

# TRADEOFFS BETWEEN DYNAMIC MAPPING WITH METAL MAPPER 2x2 AND THE EM61 MK2

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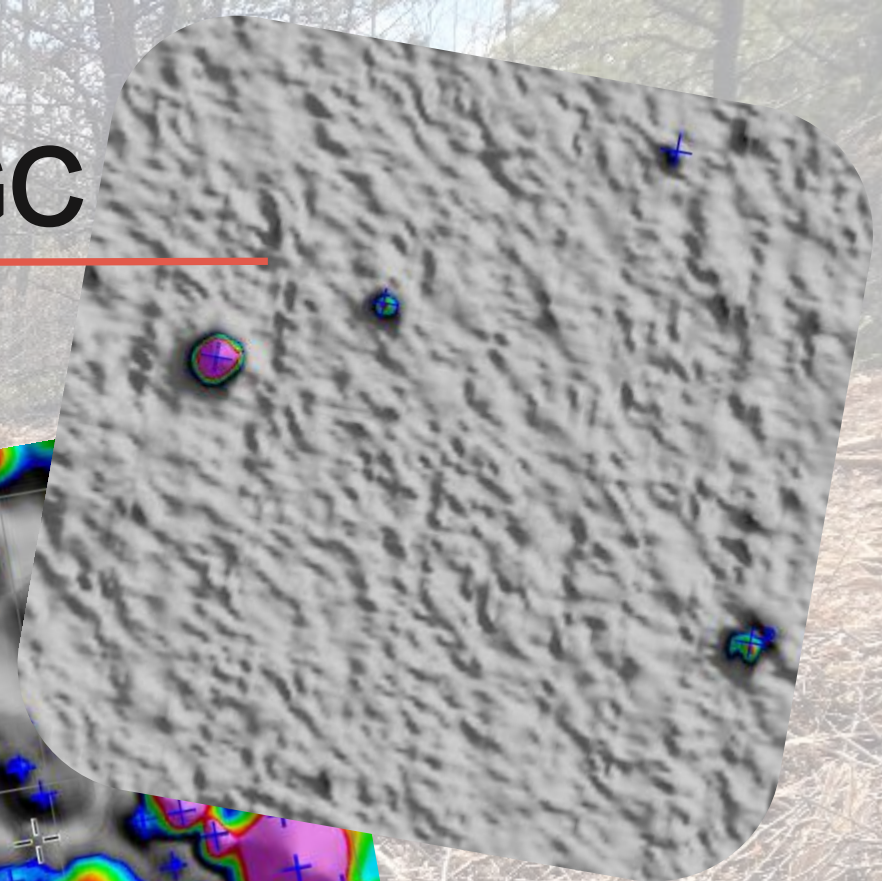
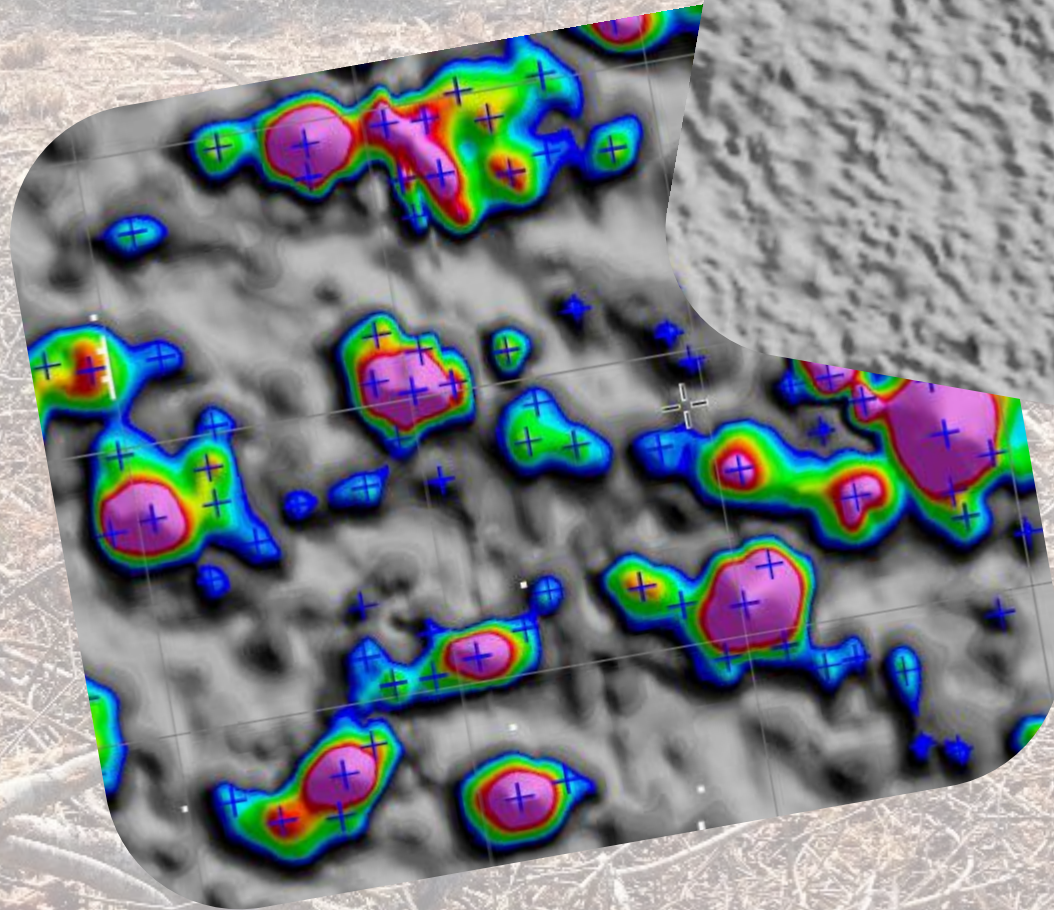
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# Dynamic Detection Data for AGC

Gives us targets upon which to collect static data.





## EM61 MK2

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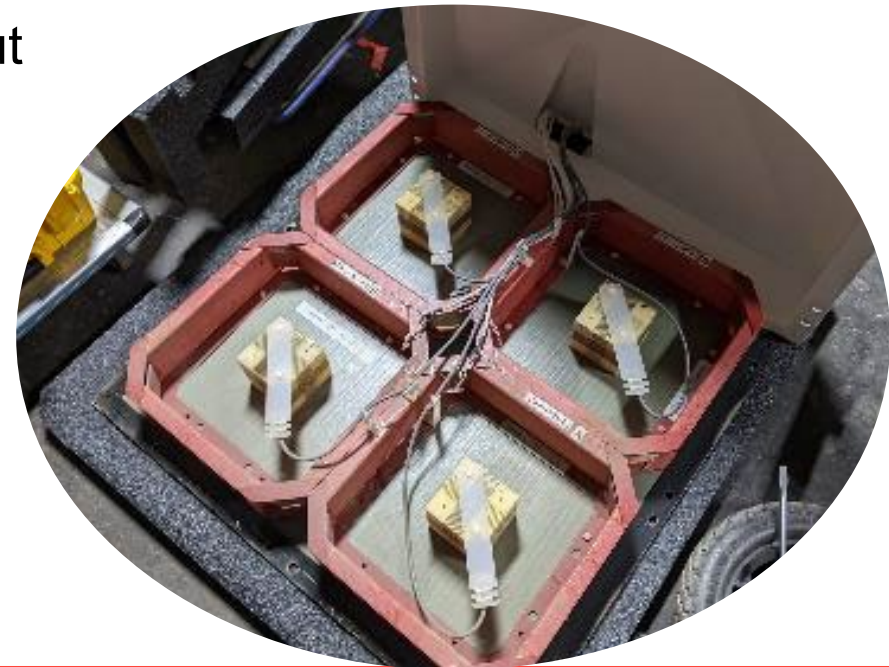
- EM61 used for munitions since at least the 1990s.
- Single 0.5 m x 1 m transmitter coil and a single, co-located receiver coil.
- Positioning limited by size of the coil
- No internal IMU



## Metal Mapper 2 x2 Dynamic

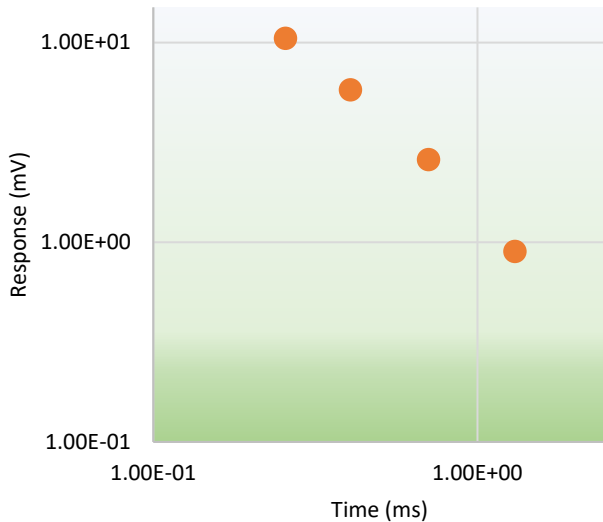
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- AGC instruments in use since 2016.
- Four 35cm x 35cm transmitter coils
- Four receiver cubes with receivers in 3 directions.
- Smaller coils lead to better positioning but also, lower depth of detection



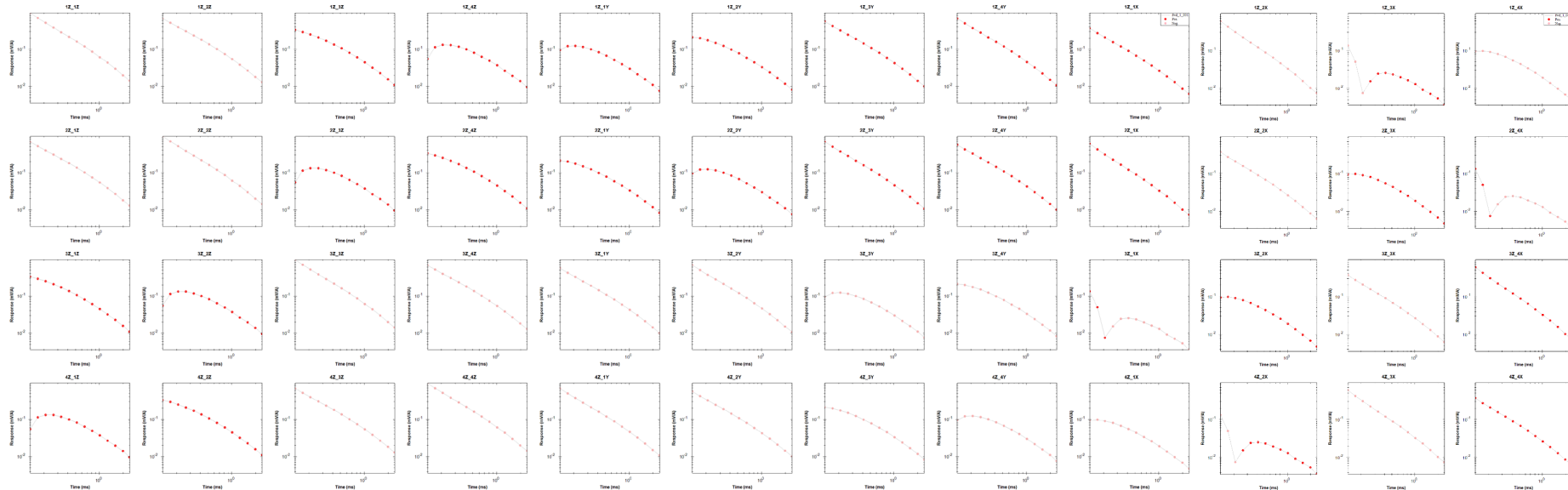
# EM61 MK2

- 4 time gates
- 4 data points
- No inversion



# Metal Mapper 2 x2 Dynamic

- 14 Useable time gates, 4 transmitters, 12 receivers
- 48 receiver / transmitter pairs
- 672 data points
- Allows for informed source selection





# Cost and Availability

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## EM61-MK2

- Purchase Price- \$40,000
- Shipping – 200 pounds, \$500
- Availability – Readily available from multiple vendors
- Rental Price - \$150 per day, \$150 prep
- Weston Owned – 6 units

## Metal Mapper 2x2

- Purchase Price- \$165,000
- Shipping – 405 pounds, freight shipping, up to \$3000, taking a week.
- Availability – 3 units in rental pool
- Rental Price - \$1,000 per day, \$1,800 prep
- Weston Owned – 5 units



# Durability & Maneuverability

## EM61 MK2

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- Very rugged
- Large wheels, lighter weight, no backpack = easier to maneuver
  - Can roll over obstacles easier (vegetation doesn't need to be cleared as low)
- No over heating
- Better sealed from the elements





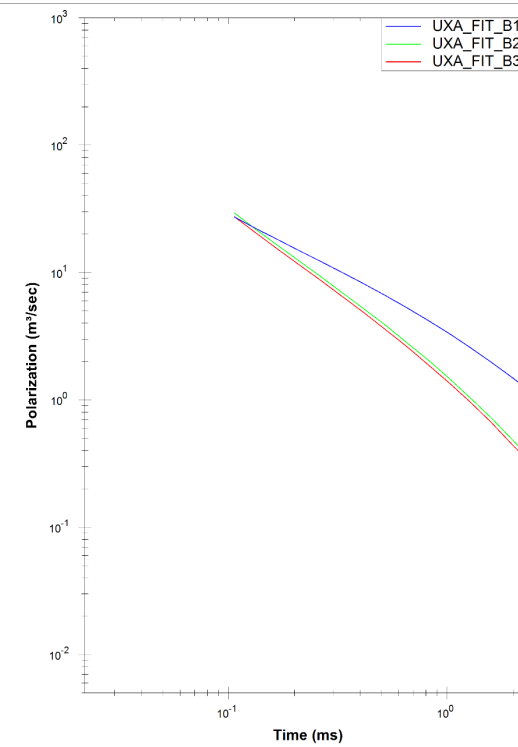
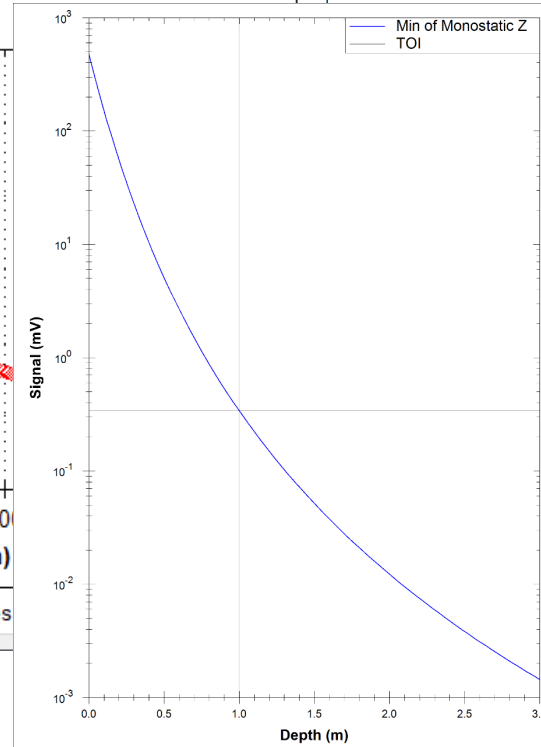
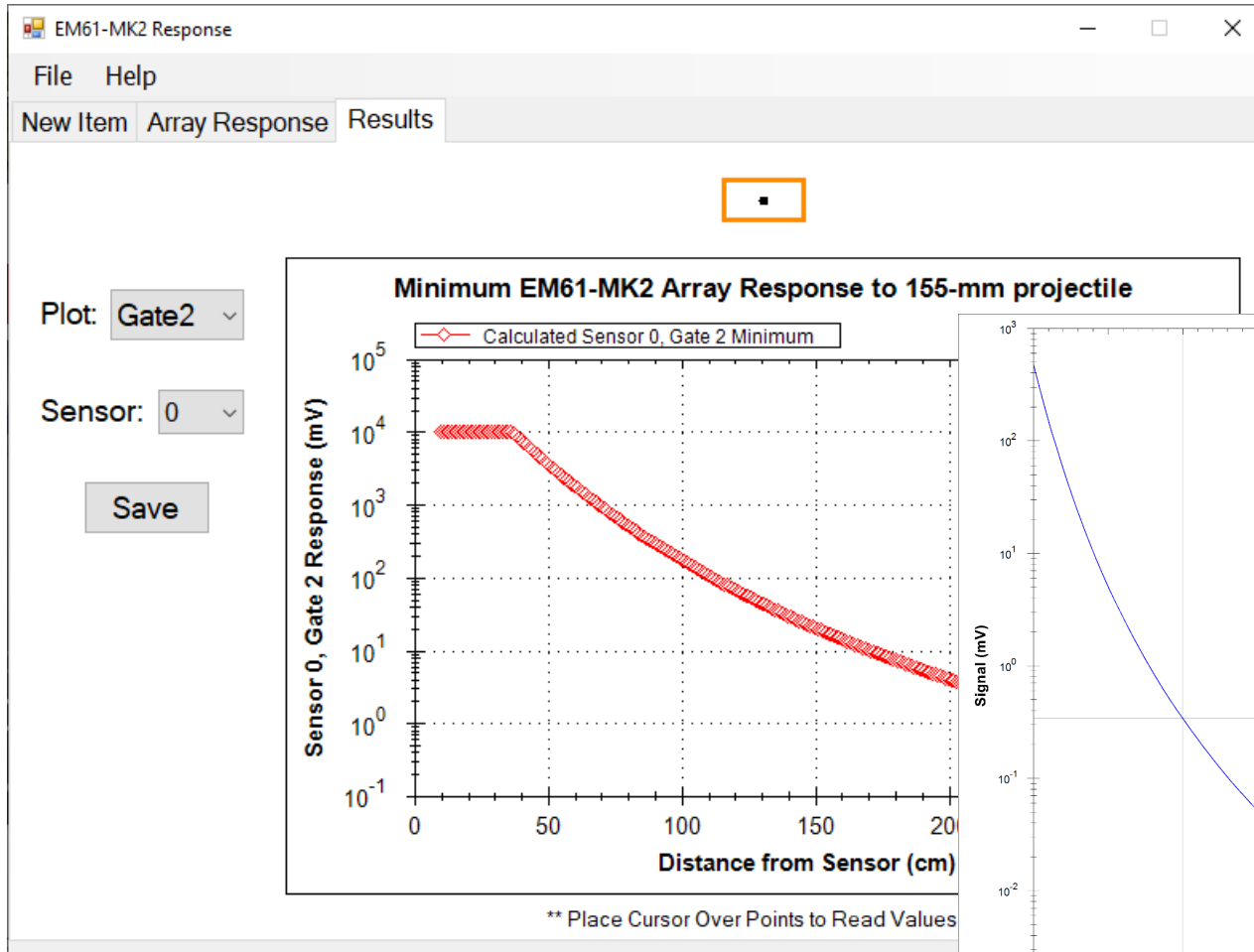
# Durability & Maneuverability



## Metal Mapper 2x2

- Smaller wheels = closer to ground
  - Need lower vegetation clearance
- Craters and bumps more difficult
- Backpack heavy, difficult for smaller people
- More connections, cables, etc, easier to dislodge & damage

# Depth of Detection



**Depth Response Curve**

Sensor: MetalMapper2x2 3ms 19gates  
 Configuration: MetalMapper2x2 3ms 19gates  
 Height (m): 0.31

Target Of Interest: Example\_Library\_3ms\_19gates.gdb  
 Library database: Example\_Library\_3ms\_19gates.gdb  
 Group: Targets  
 Description channel: UXA\_LIBRARY\_ID  
 TOI: 155mm Projectile-M107-METALMAPPER\_BP\_4\_001\_11  
 Orientation: Horizontal in-line

TOI Reference Database  
 Output databases prefix: 155\_horiz

Plot - Depth Response Curve  
 Gate: 5  
 Data to plot: Min of Monostatic Z data  
 X - Depth (m): Min: 0.00 Max: 3.00  
 Y - Signal amplitude (mV): Min: 0.00 Max: 1000.00

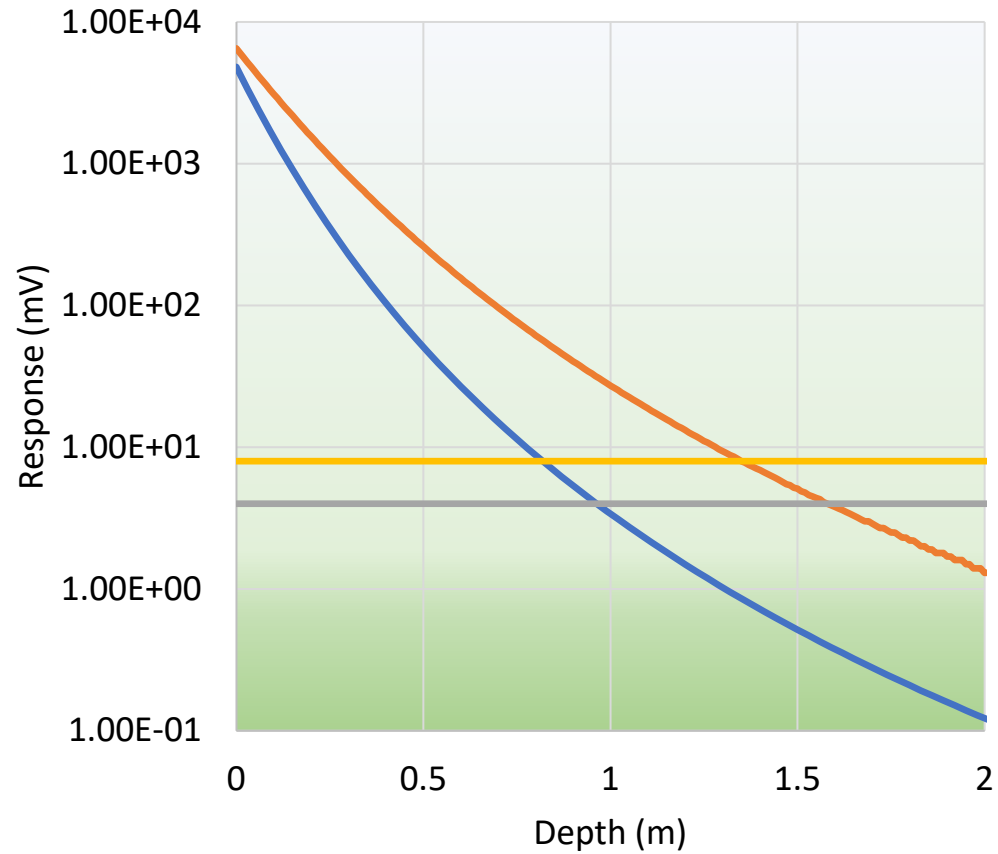
Plot - Polarization Curves  
 X - Time (ms): Min: 0.02 Max: 2.43  
 Y - Polarization (m<sup>2</sup>/s): Min: 0.01 Max: 1000.00

Created on: 2023/03/21 15:25  
 Output plot prefix: 155\_horiz  
 Save result to a CSV file: True



# Depth of Detection

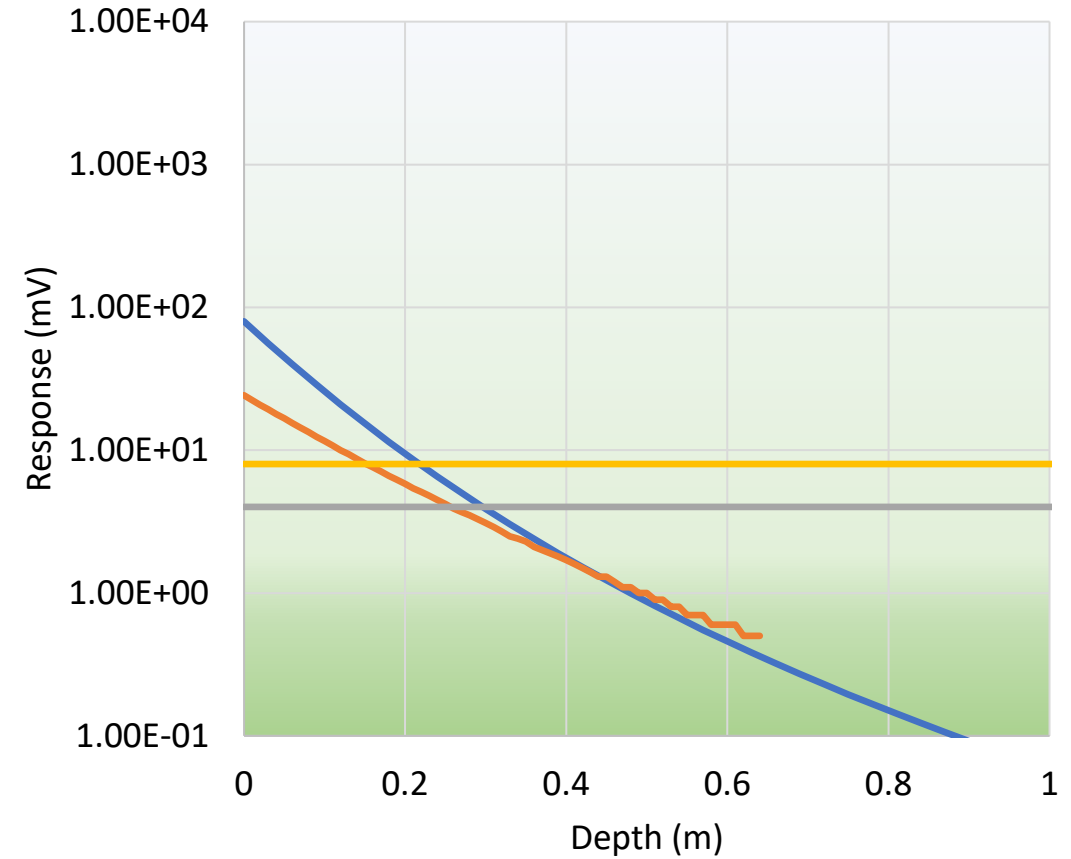
155 mm



— MM2x2 155mm  
— MM2x2 Threshold

— EM61MK2 155mm  
— EM61MK2 Threshold

Small ISO

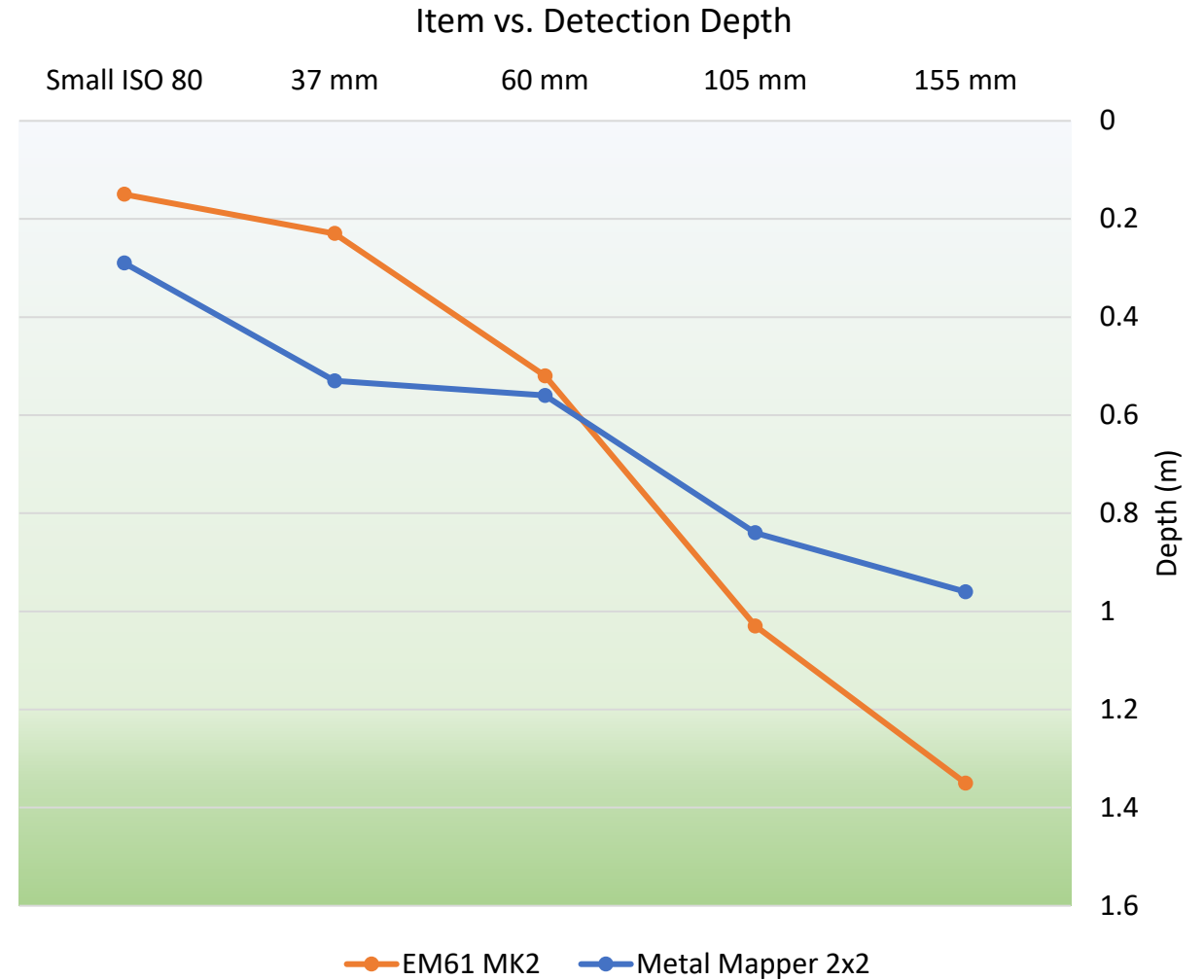


— MM2x2 SISO  
— MM2x2 Threshold

— EM61MK2 SISO  
— EM61MK2 Threshold

# Depth of Detection

Item	Diameter (cm)	Depth @ 8mV Threshold EM61MK2 (m)	Depth @ 4mV Threshold MM 2x2 (m)
Small ISO 80	2.54	0.15	0.29
37 mm	3.7	0.23	0.53
60 mm	6	0.52	0.56
105 mm	10.5	1.03	0.84
155 mm	15.5	1.35	0.96





# Case Studies

## Site A: RA, EM61 MK2

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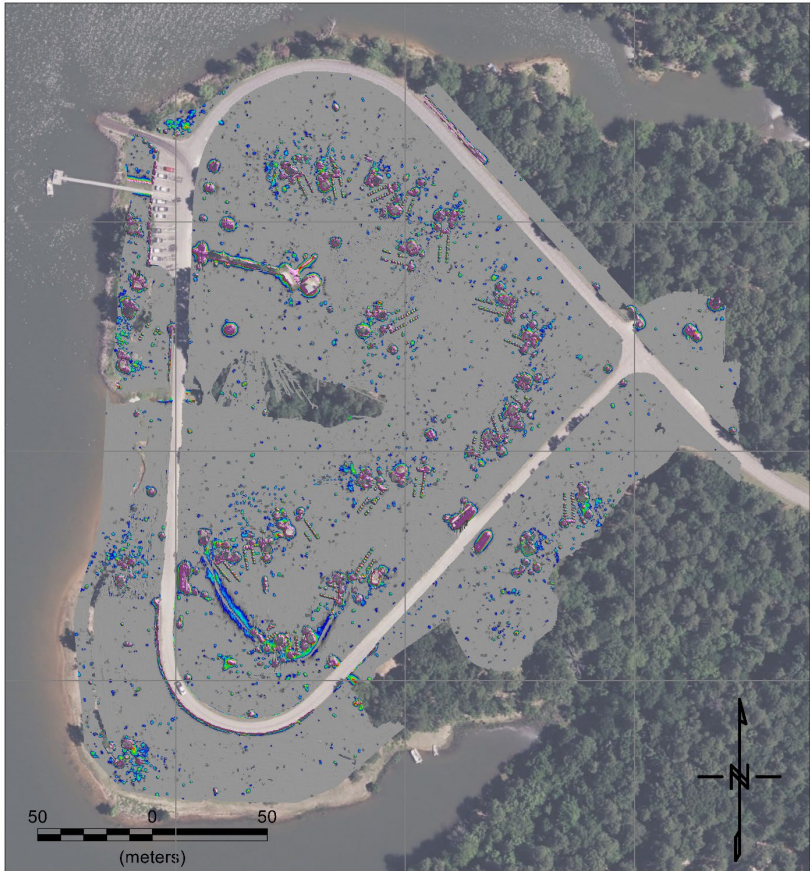
- EM61 for dynamic detection
- Contiguous grids
- Trees & culture (campground)

## Sites B, C & D: RI, Metal Mapper 2x2

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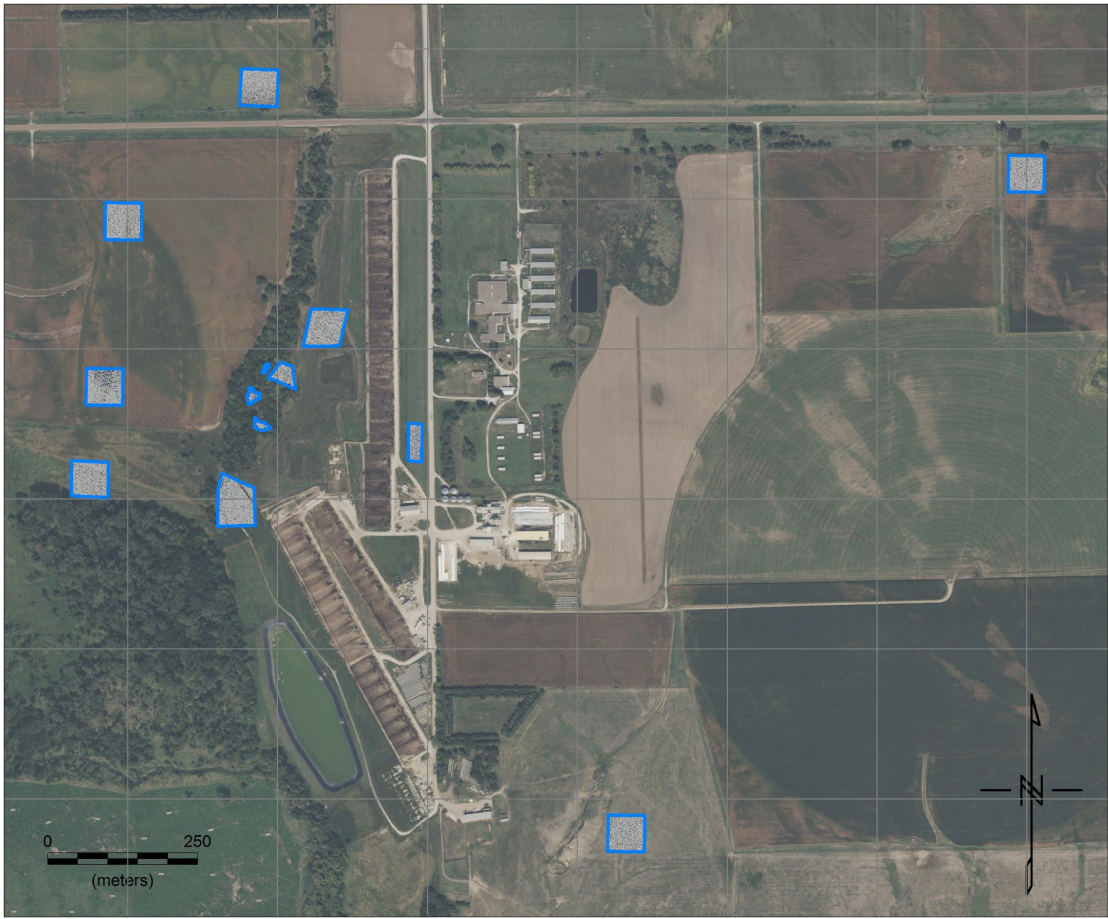
- 3 RIs with widely spaced grids of varying density
- Mostly farmland

# Site A



Leveled Channel 2 (mV)

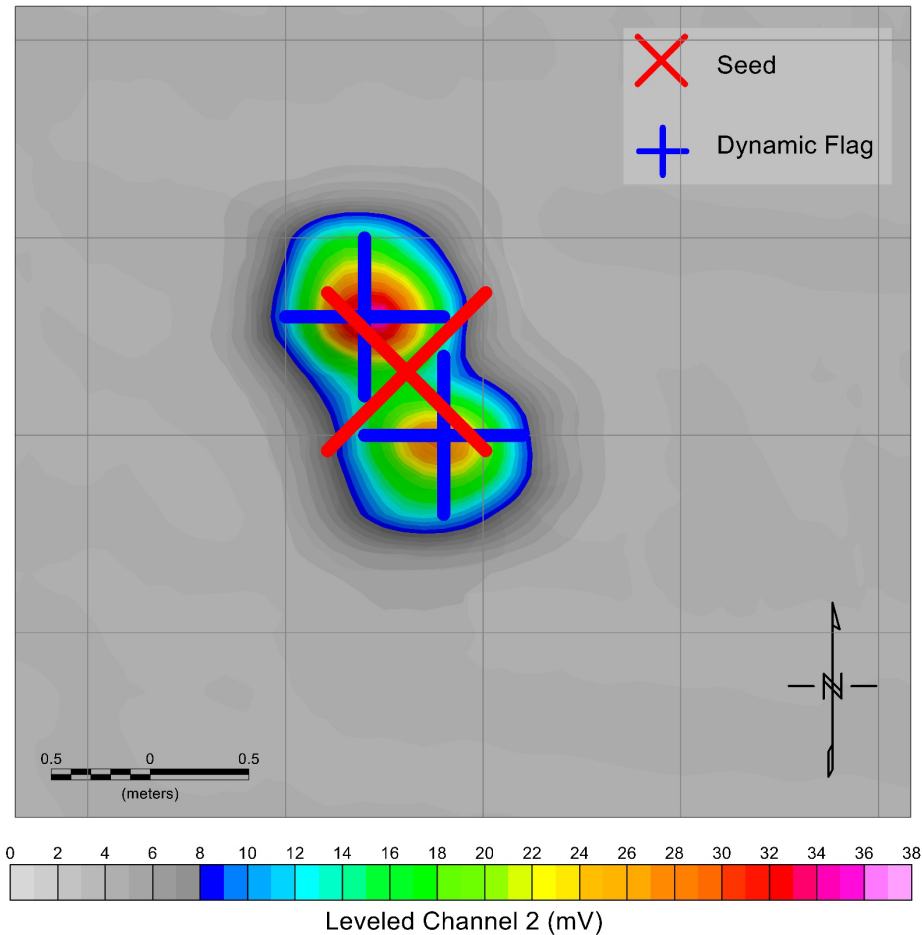
# Site B





# Site A: EM61 MK2

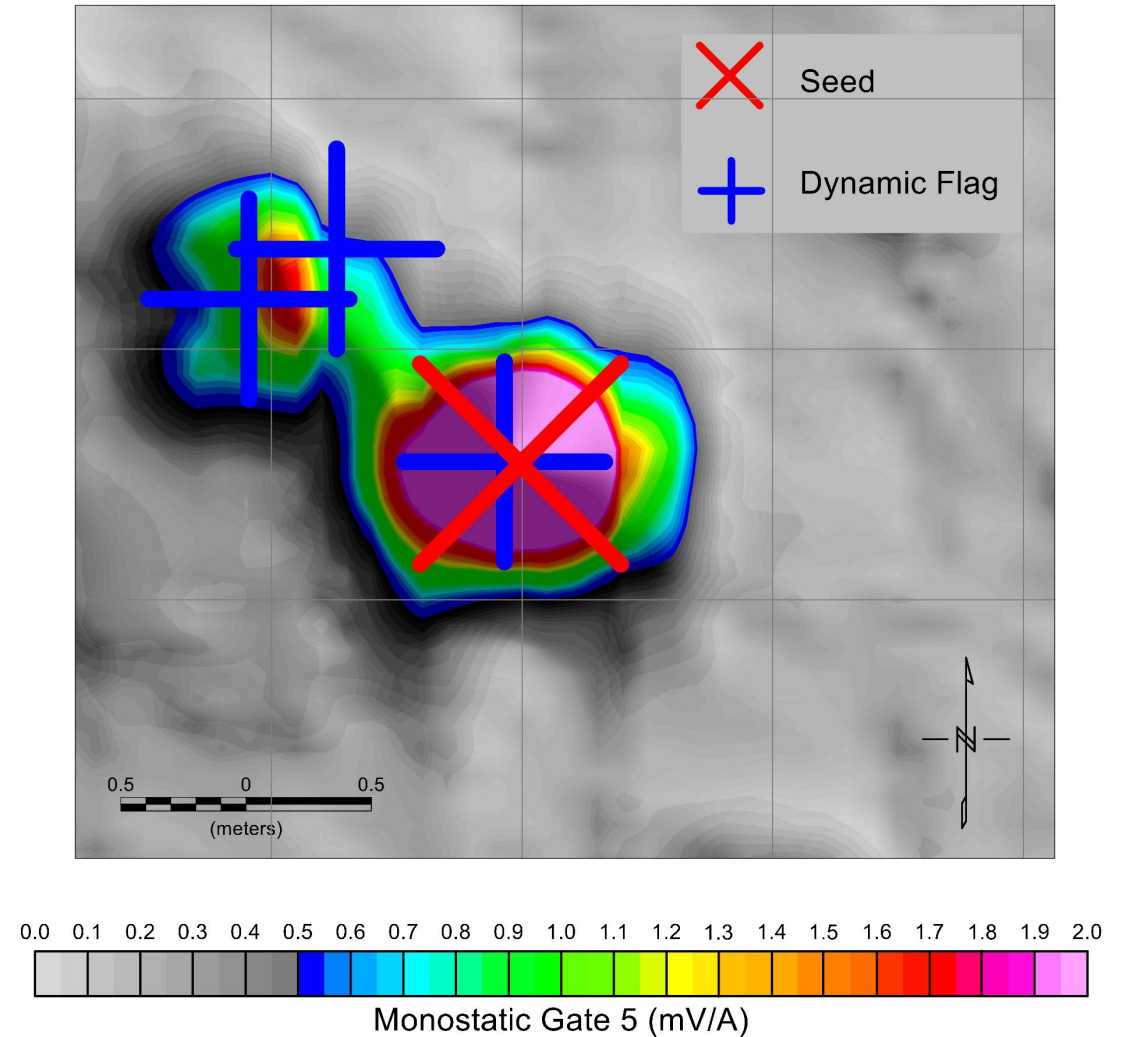
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- Average Production Rate:  
0.36 acres / day / system
- Looked at 57 Seeds:  
Average offset: 28.6 cm  
Average Flags per seed: 1.8
- 2435 Flags  
Recollects: 836 (34% of flags)  
Inconclusive: 96 (28% of digs)

# Sites B, C, and D: Metal Mapper 2x2

- Average Production Rate:  
0.6 acres / day / system
- Looked at 134 Seeds:  
Average offset: 10 cm  
Average flags per seed: 1.2
- 5961 Flags  
Recollects: 303 (5% of flags)  
Inconclusive: 185 (14% of digs)



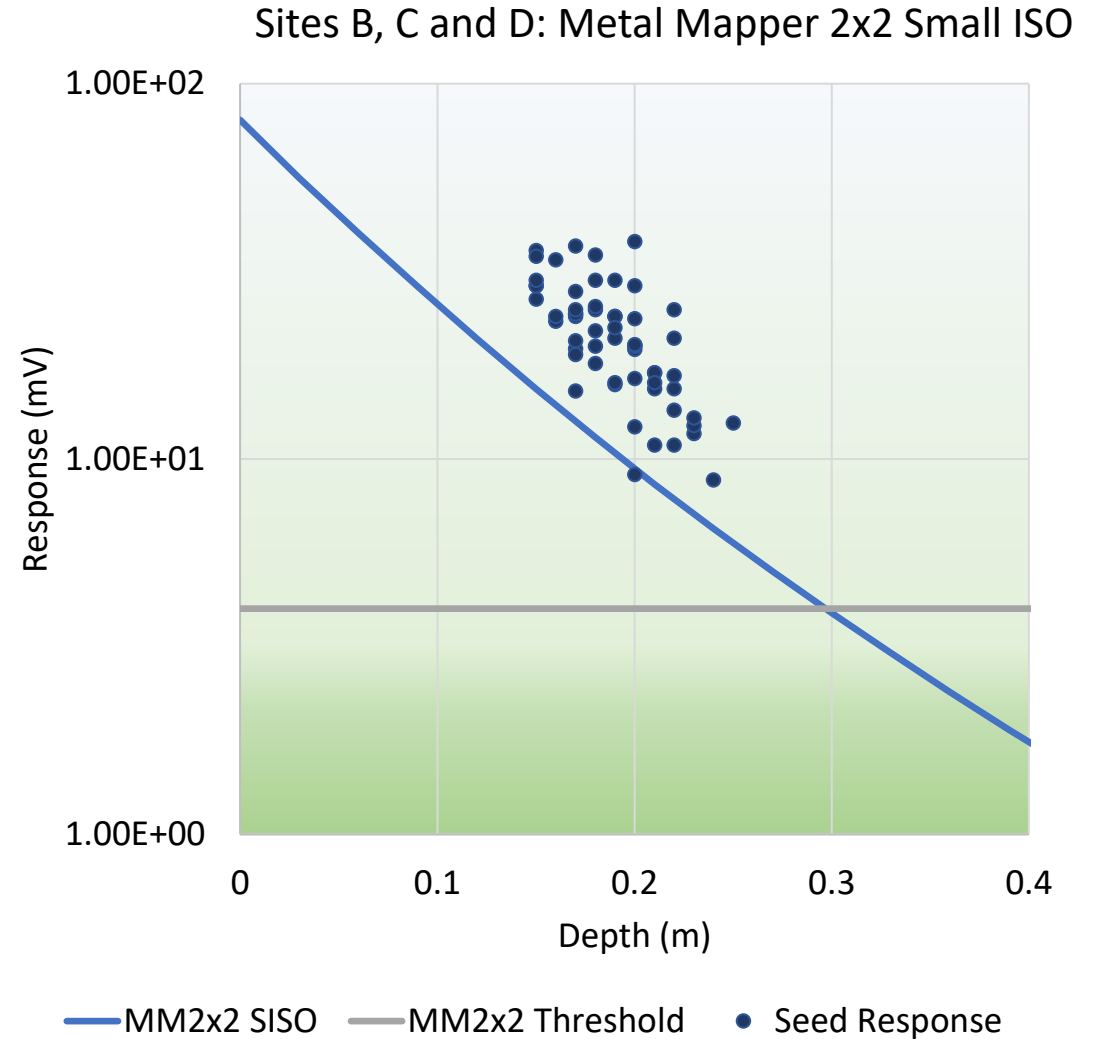
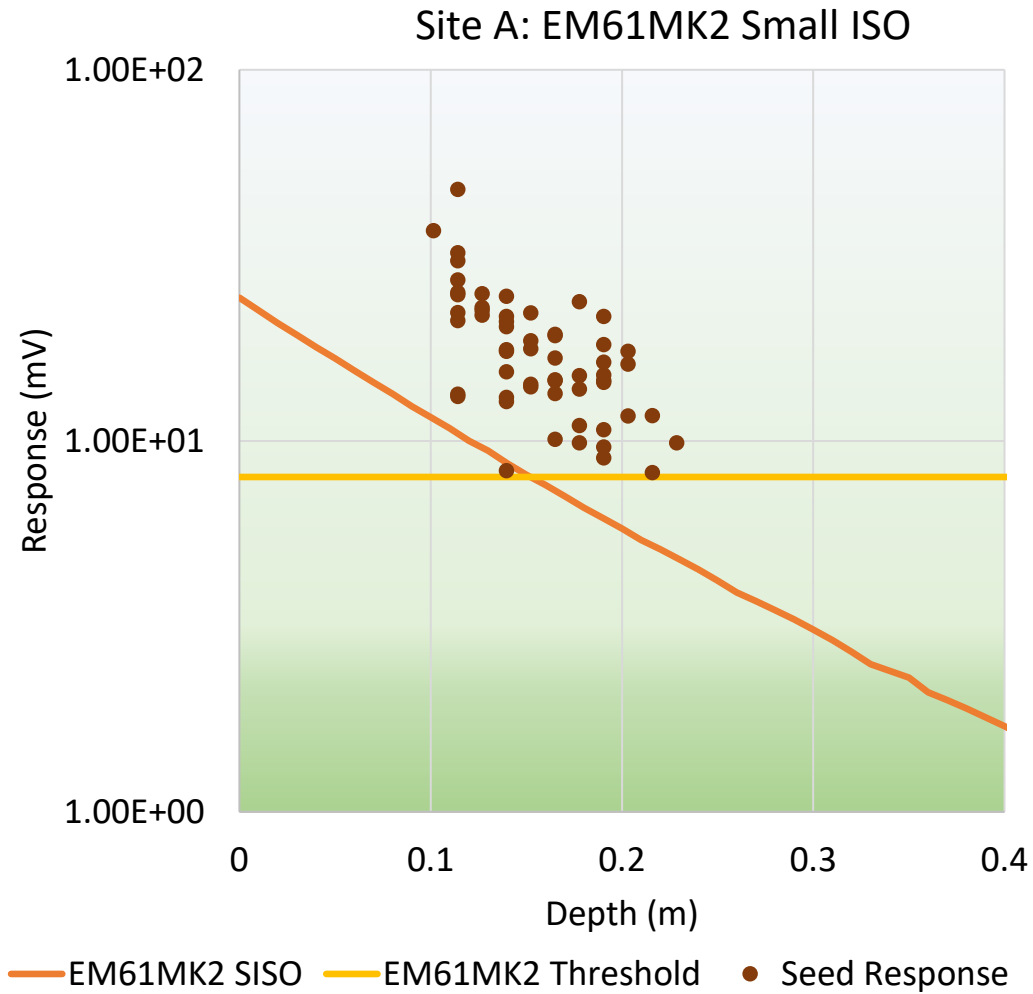


# Site Comparison

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Sites	System	Production Rate (acres / day / system)	Average Offset (cm)	Flags per seed	Recollection Rate	Inconclusive Rate
A	EM61 MK2	0.36	29	1.8	34%	28%
B, C, D	Metal Mapper 2x2	0.6	10	1.2	5%	14%

# Depth of Detection



# Metal Mapper 2x2

## Equipment Issues and Repairs - 2022 Field Season

Equipment overheating from direct sunlight

Field mitigation: Cooling EDA box with ice packs and shade

TX and RX cable connection issues while in dynamic mode, dust particles infiltrating cable connections when working in corn fields

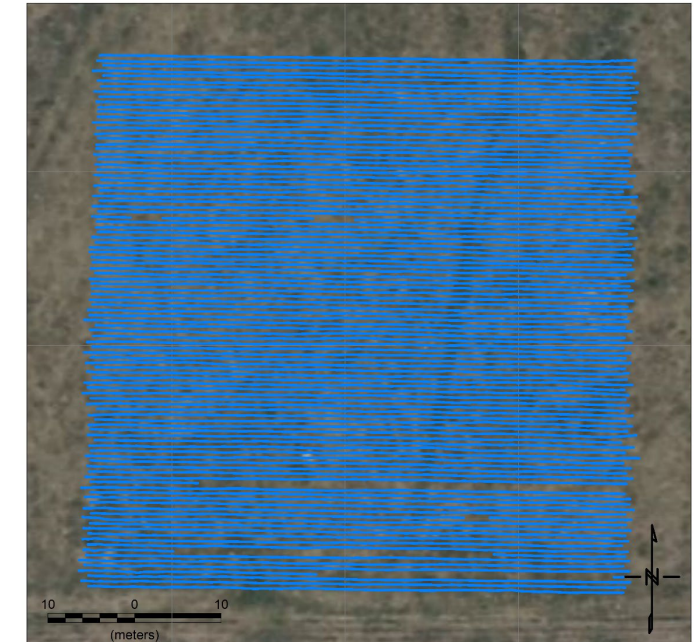
Field mitigation: Removing dust build up with compressed air and brushes

Low battery current errors

Field mitigation: Routine maintenance to keep connections clear of dust particles

Ethernet connection from EDA box to tablet intermittently losing connectivity, most prevalent in dynamic mode

Field mitigation: Restarting system for each occurrence





# Metal Mapper 2x2

Equipment Issues and Repairs - 2022 Field Season



## Repairs

- RJ-45 patch cables were replaced
- Ethernet cables were rebuilt
- Right-angle ethernet adapter was provided to reduce cable strain
- Cart assemblies were fully cleaned, new weather stripping added
- Strain relief fixture was installed on tablet to mitigate connection issues between EDA and tablet's ethernet port connector
- Tablets were updated with latest MM2x2 software
- Cracked cover was noted but was not replaced due to the 5 to 6 week wait time for new cover
- Geometrics installed larger heat sinks this winter

# Conclusions

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## → EM61 MK2:

- More availability.
- More maneuverable & durable.
- Better depth of detection for larger items.
- **Cheaper?**

## → Metal Mapper 2 x 2:


- Improves seed offsets (and most likely offsets to TOI and other metal sources).
- Decreases recollects and inconclusive targets.
- Better depth of detection for smaller items.

# Contact

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# Questions & Answers



Q&A

