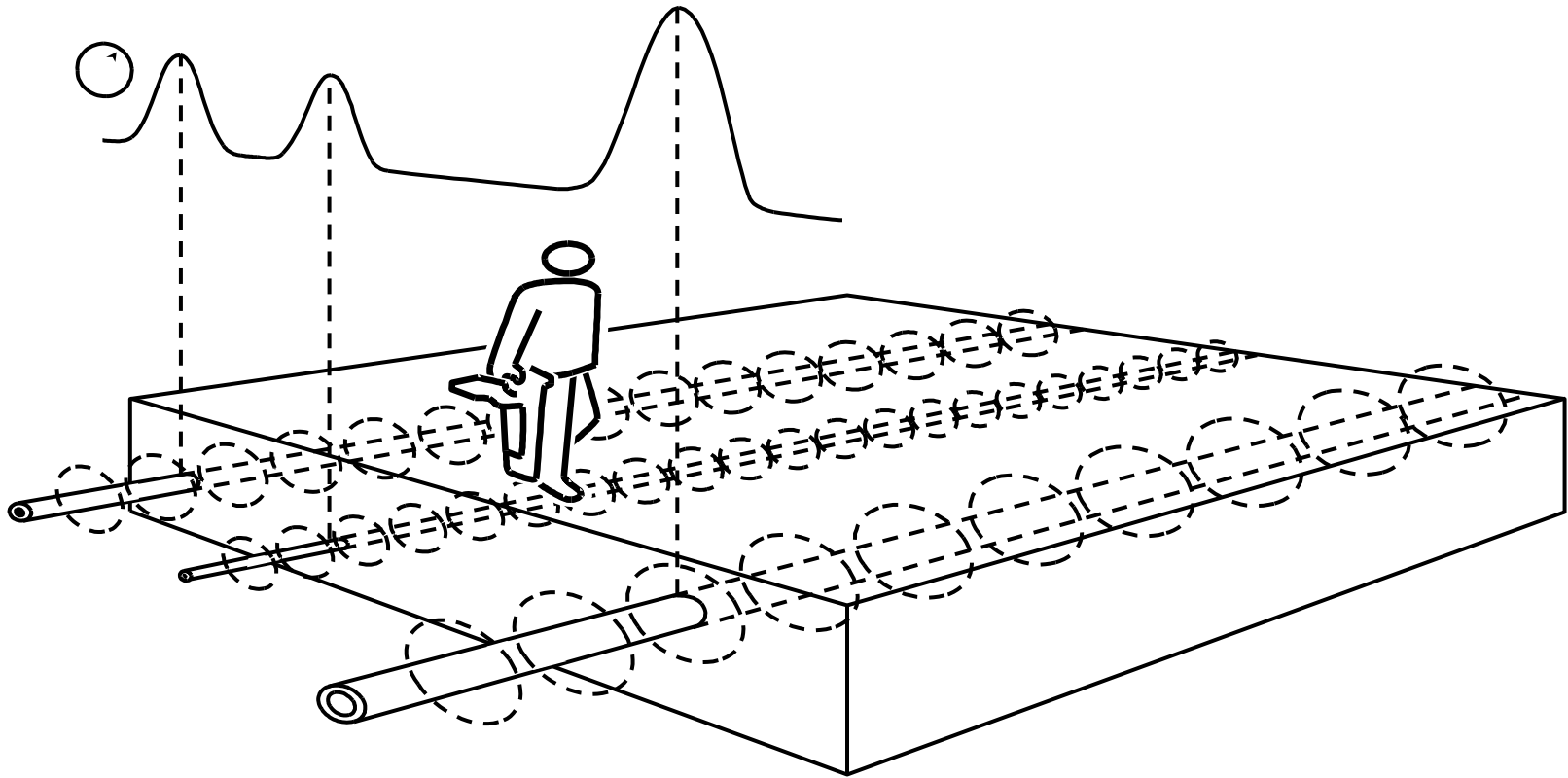
3. PUT A FIELD IN IT.

Passive



The proliferation of power and radio technology has caused many underground metallic pipes and cables to emit detectable magnetic fields.

Passive



Fast

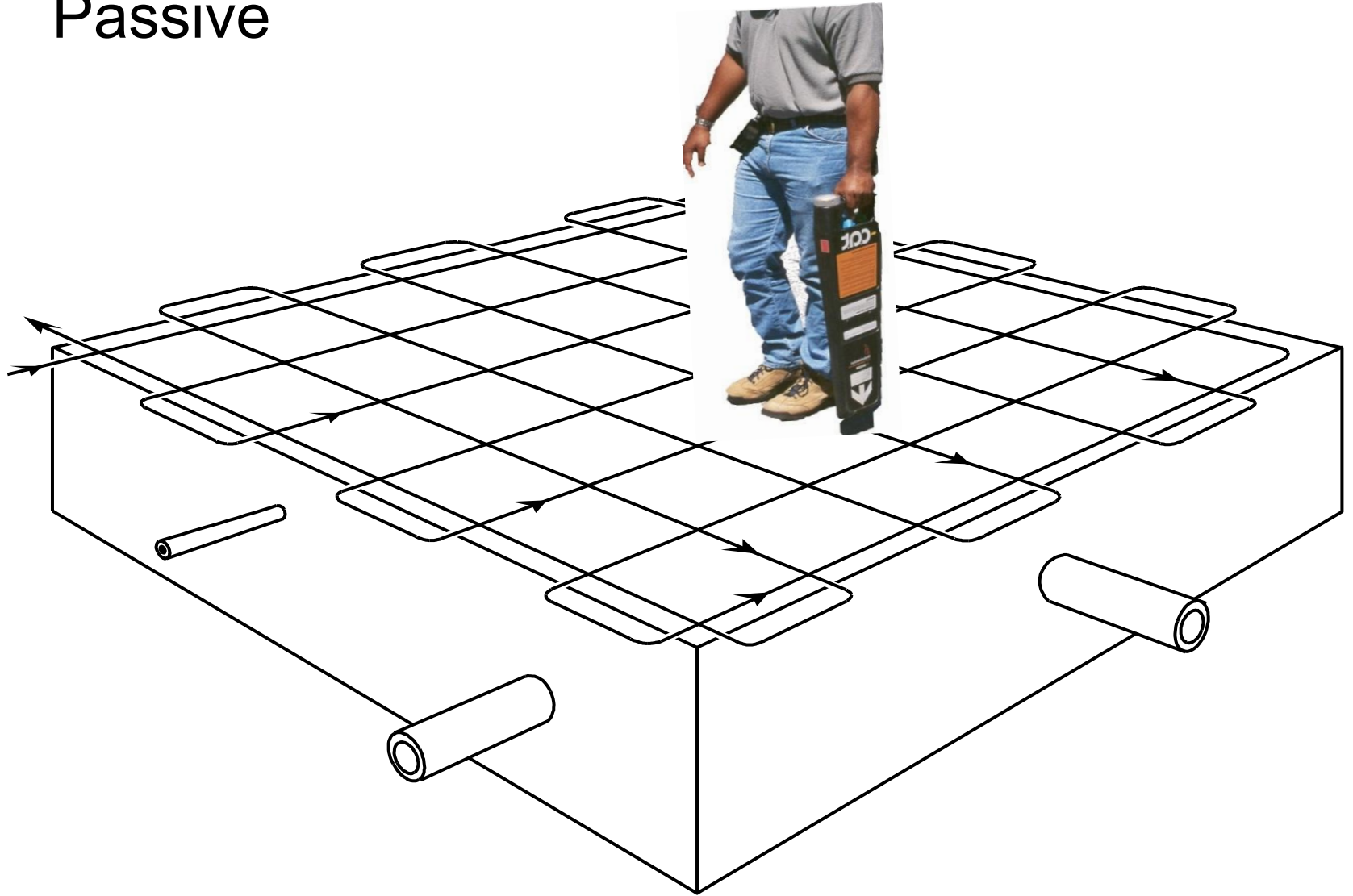


Easy



Does not identify

Passive



Ensure a full grid search is done to detect conductors laid in different directions.

Read the Street

- Visible clues
- Maps & Drawings
- Experience



Fire Hydrants	Valve Box Covers	Manhole Covers
Pedestals	Splice Boxes	Pad Mounted Transformers
Overhead Cables	Utility Poles	Dip or Riser Cables
Gas Meters	Meter Pits	UG Vaults
Electric Meters	Network Interface Devices	Utility Markers or Existing Markings

Read the Street



Read the Street



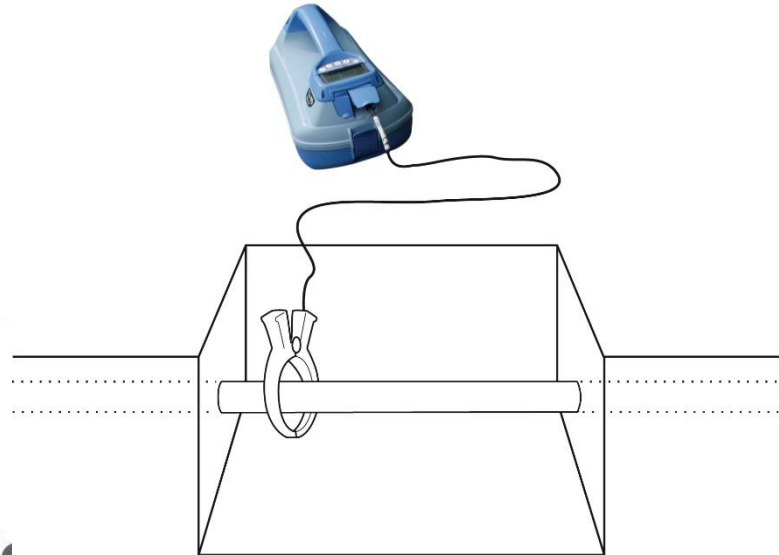
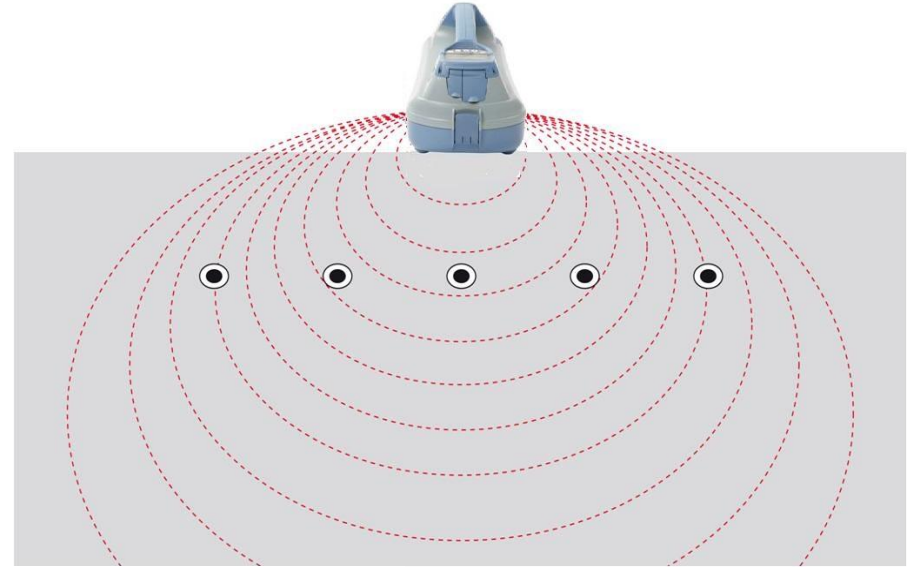
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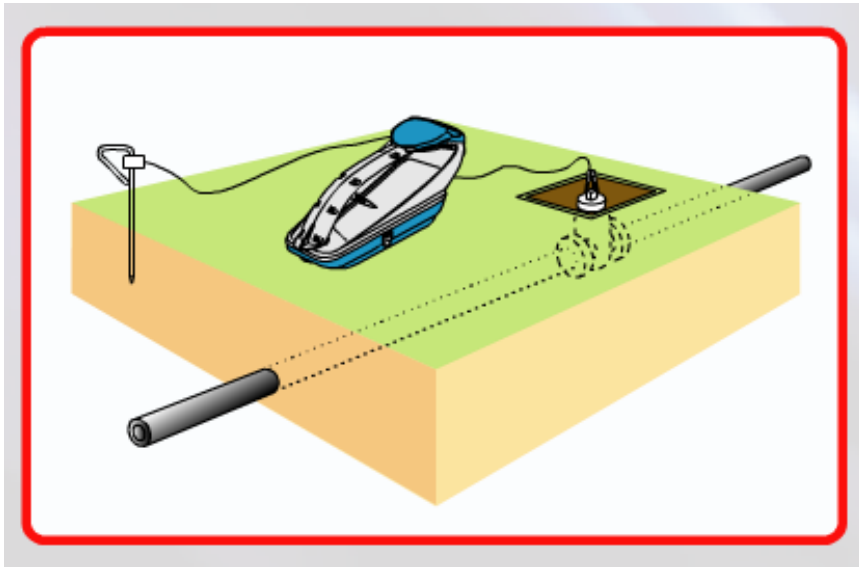
3. LOOK FOR A FIELD THAT'S
ALREADY ON IT.

Applying a Signal



Applying Locate Signal to a Pipe

Direct Connection

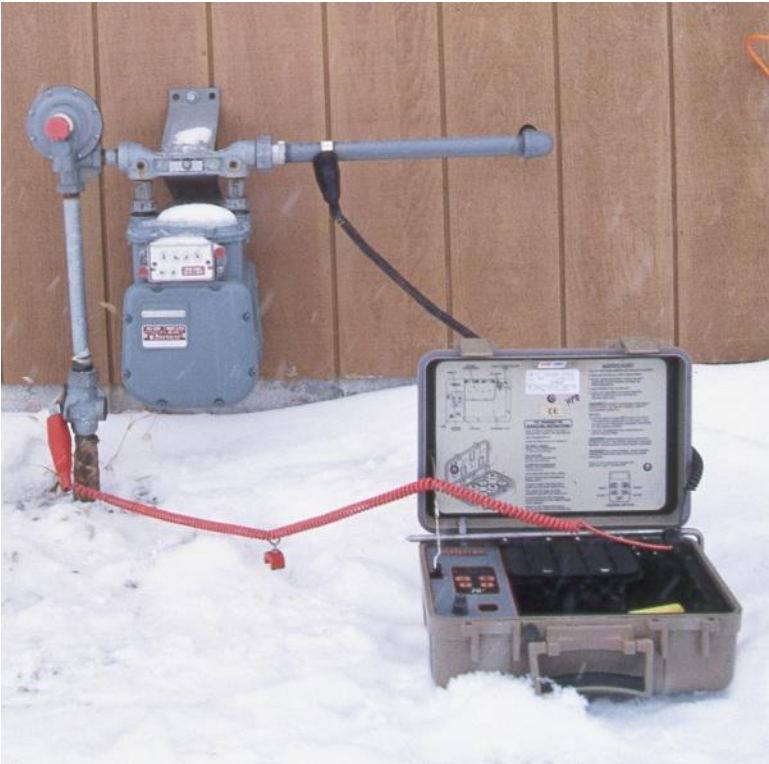


- Can use Lower Frequency
- Can apply More Power
- Allows Better Identification
- Allows Better Depth Reading
- A Good Ground Makes a Good Locate
- Can Control Interference
- Can Control Signal Transfer to Nearby Utilities

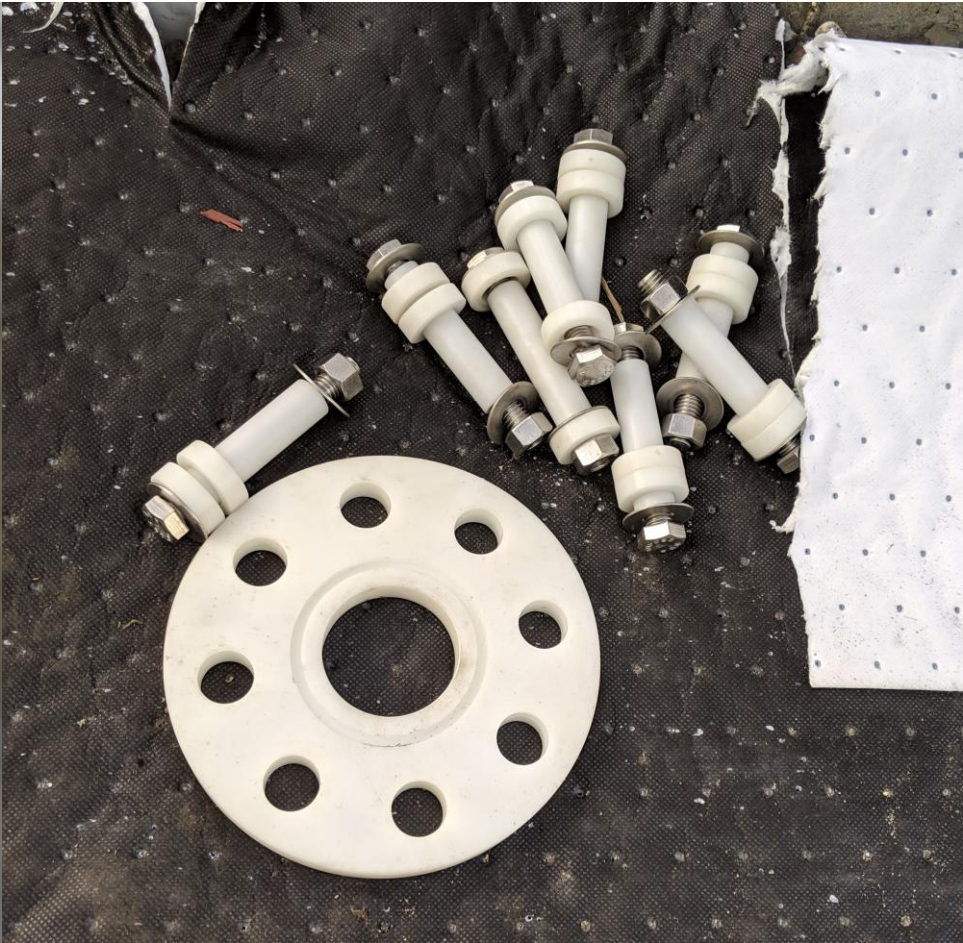
Connection – Gas



Connection – Gas



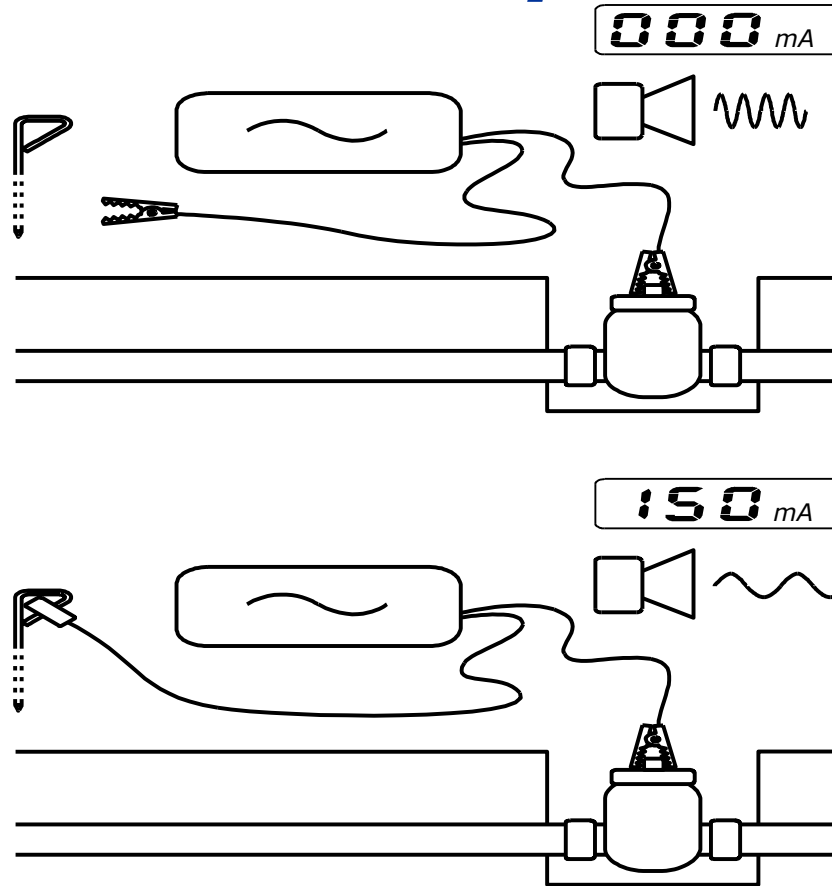
Connection – Gas



Connection – Tracer Wire



Transmitter Output Verification

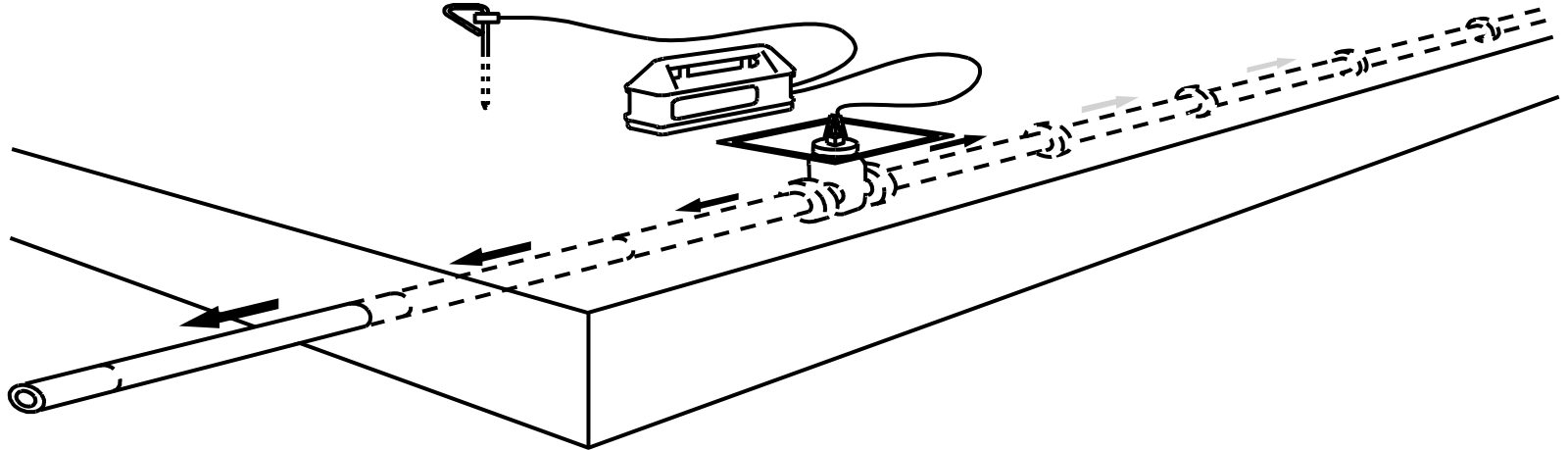


A successful connection to the metallic pipe or cable will be indicated by a change in the transmitter audio or visual indicator. Always make the best possible connection for reliable signal.



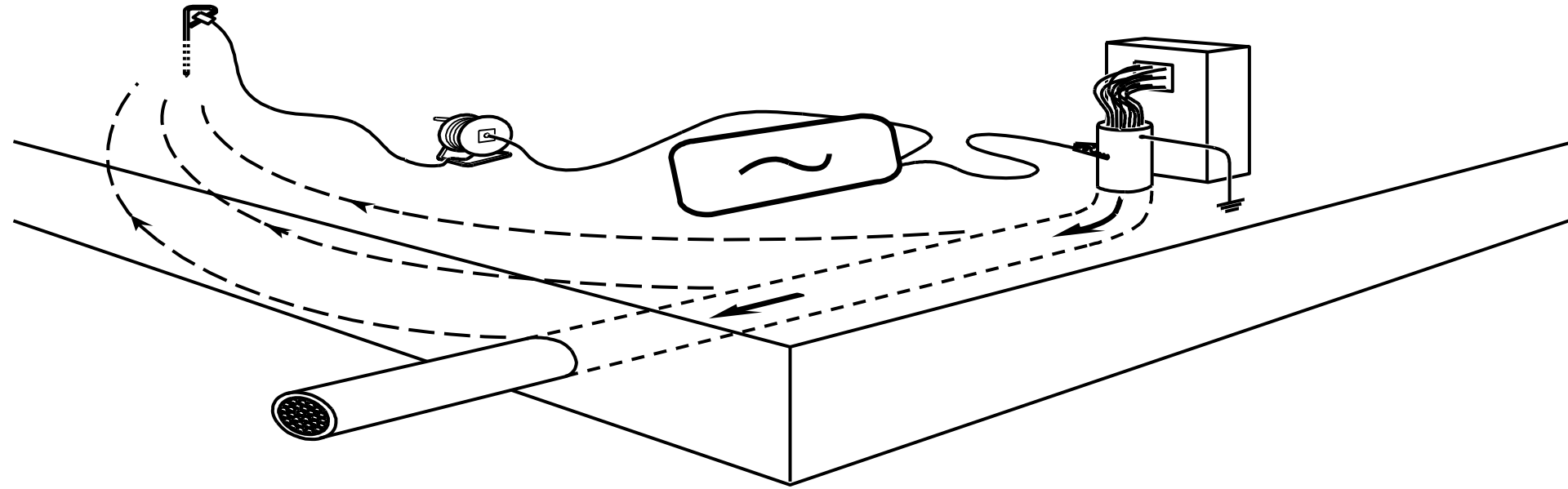
**Newer transmitters display a quality ground
with a Volts and *mA* Reading**

Connection



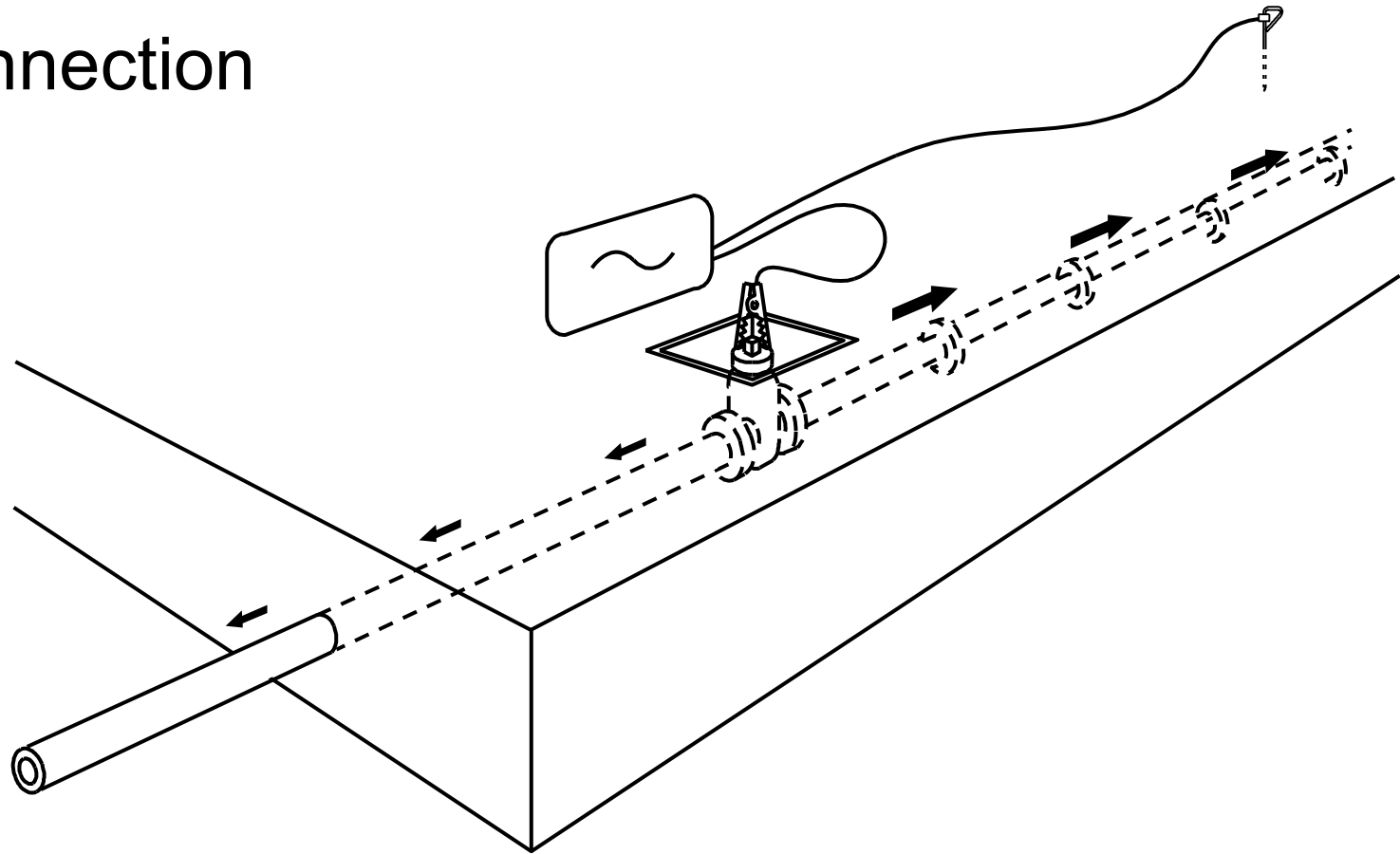
The ground return point is the "back door" that the outgoing signal returns to. **What you ground to and where you place the ground** can significantly affect your results.

Connection



For greater signal travel, an extension ground spool can be used to place the ground stake further away.

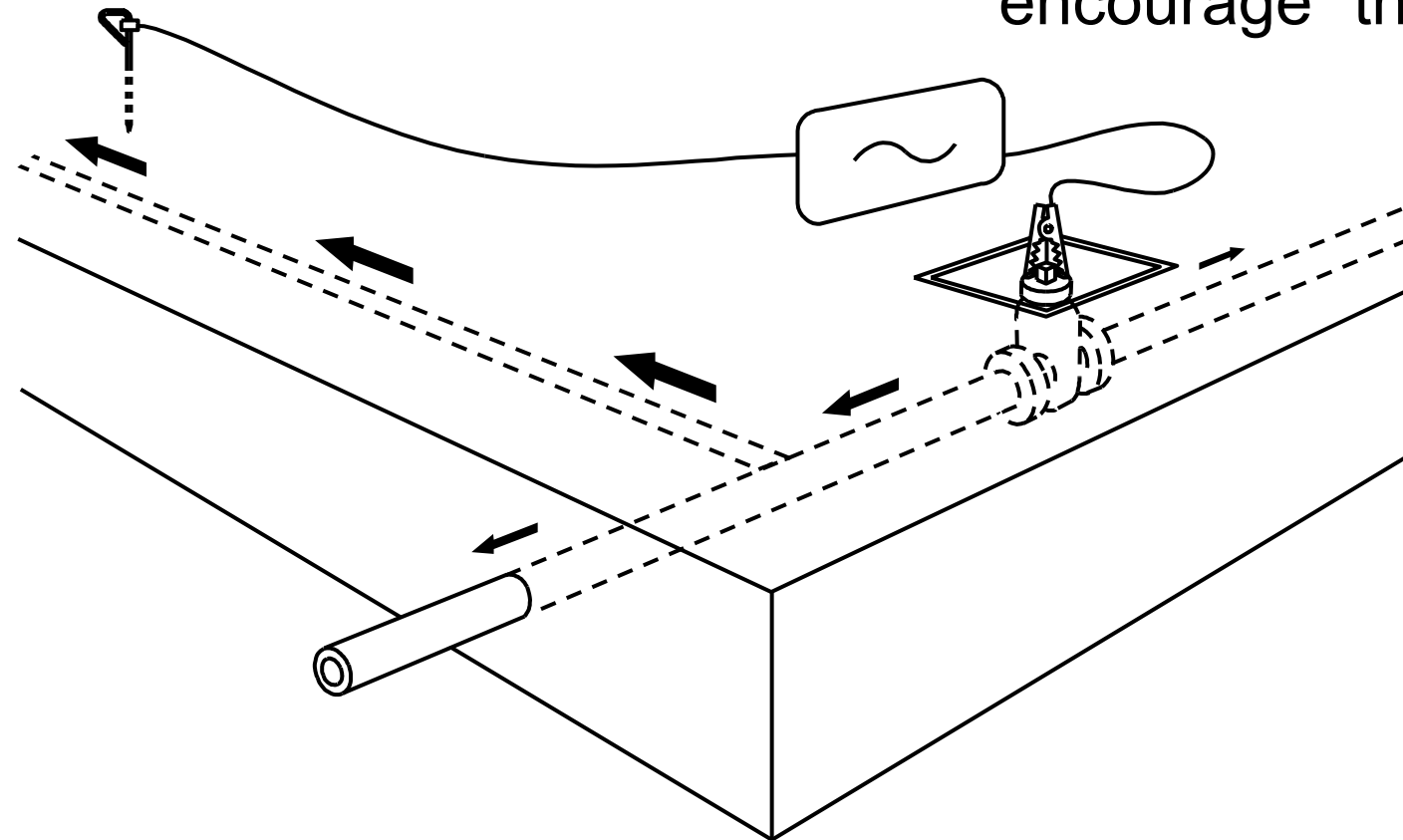
Direct Connection

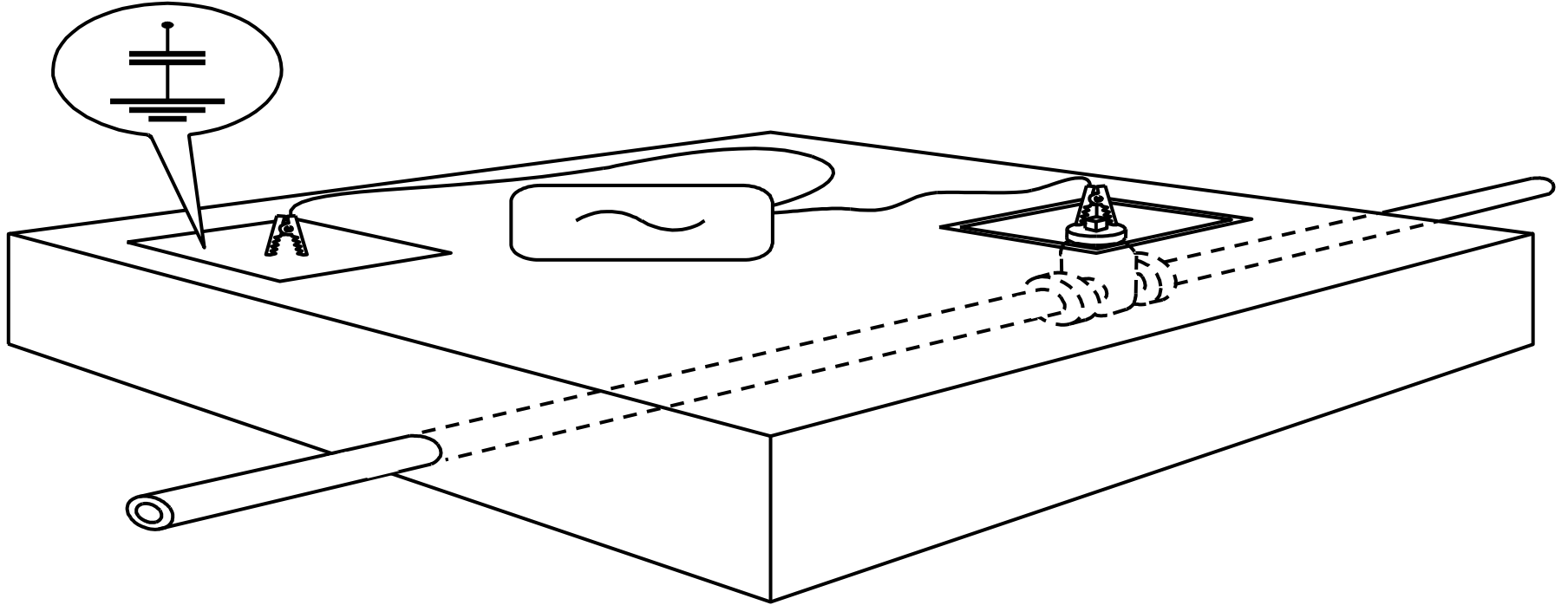


Positioning the ground stake in the direction you wish to locate will often encourage the signal to flow in that direction.

Direct Connection

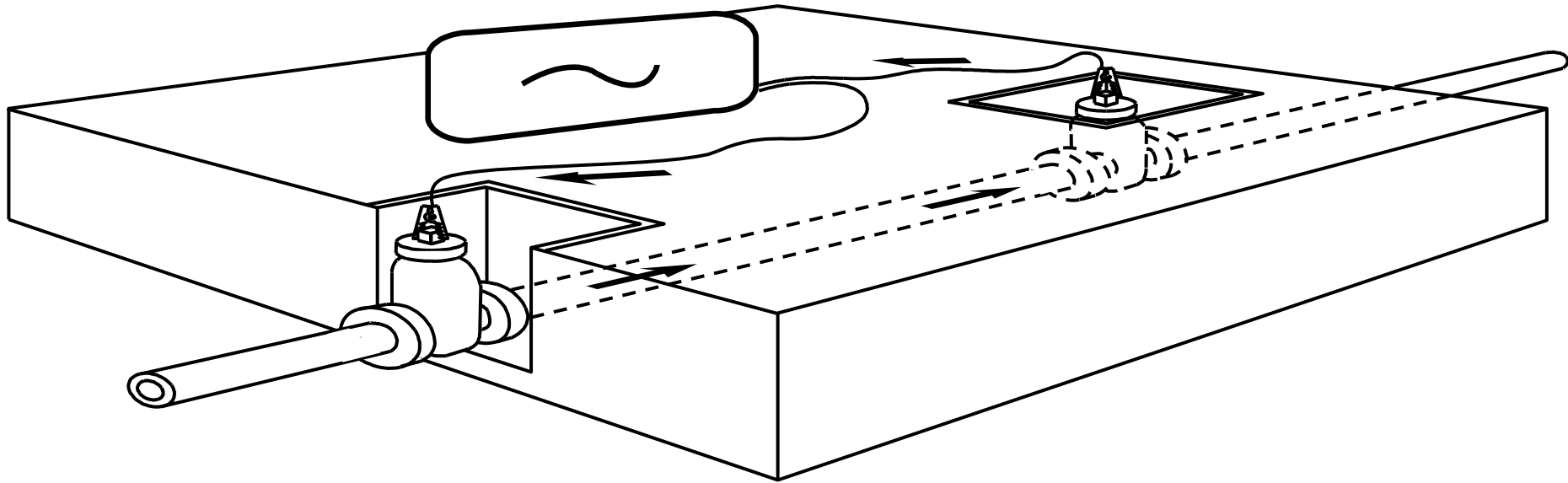
When locating Tees, place the ground stake in the direction you wish to “encourage” the signal to go to.





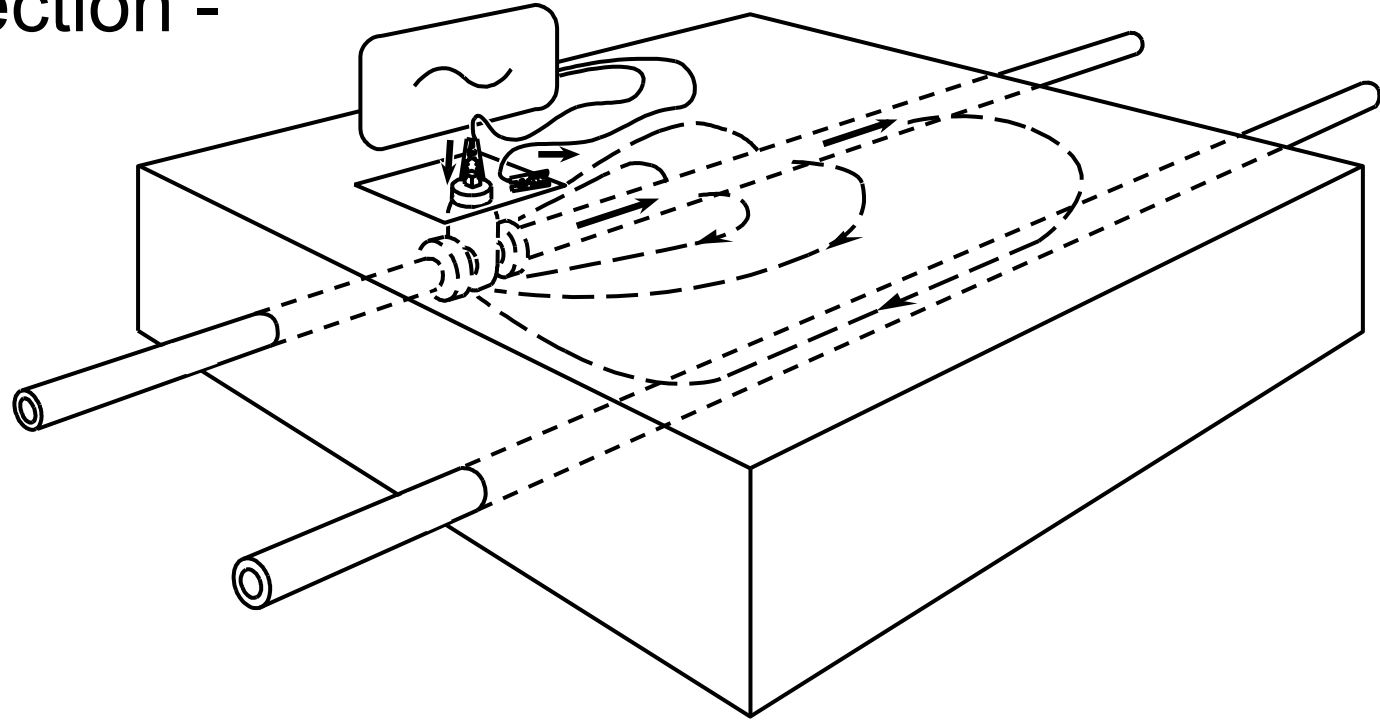
High frequency can use a capacitive ground connection through a metal plate. This provides a ground in areas where direct earth ground cannot be achieved.

Connection



A double-ended connection does not use the ground as part of the circuit and is more dependable. This is particularly true when trying to locate metallic pipes buried close together.

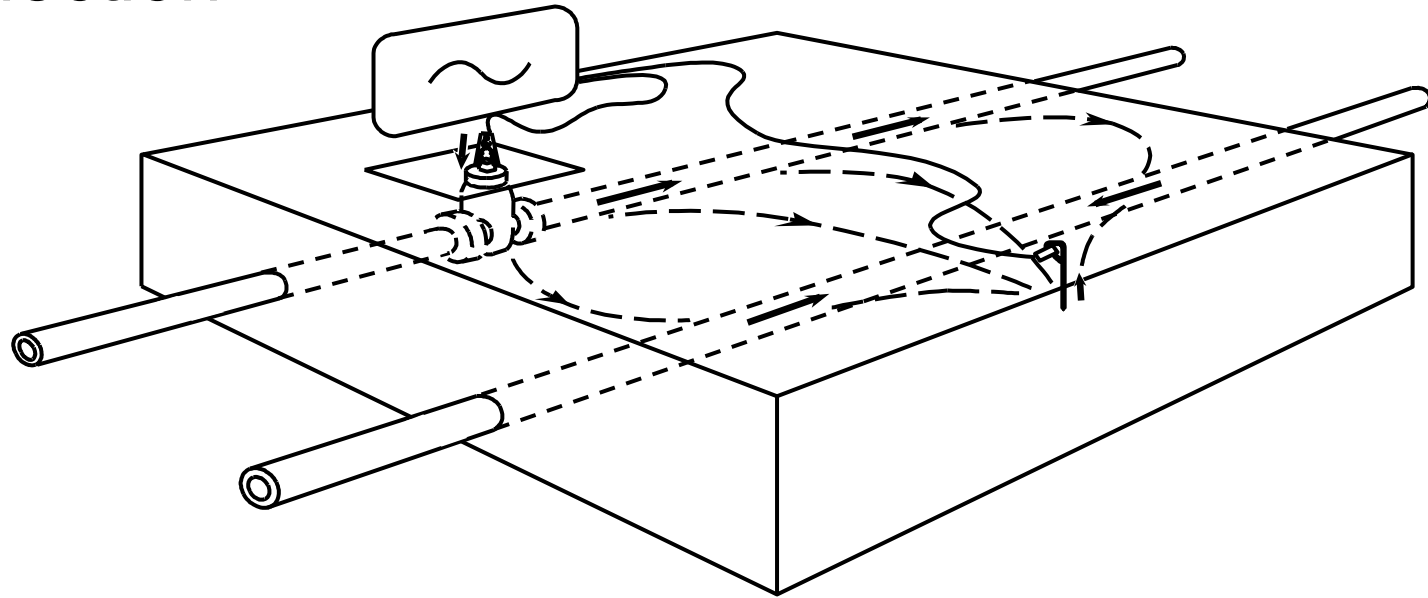
Direct Connection - Mistakes



Ground stake too close to target conductor:

- Less range
- Some signal transfer.

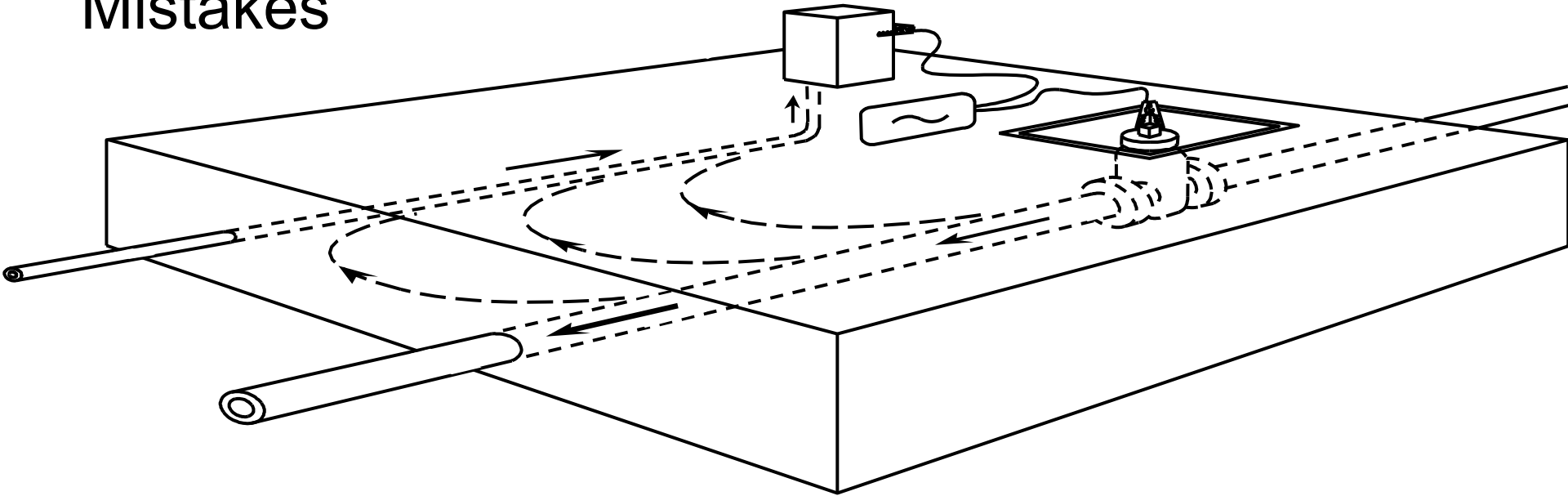
Direct Connection - Mistakes



Badly positioned remote ground causes more signal transfer.

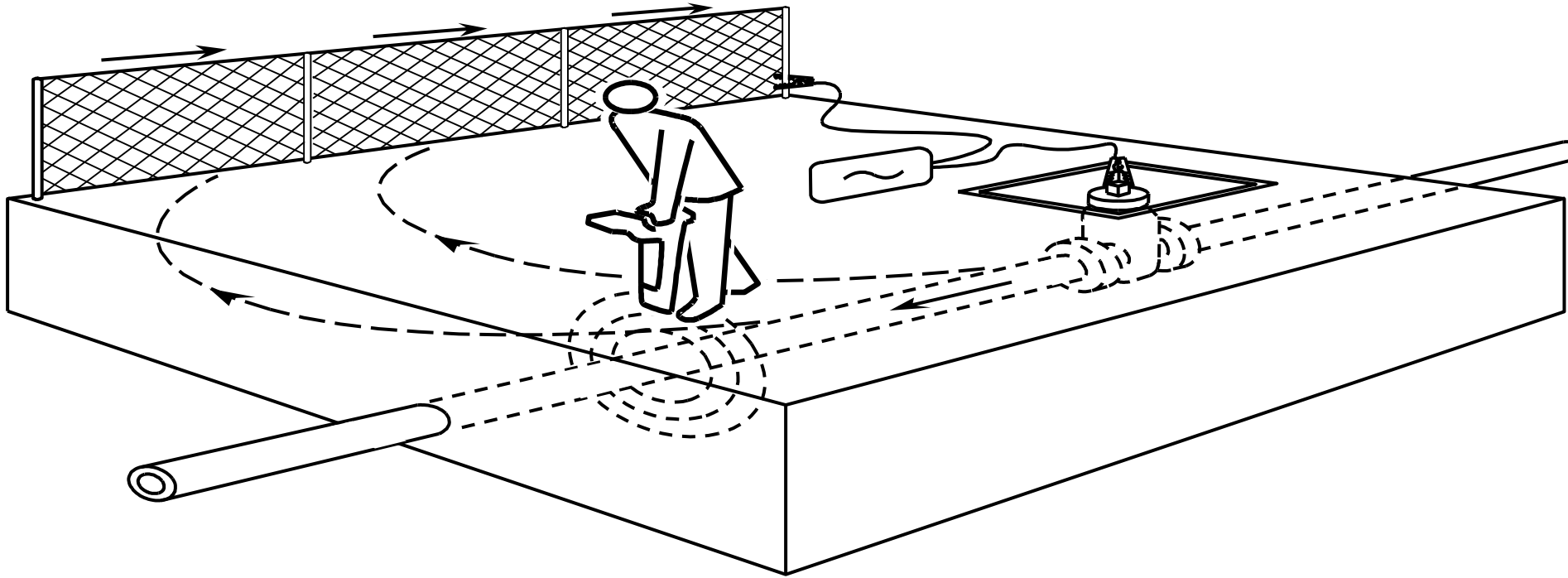
Where possible, place ground rod away from known adjacent utilities which may act as return paths.

Direct Connection - Mistakes



Grounding to a structure which is also grounded can produce multiple signals.
The signal returns on every conductor that shares the same ground.

Direct Connection - Mistakes



Metal fences may seem a convenient ground point, but might produce interfering signals.

Always use an independent ground such as a ground stake, **large** screwdriver or other isolated metallic object buried in the ground.



Ground Tips



Guide - wires as ground

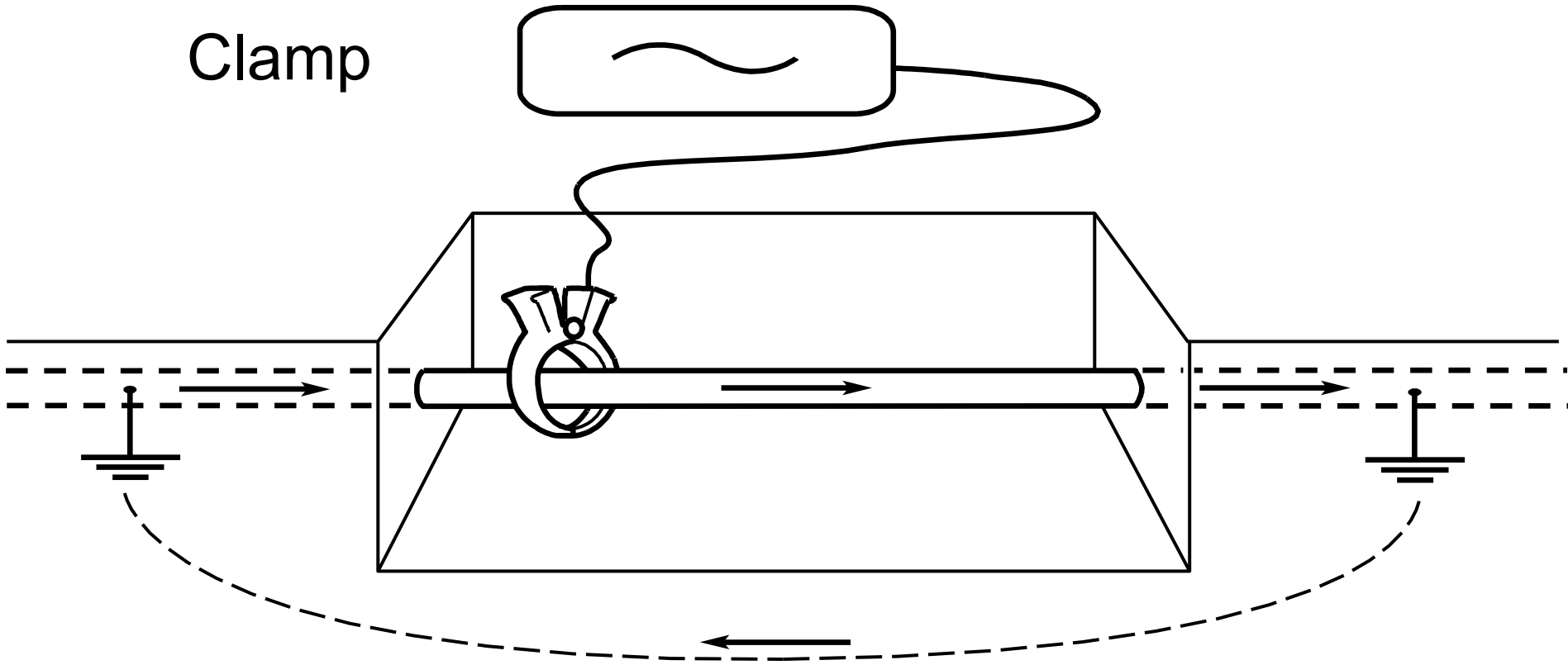
Applying Locate Signal to a Pipe

Signal Clamp



- No Ground Required
- Use Whenever you Can Clamp Around the Pipe or Cable
- Simple, Fast and Effective
- Works well with Different Frequencies and Power Settings

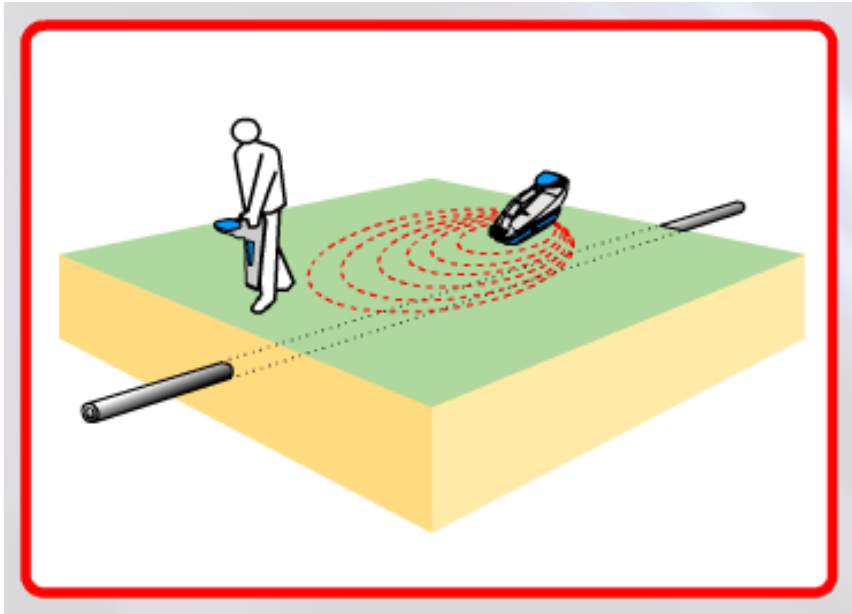
Clamp



When using a clamp, the applied signal moves away from the nearest ground to a distant ground. For this reason, it's a useful way to put a locate signal on a specific line.

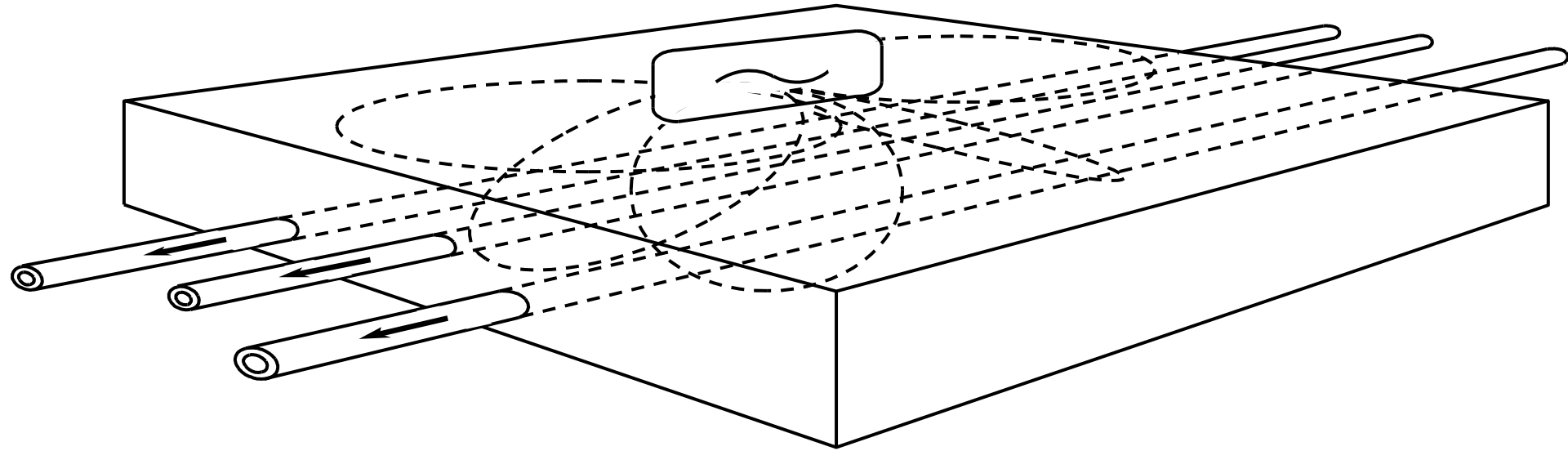
Applying Locate Signal to a Pipe

Induction



- Does not Require Access to the Pipe
- Must use a High Frequency
- The Closer the Transmitter is to the Pipe the Better
- Transmitter Antenna is Directional
- Must Keep Distance to Avoid **Air Coupling – Approx. 25' – 30'**
- Risk of Signal Jumping to Other Nearby Lines

Induction

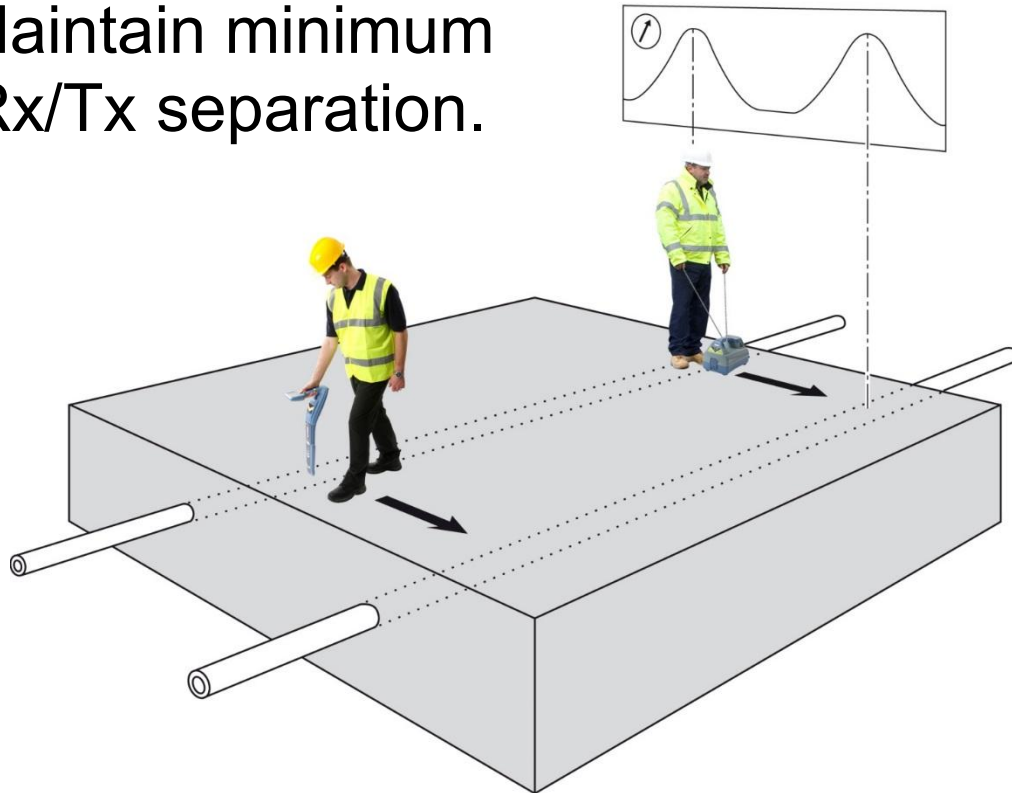


Often induction will energize every metallic conductor close to the transmitter. This is useful for checking an area for buried conductors, but not useful for finding specific conductors in congested areas.

Induction

Induction Search –
Great for Avoidance
(two person).

Maintain minimum
Rx/Tx separation.



How Do Receivers Read Signal ?

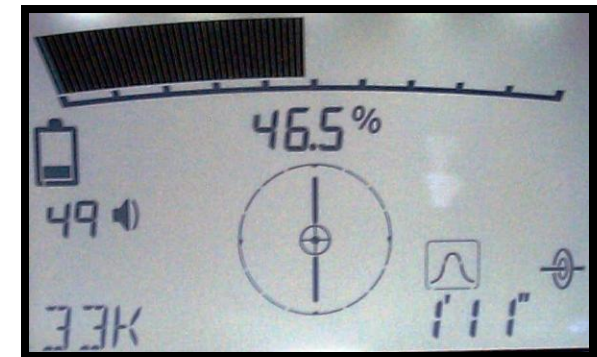
Whether the Method is Peak or Null – All Receivers Have a Way to Indicate the Strength of the Signal and Location of the Line



Audible Tone
Simple Meter



Digital Strength
with Direction Arrows

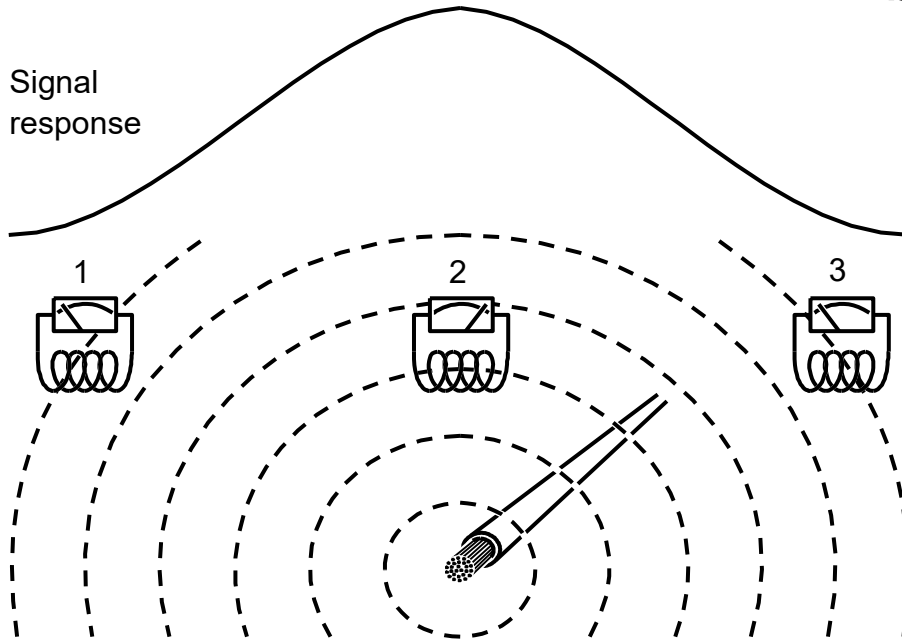


Digital Strength
and Bargraph



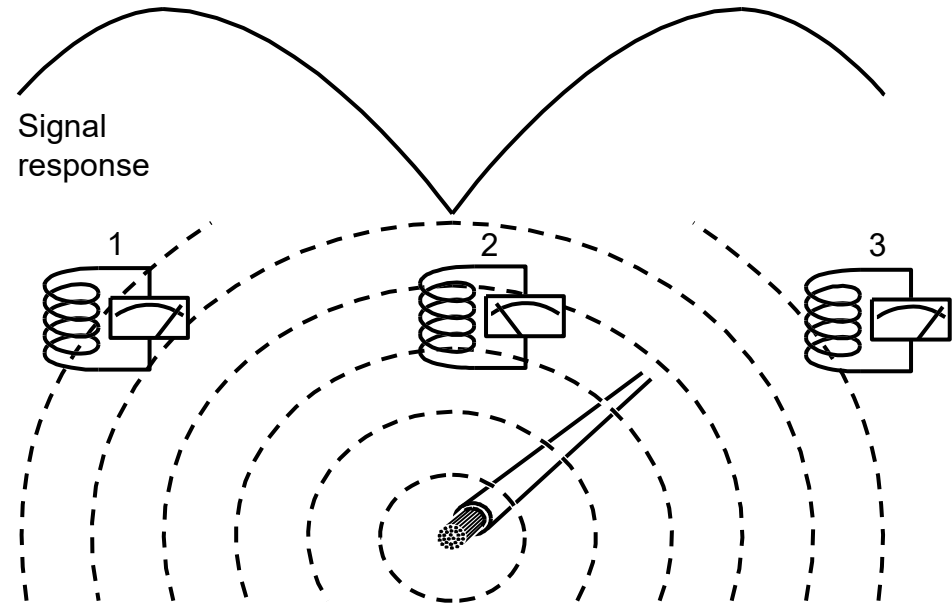
Antenna Responses

Different antenna orientations can be used for different responses.



PEAK

MOST
RELIABLE



NULL

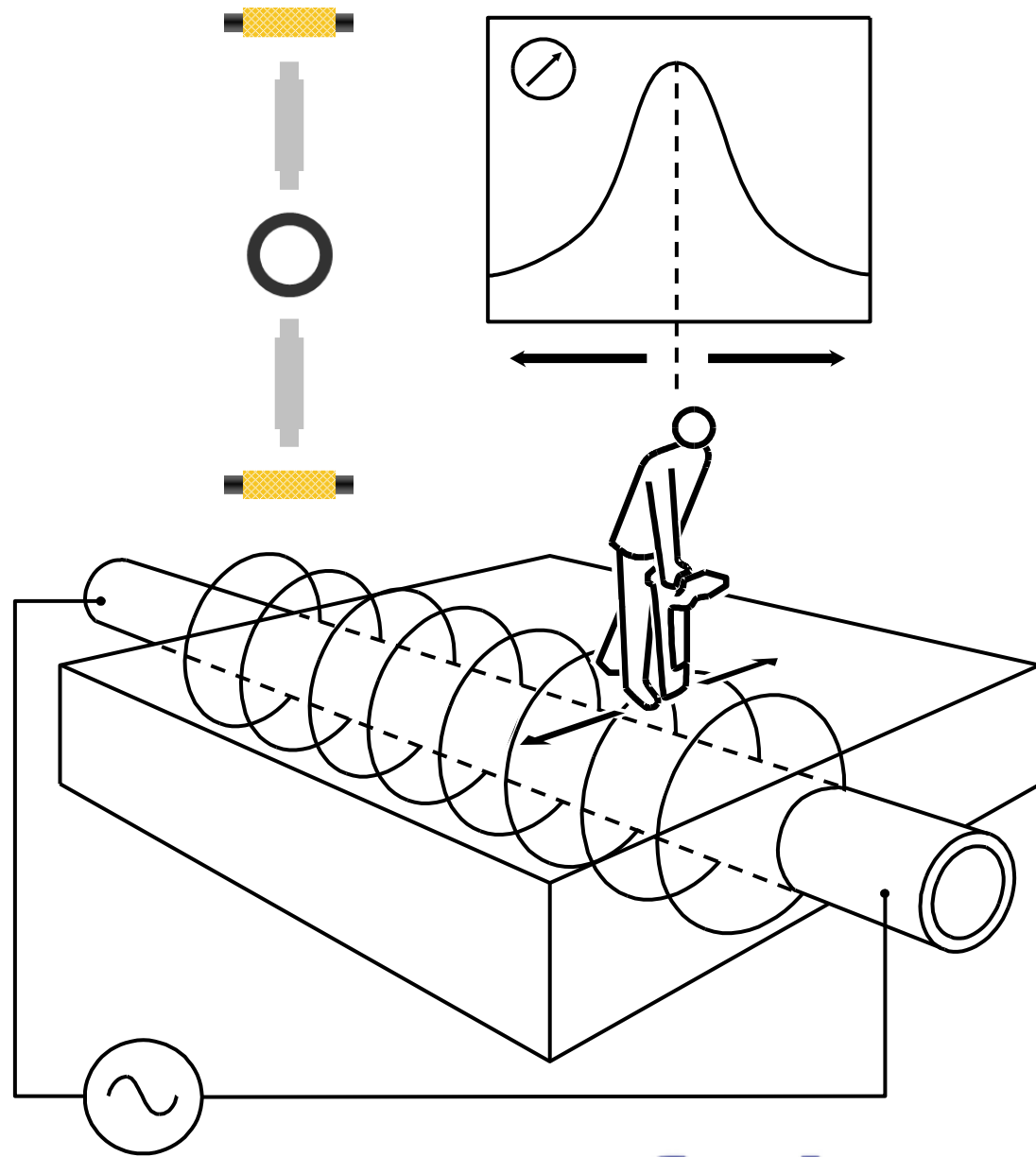
LESS
RELIABLE

Receiver Response

Typical **PEAK** signal response over a buried conductor.

PEAK response provides position and direction.

Note that the maximum signal response occurs directly over the center of the underground conductor.

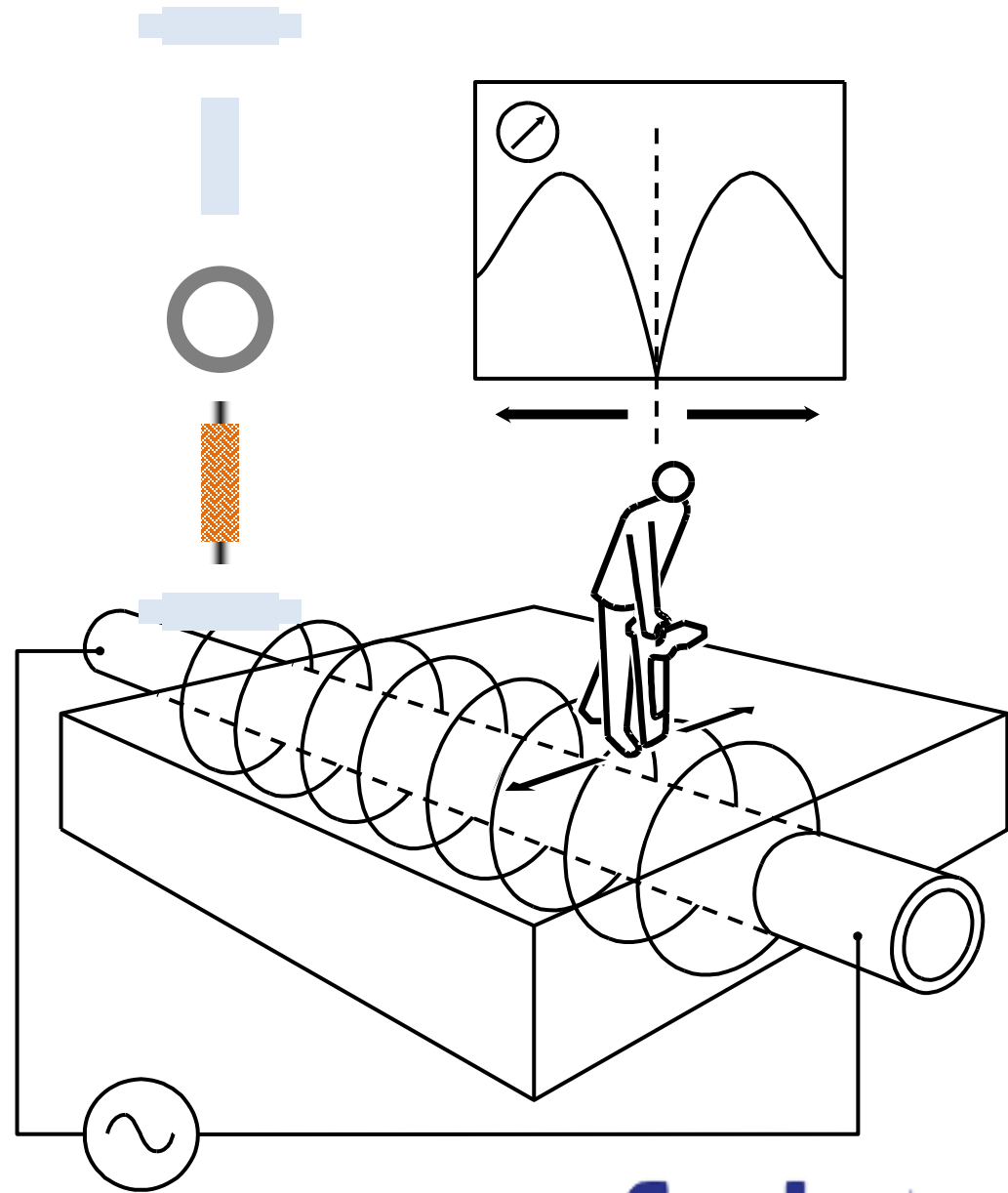


Receiver Response

In NULL, minimum signal is encountered exactly over the center of the buried conductor field.

A maximum signal response will be detected on each side of the minimum.

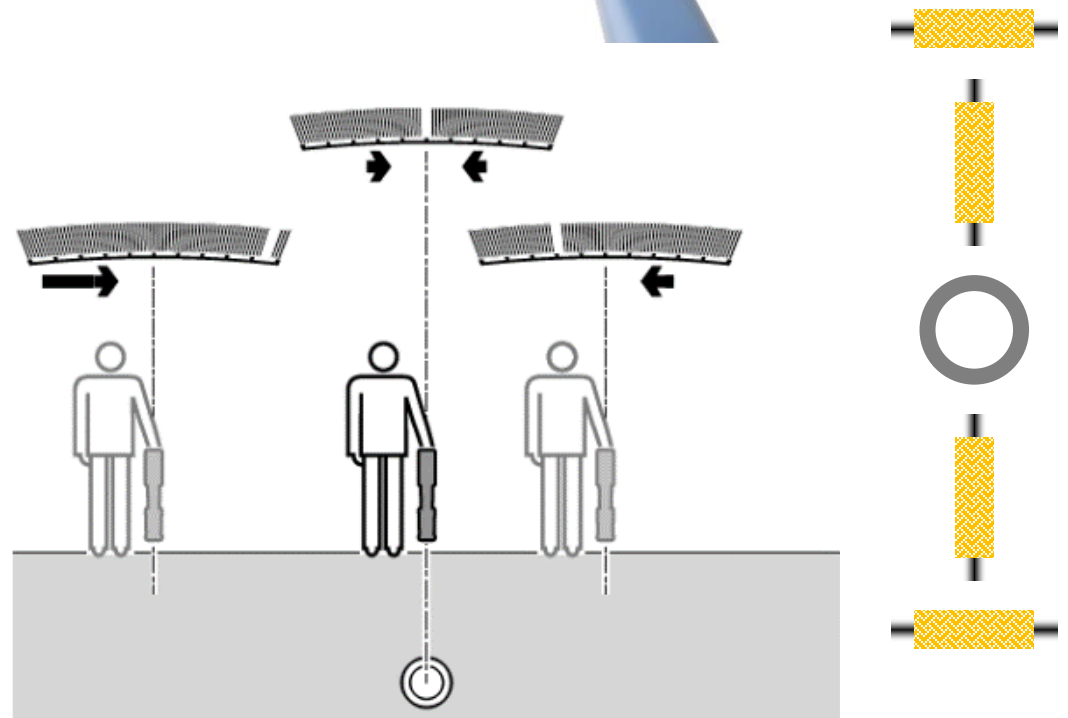
If both of the "shoulders" are symmetrical, the **NULL** point is accurate.



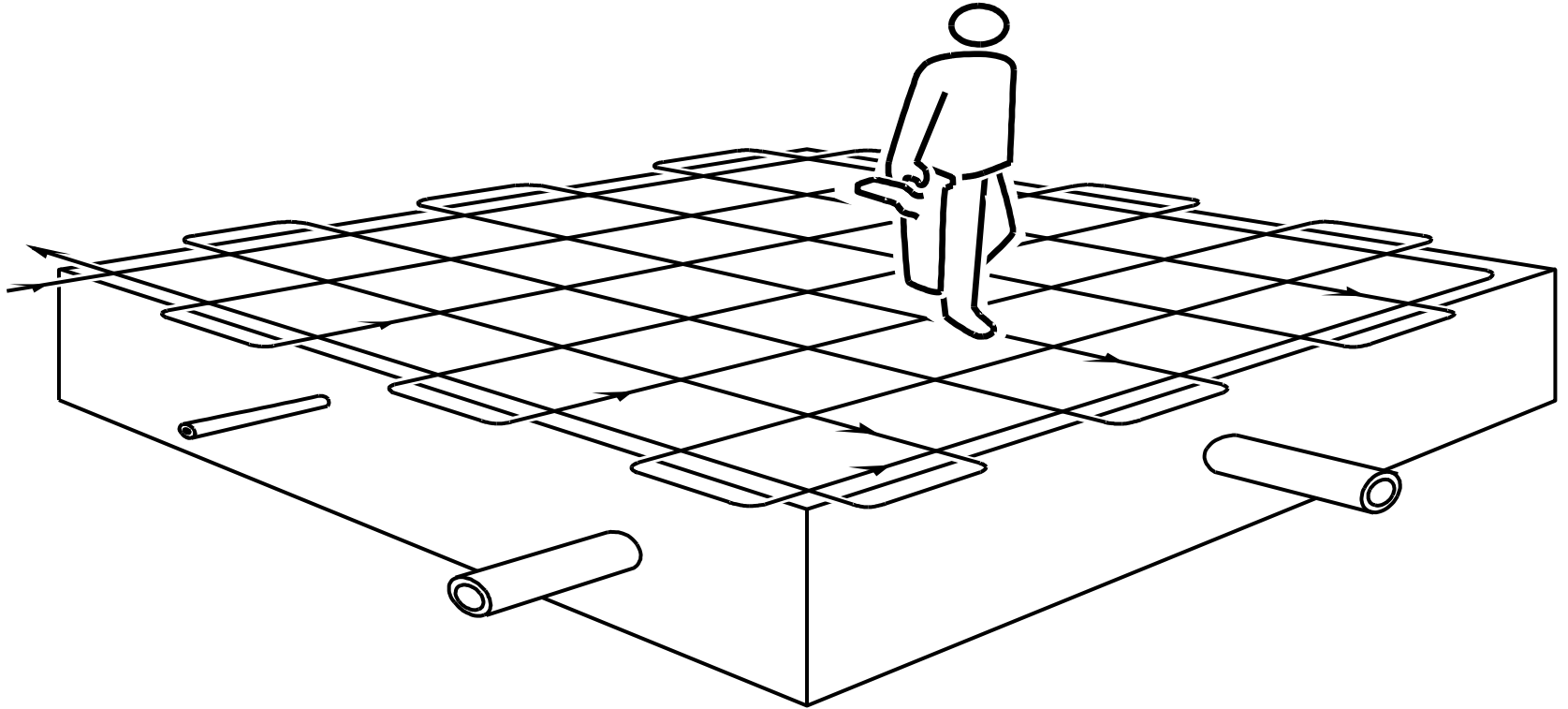
Guidance Mode

Interference resistant -
better for congested
areas than
conventional Null
locating.

Needle and arrows are
centralized when
directly
above a cable or pipe -
Automatic gain
Simultaneous depth &
current

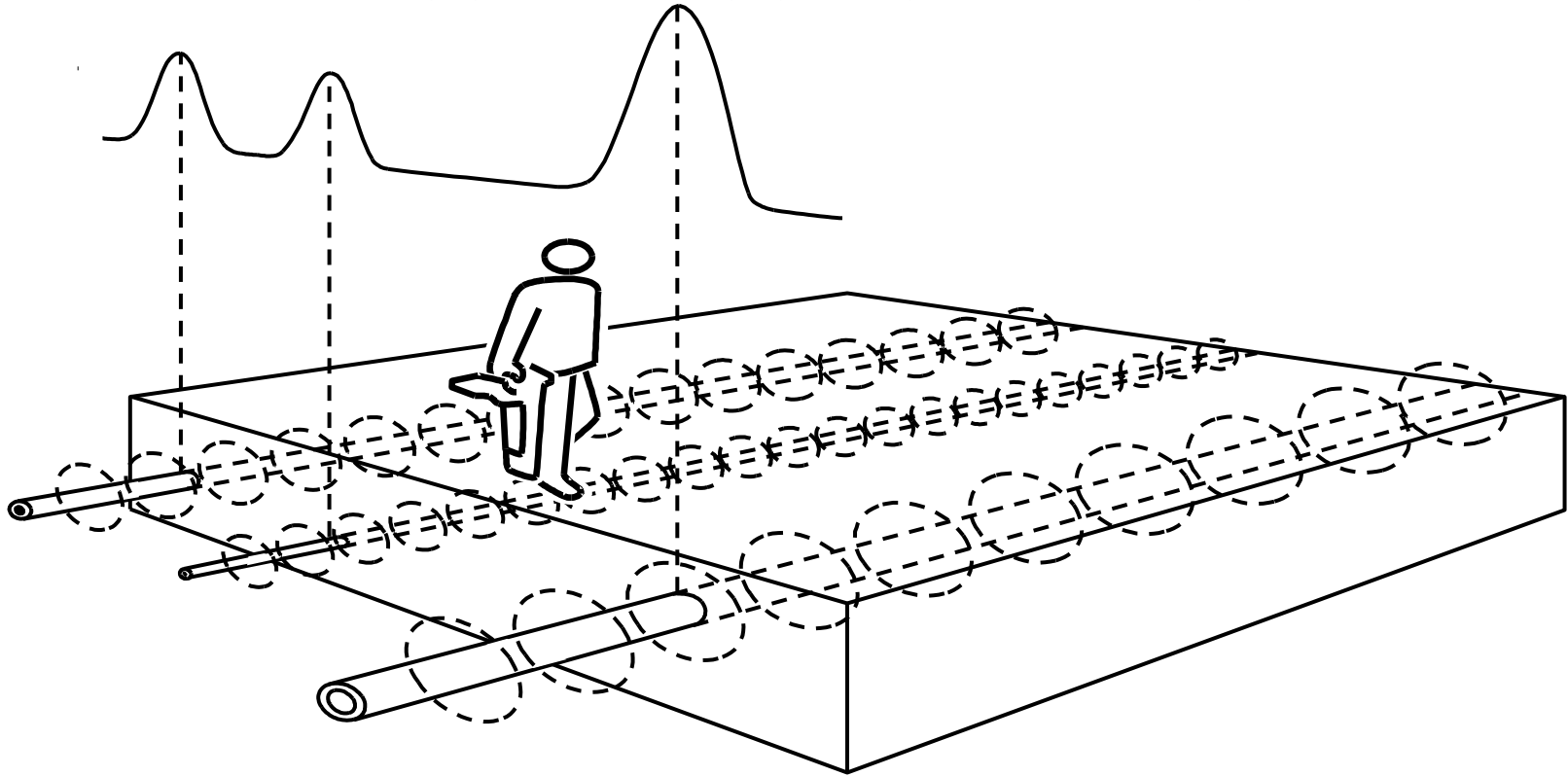


Scan Search Area



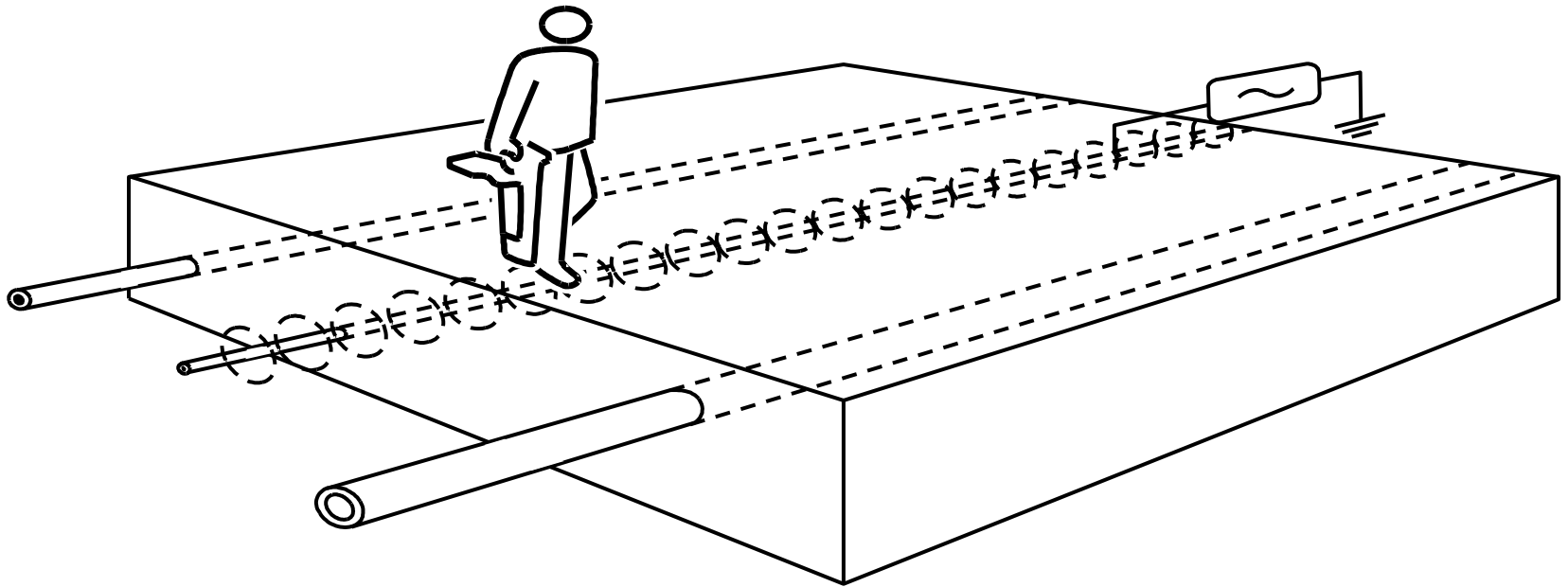
Ensure a full grid search is done to detect conductors laid in different directions.

Scan Search Area



Higher gain or sensitivity settings may show Multiple signals to analyze.

Scan Search Area



When scanning a low gain or sensitivity setting may result in detection of only the strongest signal.

Verification

- Complete job by confirming visible clues such as:

Fire Hydrants	Valve Box Covers	Manhole Covers
Pedestals	Splice Boxes	Pad Mounted Transformers
Overhead Cables	Utility Poles	Dip or Riser Cables
Gas Meters	Meter Pits	UG Vaults
Electric Meters	Network Interface Devices	Utility Markers or Existing Markings

- Did you consult maps and drawings from utility companies?
- Did you complete your assigned job task?

Judging Accuracy of the Signal – 3 Checks

1. Do Peak and Null Align?
2. Does your Depth Reading Track Properly?
3. Does your Signal Change to Either Side Uniformly?

Your Tools to Combat DISTORTION

1. Method of Signal Application
2. Choice & Quality of Ground
3. Peak or Null
4. Frequency Applied

When You Struggle ...

4 CHANGES and 1 MOVE

1. Change your Ground
2. Change your Frequency
3. Increase Transmitter's Voltage
4. Change How you Apply the Signal
5. Move your Transmitter

THREE WAYS TO LOCATE A BURIED CONDUCTOR;

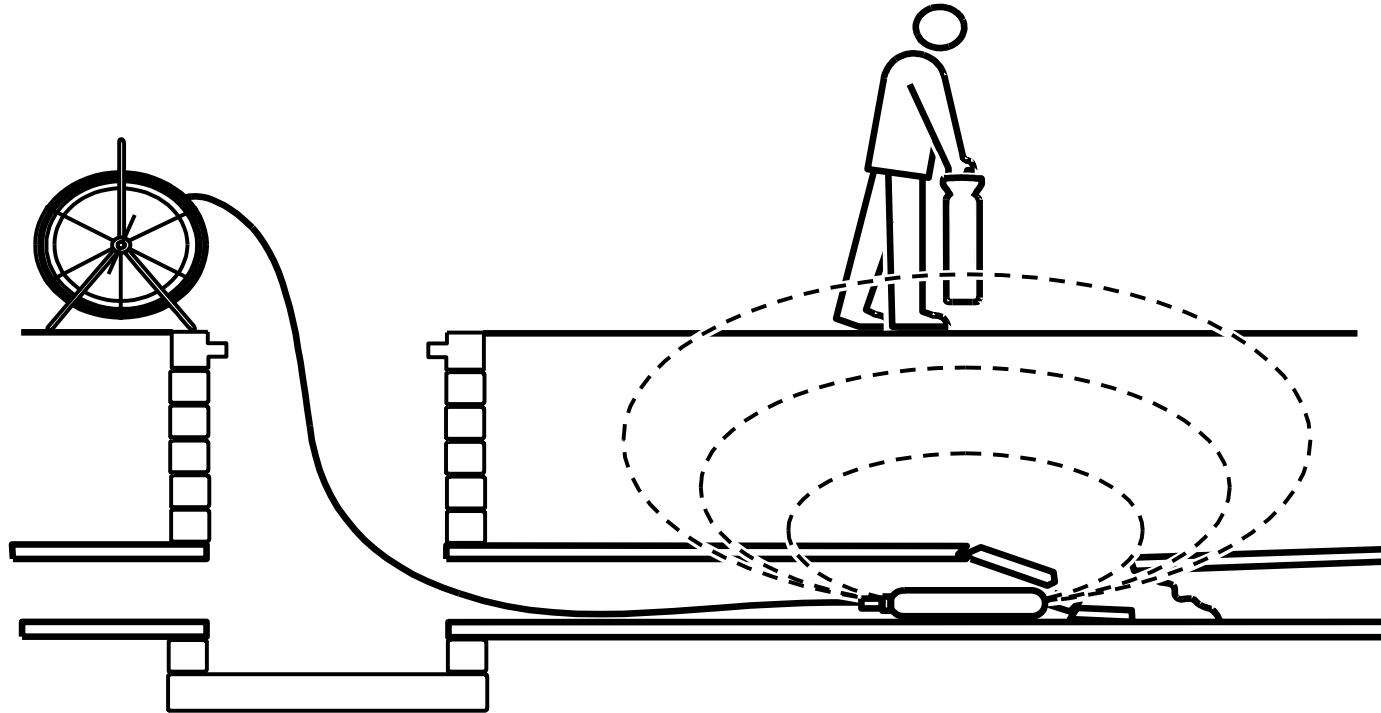
1. LOOK FOR A FIELD THAT'S
ALREADY ON IT.

2. PUT A FIELD ON IT.

3. PUT A FIELD IN IT.

Non-Metallic Lines

PUT A FIELD IN IT.



- **Inspection Cameras, Sondes** and **Detectable rods** can be inserted into the pipe
- Pinpoint Lines, Blockages or Obstructions
- Best Used in Non-Metallic Pipe
- Detectable by a Locator at Ground Level







EM Locators



- **Frequency & color coded**

Power - Red

Water - Blue

Sanitary - Green

Telephone - Orange

Gas - Yellow

Cable TV - Orange/Black

Non-Potable Water – Purple

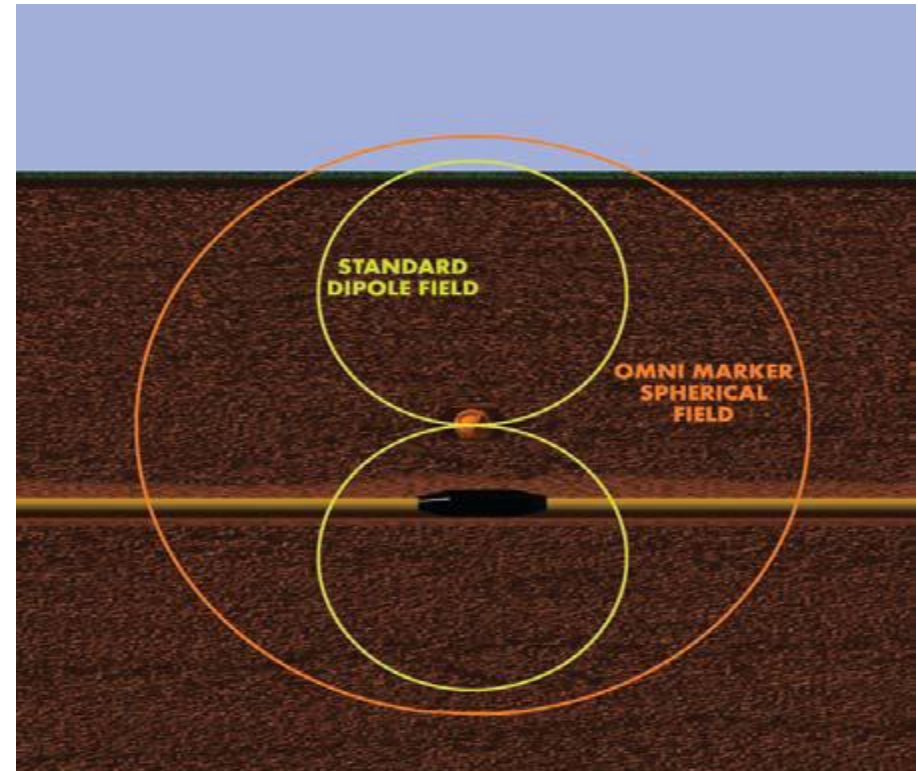
- **Scan mode provides simultaneous detection of all marker types**



> Radiodetection®

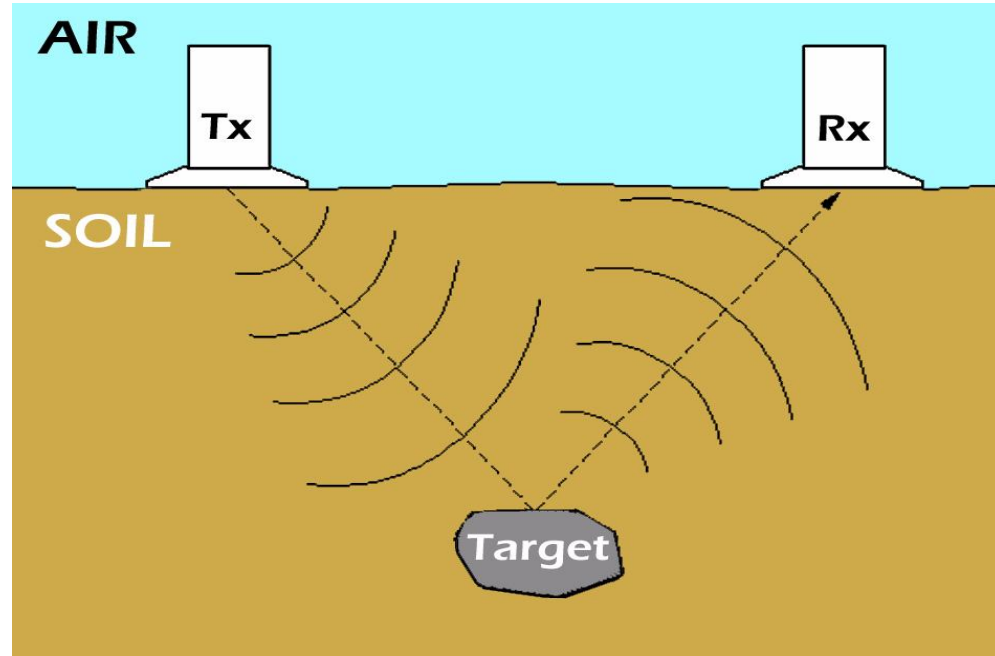
Eastcom
67

Electronic Marker Locators



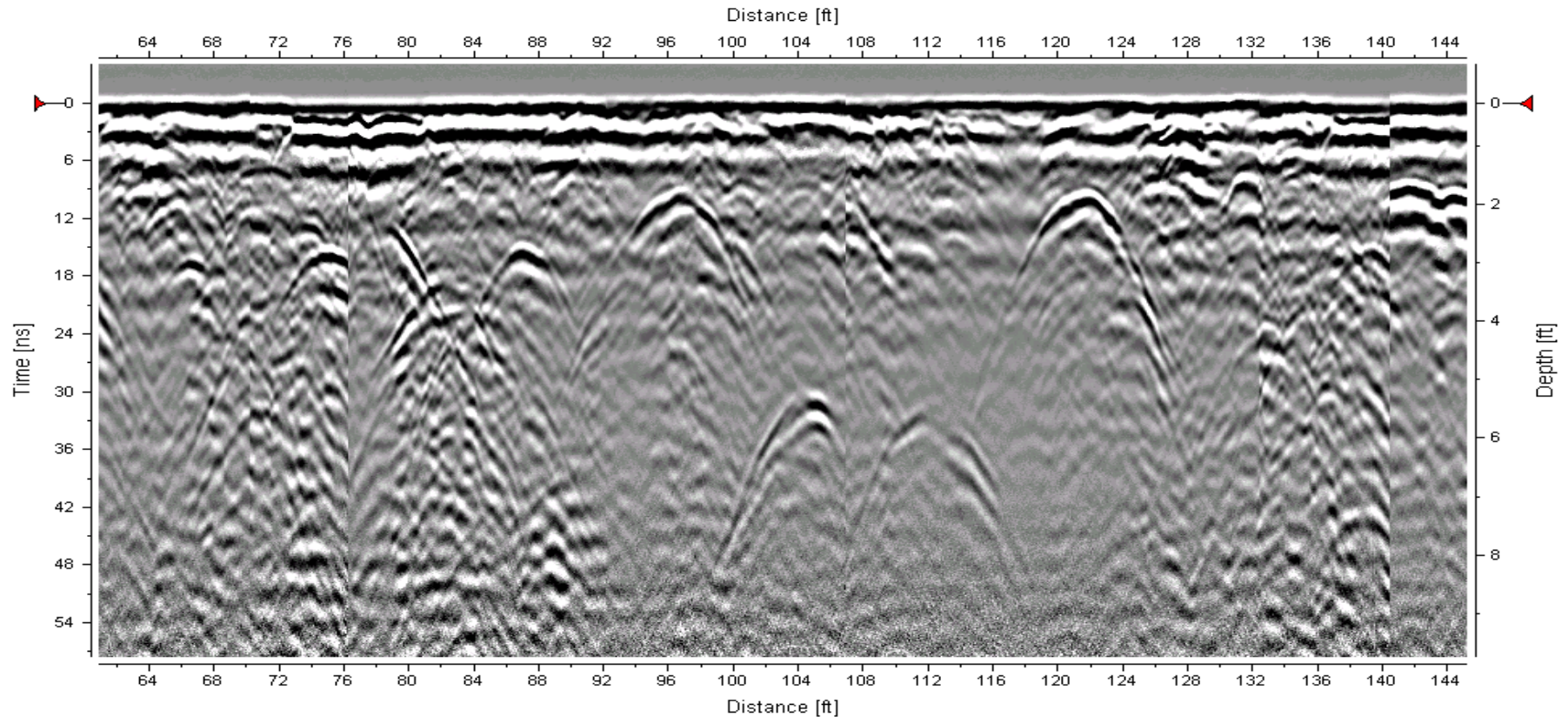
When excited by any standard marker locator, these passive circuits produce a uniform, spherical RF field in every direction.

Ground Penetrating Radar



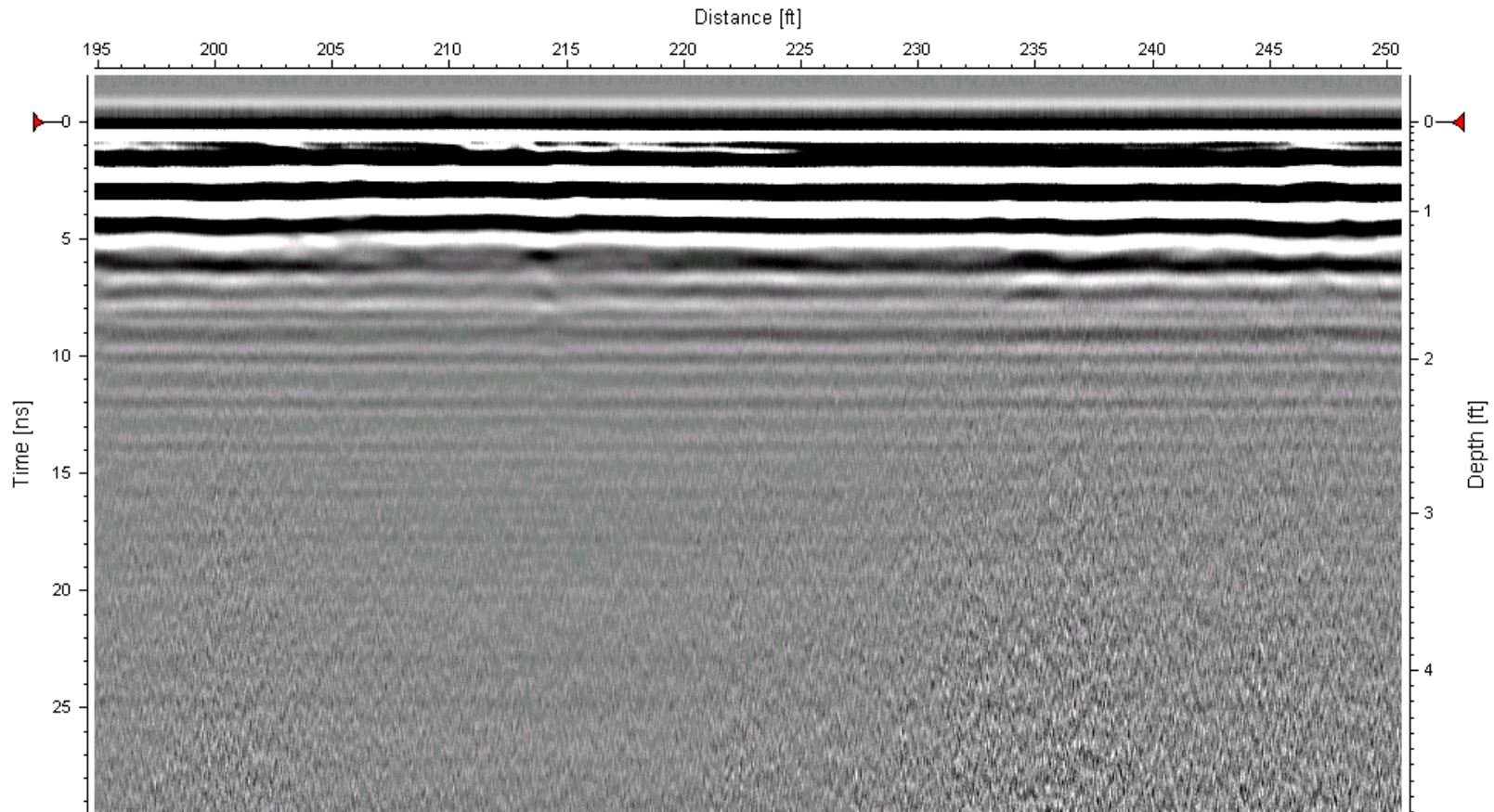
- GPR is the electromagnetic equivalent to a sonar or a fish finder.
- A transmitter produces electromagnetic impulses which are transmitted through the subsurface.
- Reflections occur where the electrical properties of materials change
- These reflections are detected by the GPR receiver and displayed on a monitor.

Ground Penetrating Radar



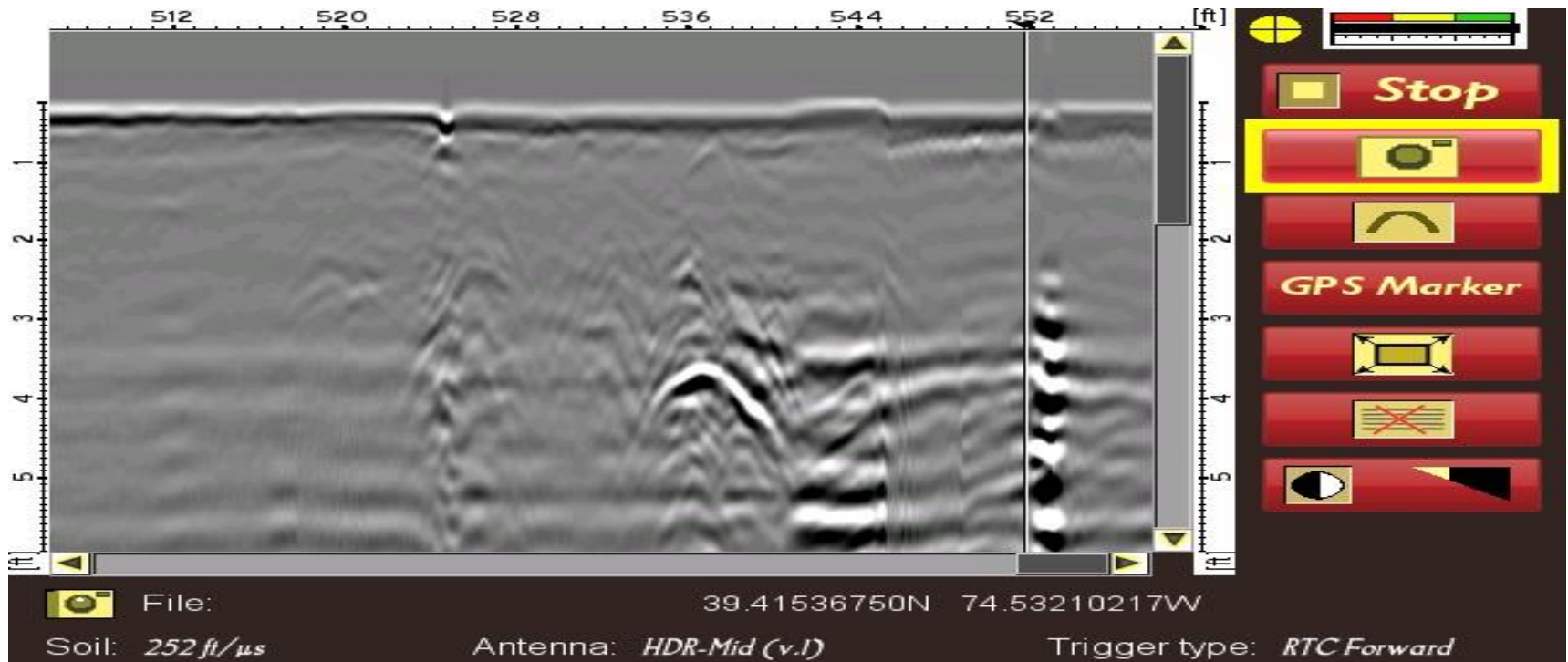
Example of Radar Data in Receptive
Soil Conditions (Gravel / Sand)

Ground Penetrating Radar

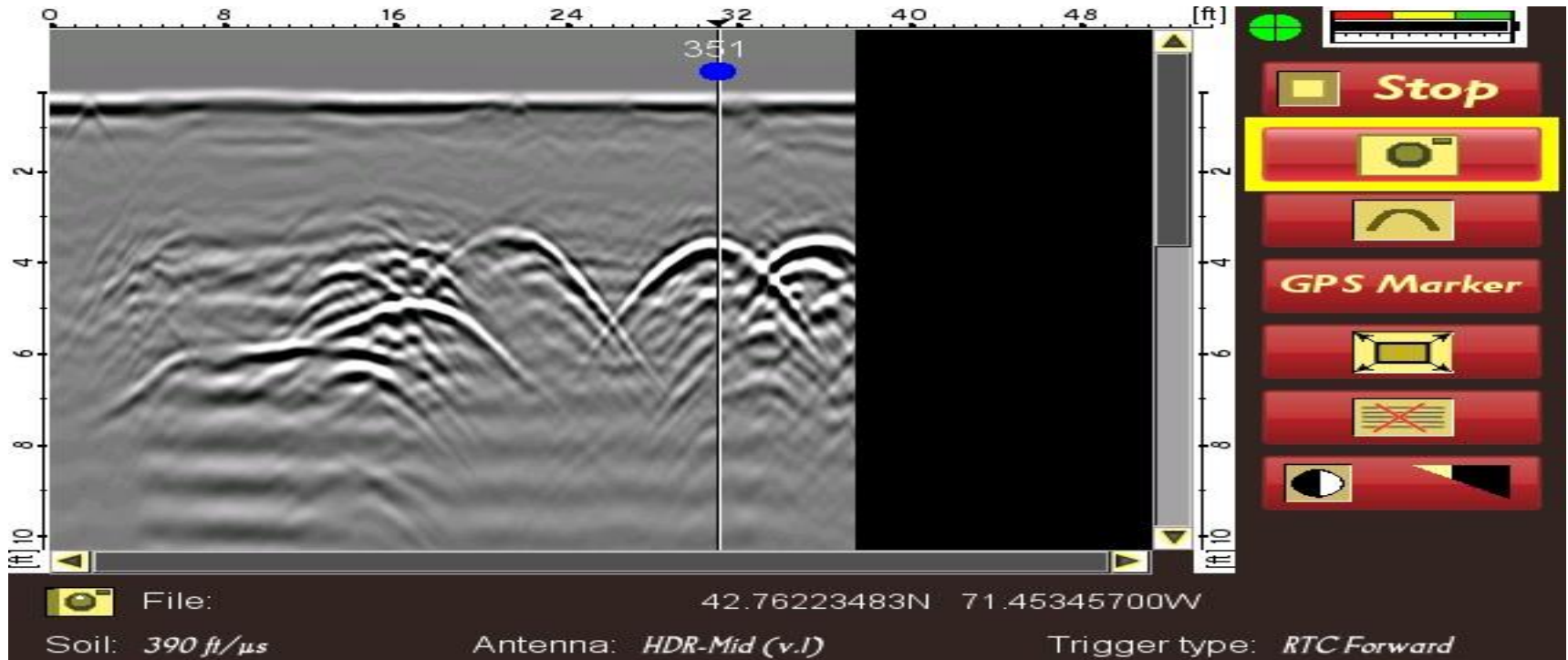


Example of Radar Data in Non-Receptive Soil Conditions (Clay)

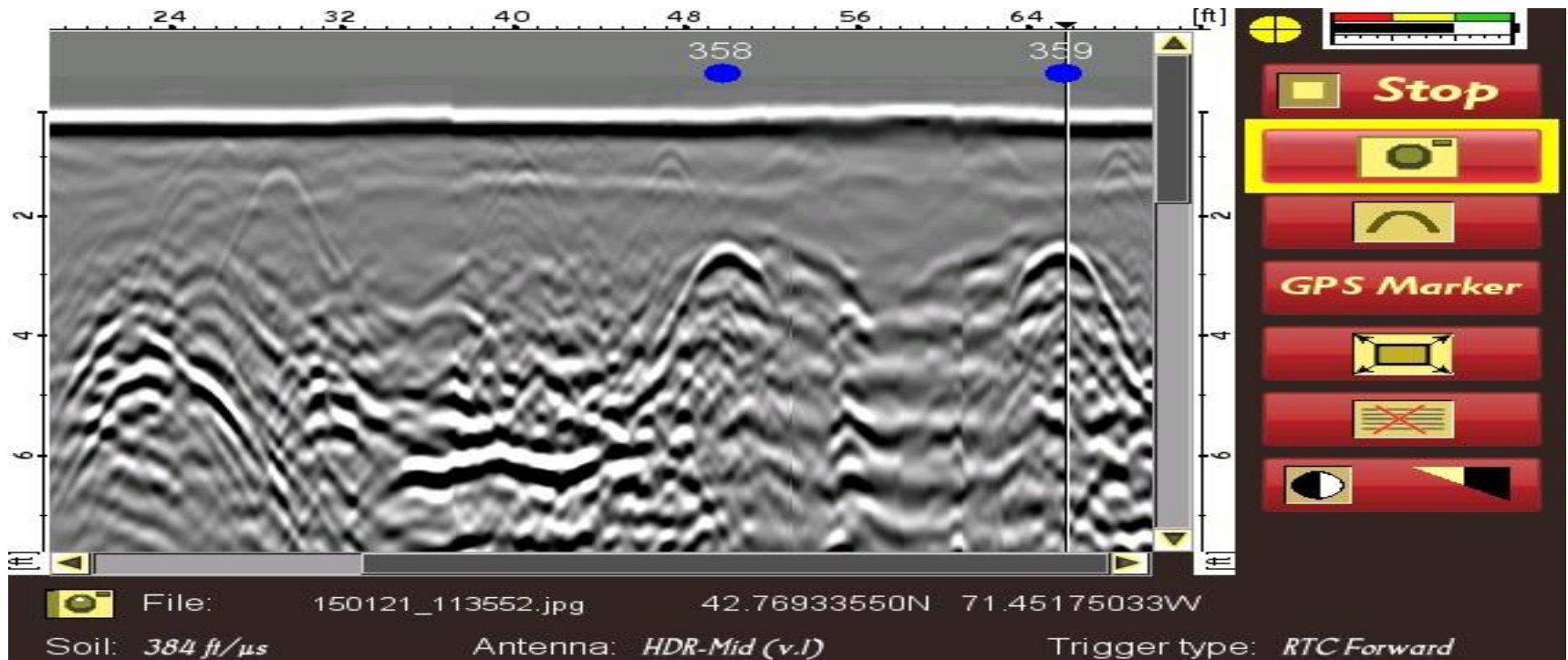
Ground Penetrating Radar

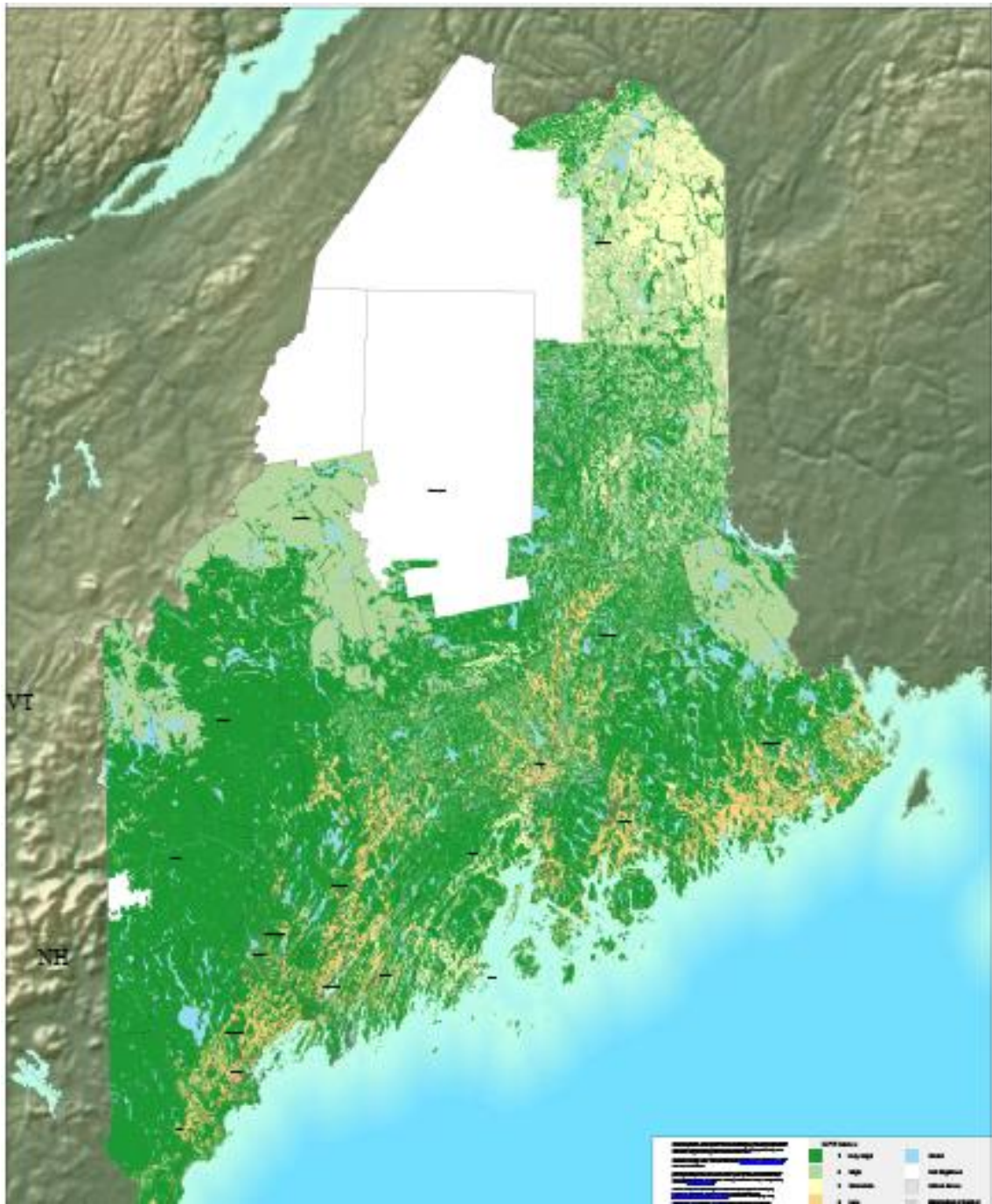


Ground Penetrating Radar

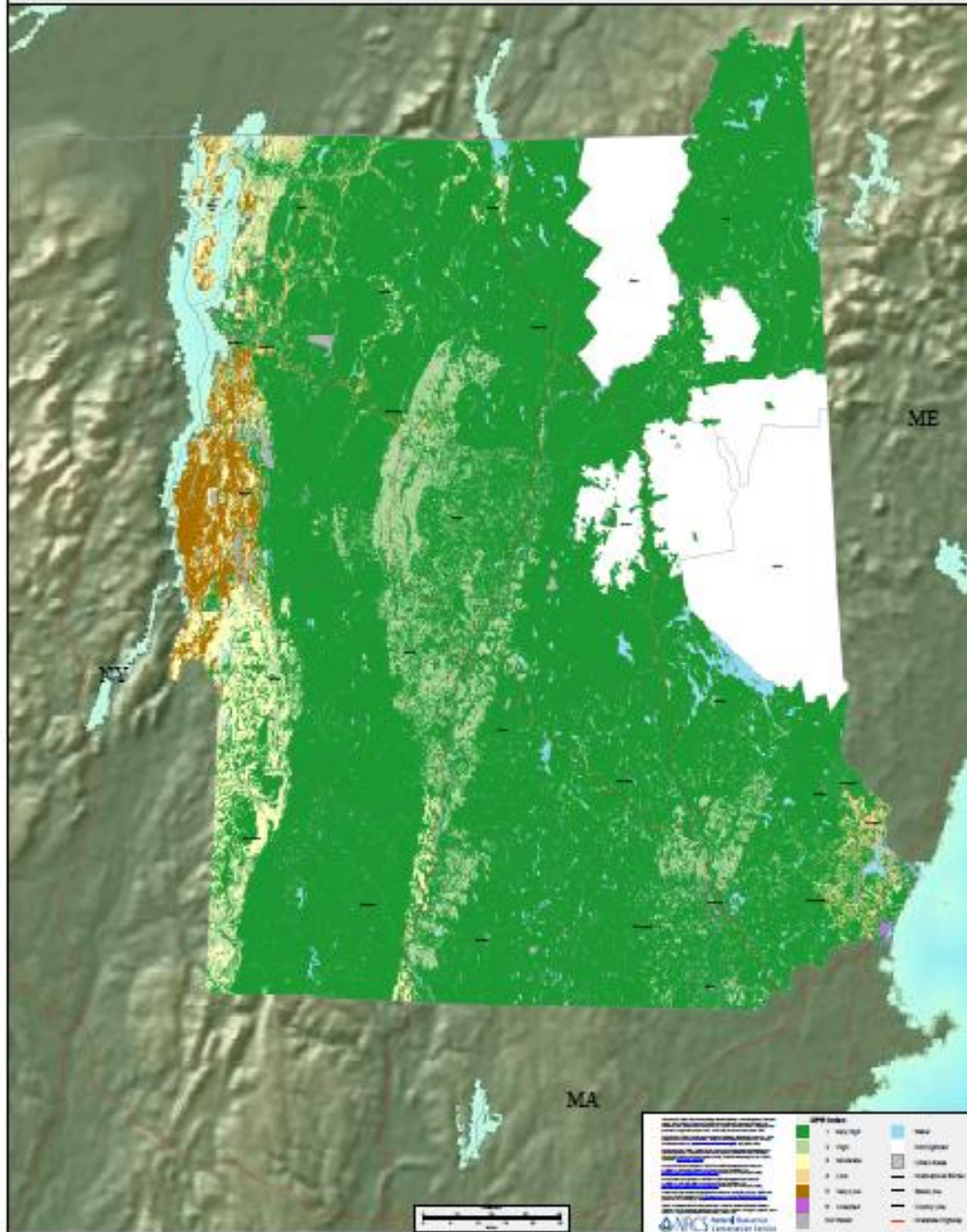


Ground Penetrating Radar





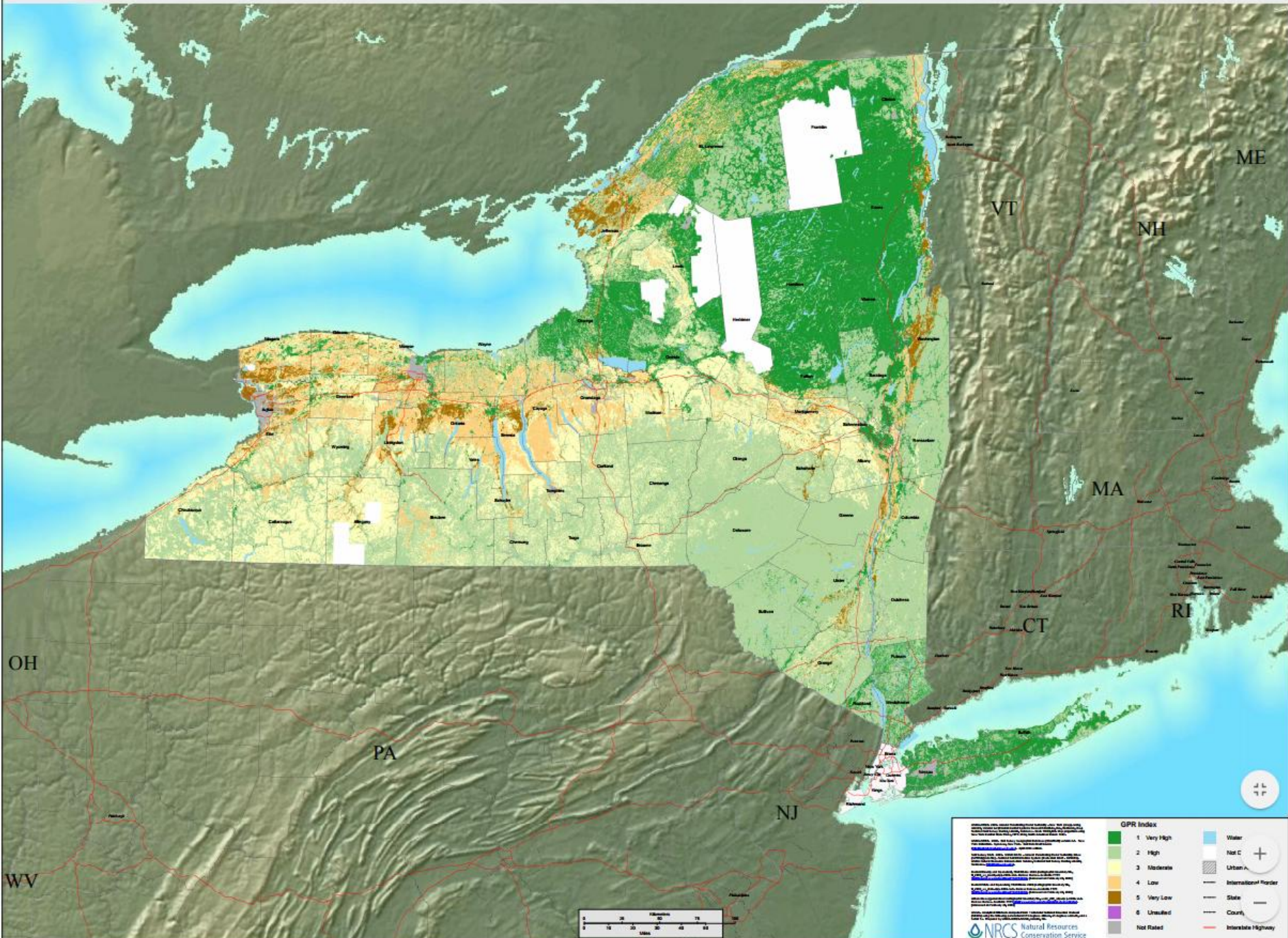
GPR SUITABILITY MAP - NEW HAMPSHIRE AND VERMONT



GPR SUITABILITY MAP - MASSACHUSETTS, CONNECTICUT AND RHODE ISLAND



GPR SUITABILITY MAP - NEW YORK



GPR Index

Green	1 Very High	Blue	Water
Dark Green	2 High	White	Not C
Yellow	3 Moderate	Grey	Urban A
Orange	4 Low	Black	International Border
Light Orange	5 Very Low	Red	State
Purple	6 Unrated	Black	County
Grey	Not Rated	Red	Interstate Highway

Legend:

- Water
- Not C
- Urban A
- International Border
- State
- County
- Interstate Highway

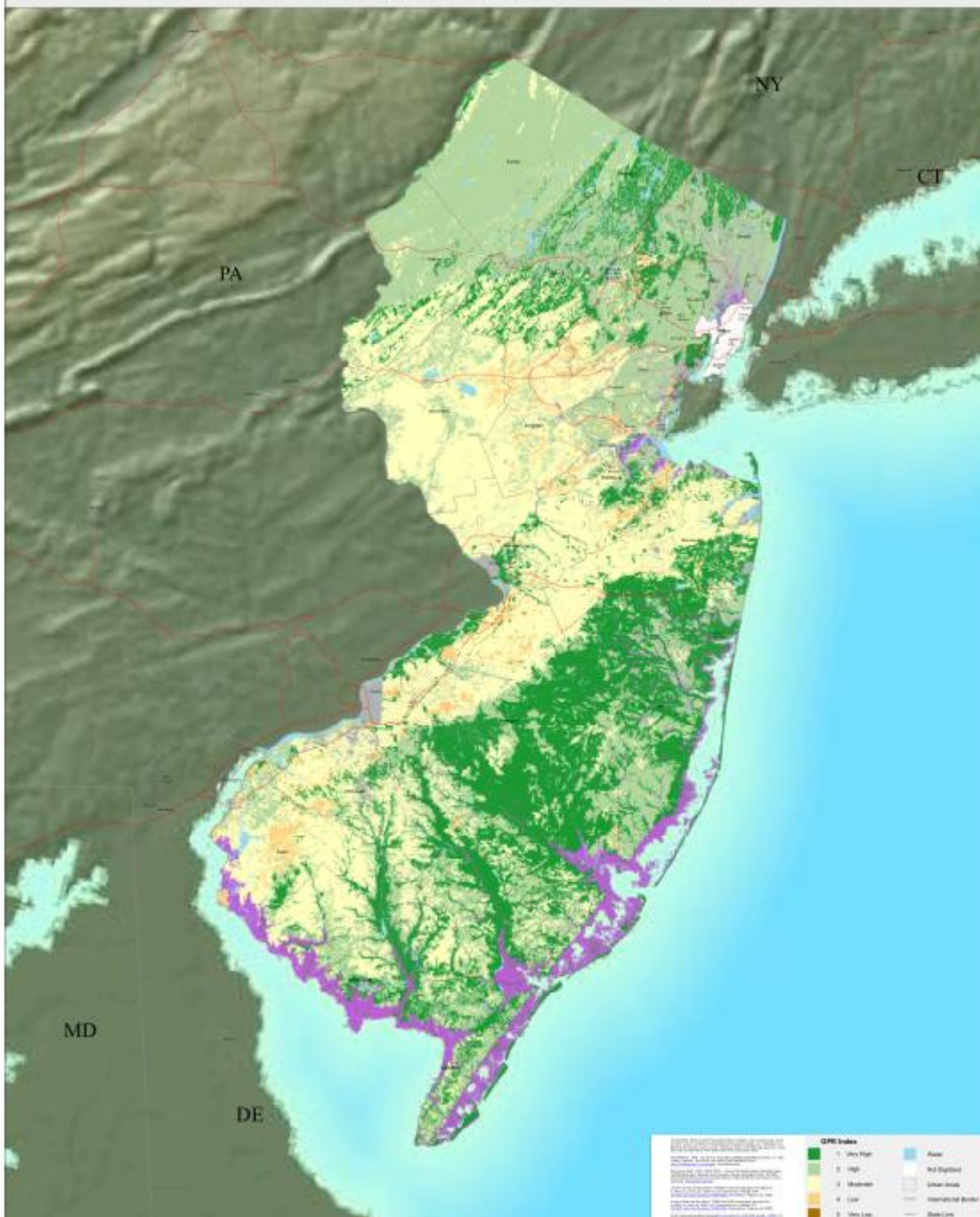
Scale: 0 10 20 30 40 50 Miles

Metadata:

Prepared by: [illegible]
 Date: [illegible]
 Version: [illegible]
 Contact: [illegible]

Logos: NRC S Natural Resources Conservation Service

GPR SUITABILITY MAP - NEW JERSEY



Questions?

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